National Institute for Health and Care Excellence

1

Consultation

Chapter 3 Paramedics with enhanced competencies

Emergency and acute medical care in over 16s: service delivery and organisation

NICE guideline <number>

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Chapter 3 Paramedics with enhanced competencies

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3 Paramedics with enhanced competencies

3.1 Introduction

Paramedic training has traditionally focussed on the immediate assessment and management of potentially life threatening medical emergencies with on-going treatment and transfer to an appropriate receiving unit. Increasingly evidence suggests that an appreciable proportion of patients accessing ambulances services with lower acuity presentations have the potential to undergo assessment and management in the community without the need for hospital admission.

Practitioners with an enhanced level of education enabling the autonomous treatment and discharge of patients with unscheduled care needs are commonplace in other professional groups such as nursing and physiotherapy. The development of similar competencies within the paramedic workforce has the potential to reduce unnecessary hospital attendance, improve ambulance availability for higher acuity calls, and deliver an improved service to patients. The guideline committee therefore investigated whether enhancing the competencies of paramedics resulted in a reduction in hospital admissions and demand for Emergency Department services.

3.2 Review question: Does enhancing the competencies of paramedics reduce ED demand, hospital admissions and improve patient outcomes?

For full details see review protocol in Appendix A.

Table 1: PICO characteristics of review question

Population	Adults and young people (16 years and over) with a suspected AME.
Interventions	Paramedics with enhanced competencies (specialist and advanced paramedics for example, paramedic practitioner or emergency care practitioner).
Comparisons	Paramedics with standard competencies.
Outcomes	• Mortality (CRITICAL) • Quality of life (CRITICAL) • Conveyance (carriage) rates (CRITICAL) • Number of patients seeking further contacts after initial assessment by paramedic (GP, 999, ED or 111) Or Re-contact rates within 7 days (CRITICAL) • Patient and/or carer satisfaction (CRITICAL) • Adverse events (CRITICAL) • Number of hospital admissions (IMPORTANT) • Staff satisfaction (IMPORTANT)
Study design	Systematic reviews (SRs) of RCTs, RCTs, observational studies only to be included if no relevant SRs or RCTs are identified.

3.3 Clinical evidence

Three studies were included in the review[27,28,30]; 2 studies[27,28] (from the same RCT) looked at a Paramedic practitioner service in the UK which gave enhanced training compared to the standard 999 service. The other study[30] was a non-randomised study (quasi-experimental study) of Emergency Care Practitioners who worked as a single responder to ambulance service 999 calls compared to standard paramedic or technician ambulance responding to ambulance service 999 calls. These are summarised in Table 2 below. Evidence from these studies is summarised in the GRADE clinical

evidence profile/clinical evidence summary below (Table 3/Table 4). See also the study selection flow chart in Appendix B, study evidence tables in Appendix D, forest plots in Appendix C, GRADE tables in Appendix F and excluded studies list in Appendix G.

Table 2: Summary of studies included in the review

Study	Intervention and comparison	Population	Outcomes	Comments
Mason 2007[27] Mason 2008[28] Cluster RCT	Paramedic practitioner service. Versus Standard 999 service. Paramedic practitioner service: Paramedic practitioners trained with extended skills to assess, treat, and discharge older patients with minor acute conditions in the community (not immediately life threatening). Practitioners underwent a 3 week full-time theory-based course with lectures from specialists in emergency medicine or care of the elderly. They spent a period of 45 days in supervised practice. Standard 999 service: During which the trained paramedic practitioners were removed from operational duties.	Patients (n=3018) aged 60 years and over calling the ambulance service - with a presenting complaint that fell within the scope of practice of the paramedic practitioners -in a large urban area, Sheffield, UK. Presenting complaint: Intervention group: Fall: 1369 (88.4%) Haemorrhage: 93 (6%) Acute medical condition: 86 (5.6%). Control group: Fall: 1313 (89.4%) Haemorrhage: 78 (5.3%) Acute medical condition: 78 (5.3%).	Attendance at emergency department (0 to 28 days), hospital admission (0 to 28 days), patient and/or carer satisfaction, mortality at 28 days, unplanned ED attendance.	Cluster-randomised controlled trial involving 56 clusters. Recruited during 12 month period. Seven experienced paramedics were selected through open competition and completed the training course to enable them to provide community based clinical assessment for patients aged over 60 who contacted the emergency ambulance service with minor acute conditions. During each week, a paramedic practitioner based in the ambulance control room identified eligible calls by the presenting complaint and notified a paramedic practitioner in the community (during intervention weeks) or in the emergency department (during control weeks).
Mason 2012[30] Quasi experimental intervention trial	ECPs. Versus Standard paramedic/technician ambulance. ECPs: ECPs working as	Patients (n=1107) presenting with emergency or urgent complaints that were eligible to be seen by ECPs and that presented to either the intervention or matched control services of NHS	Number referred to primary care; number referred to hospital.	Pragmatic quasi experimental multi-site community intervention trial. Analysis adjusted for confounders. Subset of the data pertains to the ambulance setting, but

Study	Intervention and comparison	Population	Outcomes	Comments
	single responder to ambulance service 999 calls. Control: Standard paramedic/technician ambulance responding to ambulance service 999 calls.	trusts in England and Scotland, UK. Presenting complaint: Intervention: Paediatric medical: 0 (0%) Paediatric trauma: 8 (1.3%) Adult medical: 270 (45%) Adult trauma 119 (19.8%) Elderly falls: 203 (33.8%) Standard: Paediatric medical: 8 (1.5%) Paediatric trauma: 10 (1.8%) Adult medical: 310 (56.4%) Adult trauma 100 (18.2%) Elderly falls: 122 (22.2%)		30% of these patients are trauma or children. Data collection over 14 months.

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Table 3: Clinical evidence summary: enhanced versus standard – RCT

Outcomes	No of Participants (studies) Follow up	Quality of the evidence (GRADE)	Relative effect (95% CI)	Anticipated absolute effects	
				Risk with Control	Risk difference with Enhanced versus standard - RCT (95% CI)
Mortality at 28 days	3018 (1 study)	⨁⨁⊖⊖ LOW[a,b] due to risk of bias, imprecision	RR 0.87 (0.63 to 1.2)	Moderate	
				50 per 1000	6 fewer per 1000 (from 19 fewer to 10 more)
Number of hospital admissions (0-28 days)	3018 (1 study)	⨁⨁⨁⊖ MODERATE[a] due to risk of bias	RR 0.87 (0.8 to 0.94)	Moderate	
				465 per 1000	60 fewer per 1000 (from 28 fewer to 93 fewer)
ED attendance (0-28 days)	3018 (1 study)	⨁⨁⨁⊖ MODERATE[a] due to risk of bias	RR 0.72 (0.69 to 0.75)	Moderate	
				875 per 1000	245 fewer per 1000 (from 219 fewer to 271 fewer)
Unplanned emergency department attendance	2025 (1 study)	⨁⨁⊖⊖ LOW[a,b] due to risk of bias, imprecision	RR 1.25 (0.97 to 1.62)	Moderate	
				95 per 1000	24 more per 1000 (from 3 fewer to 59 more)
Patient satisfaction - very satisfied with care	3018 (1 study)	⨁⨁⊖⊖ LOW[a,b] due to risk of bias, imprecision	RR 1.18 (1.08 to 1.29)	Moderate	
				359 per 1000	65 more per 1000 (from 29 more to 104 more)

(a) Downgraded by 1 increment if the majority of the evidence was at high risk of bias, and downgraded by 2 increments if the majority of the evidence was at very high risk of bias.

(b) Downgraded by 1 increment if the confidence interval crossed one MID or by 2 increments if the confidence interval crossed both MIDs.

Table 4: Clinical evidence summary: enhanced versus standard – Non-randomised study (Quasi-experimental study)

Outcomes	No of Participants (studies) Follow up	Quality of the evidence (GRADE)	Relative effect (95% CI)	Anticipated absolute effects	
				Risk with Control	Risk difference with Enhanced versus standard - NRS (95% CI)
Number referred to primary care	1107 (1 study)	⨁⊖⊖⊖ VERY LOW[a,b] due to risk of bias, indirectness	RR 18.42 (6.8 to 49.86)	Moderate	
				8 per 1000	139 more per 1000 (from 46 more to 391 more)
Number referred to hospital (ED or direct admission to a hospital ward)	1107 (1 study)	⨁⊖⊖⊖ VERY LOW[a,b] due to risk of bias, indirectness	RR 0.46 (0.41 to 0.5)	Moderate	
				926 per 1000	500 fewer per 1000 (from 463 fewer to 546 fewer)

(a) All non-randomised studies automatically downgraded due to selection bias. Studies may be further downgraded by 1 increment if other factors suggest additional high risk of bias, or 2 increments if other factors suggest additional very high risk of bias.

(b) Downgraded by 1 increment as the outcome is indirect.

3.4 Economic evidence

Published literature

One economic evaluation was identified with the relevant comparison and has been included in this review[15]. This is summarised in the economic evidence profile below (Table 5) and the economic evidence tables in Appendix E.

One economic evaluation relating to this review question was identified but was excluded due to methodological limitations[29]. This is listed in Appendix H, with reasons for exclusion given.

The economic article selection protocol and flow chart for the whole guideline can found in the guideline's Appendix 41A and Appendix 41B.

Table 5: Economic evidence profile: paramedics with enhanced versus standard competency

Study	Applicability	Limitations	Other comments	Incremental cost	Incremental effects	Cost effectiveness	Uncertainty
Dixon 2009[15] ([UK])	Partially applicable[(a)]	Minor limitations[(b)]	• Study design: cluster RCT • Economic evaluation type: Cost-utility analysis • Population: elderly patients (≥ 60 years) with a presenting complaint that fell within the scope of practice of the paramedic practitioner (PP) working within the scheme.	Saves £680	0.0003 QALYs lost	Usual care cost £2,266,667 per extra QALY gained[(c)]	Probability enhanced competencies is cost effective at a threshold of £20,000 per QALY gained: > 95%. -Sensitivity analysis using higher PP unit cost: cost saving reduced to £162. -Missing values imputation: Probability being cost effective at a threshold of £20,000 per QALY gained reduced to 73%.

Abbreviations: ICER: incremental cost-effectiveness ratio; QALY: quality-adjusted life years; RCT: randomised controlled trial.

(a) There is some uncertainty regarding the applicability of the costs and resource use from 2004 to current NHS context. Some social care costs were also included, which means that the perspective is not strictly NHS and PSS.

(b) Estimates of effectiveness are based on a single RCT, so by definition is not reflective of the whole body of evidence in this area. Baseline data on quality of life were assumed equal and not actually measured in the study. Large percentage of missing data which may reduce the power of the analysis to detect differences. Limited number of sensitivity analyses was presented.

(c) Calculated by NGC. Intervention is less costly and less effective.

3.5 Evidence statements

Clinical

- One study comprising 3018 people evaluated enhancing the competencies of paramedics to reduce ED demand, hospital admissions and improve patient outcomes in adults and young people at risk of an AME, or with a suspected or confirmed AME. The evidence suggested that enhanced competencies of paramedics may provide benefit for reducing number of hospital admissions (0-28 days), ED attendance (0-28 days) (moderate quality), and patient and/or carer satisfaction (low quality). There was no effect on mortality (low quality).
- One study comprising 2025 people evaluated enhancing the competencies of paramedics to reduce ED demand, hospital admissions and improve patient outcomes in adults and young people at risk of an AME, or with a suspected or confirmed AME. The evidence suggested that there was no effect of enhanced competencies of paramedics on unplanned emergency department attendance (low quality).
- One study comprising 1107 people evaluated enhancing the competencies of paramedics to reduce ED demand, hospital admissions and improve patient outcomes in adults and young people at risk of an AME, or with a suspected or confirmed AME. The evidence suggested that enhanced competencies of paramedics may provide a benefit from reduced number of patients referred to hospital (ED or direct admission to a hospital ward) and increased number referred to primary care (very low quality).

Economic

- One cost-utility analysis[15] found that the paramedic practitioner scheme was cost effective (less costly and less effective) compared with standard 999 service (ICER for usual care: 2,266,667 per QALY gained). This study was assessed as partially applicable with minor limitations.

3.6.1 Recommendations and link to evidence

Recommendations	1. Provide specialist and advanced paramedic practitioners who have extended training in assessing and treating people with medical emergencies.
Research recommendation	-
Relative values of different outcomes	Mortality, quality of life, conveyance (carriage) rates, patient and/or carer satisfaction, adverse events, number of patients seeking further contacts after initial assessment by paramedic (GP, 999, ED or 111) or re-contact rates within 7 days were considered by the committee to be critical outcomes. Number of hospital admissions and staff satisfaction was considered by the committee to be important outcomes.
Trade-off between benefits and harms	There was evidence from 3 studies for this review question; 2 studies from the same RCT evaluated a paramedic practitioner service in the UK which gave enhanced training compared to the standard 999 service. In the RCT the intervention included a paramedic practitioner based in the ambulance control room who identified eligible calls by the presenting complaint and notified a paramedic practitioner in the community. The other study was a non-randomised study of paramedic emergency care practitioners who worked as single responders to ambulance service 999 calls compared to standard paramedic/technician ambulances responding to ambulance service 999 calls. The RCT evidence suggested that enhanced competencies of paramedics may provide benefit for reducing number of hospital admission, ED attendance and patient and/or carer satisfaction. The evidence for enhanced competencies of paramedics suggested there was no effect on mortality and the number of unplanned emergency department attendances following a 999 emergency call compared to standard competencies. If poor decisions were made by the enhanced practitioners the number of unplanned ED attendances might rise. Therefore, this outcome is reassuring that the practitioner intervention is not less safe clinically. The committee was reassured that the enhanced service did not worsen mortality which might be a risk if patients were treated at the scene and not admitted to ED. The evidence from the non-randomised study suggested that enhanced competencies of paramedics may provide a benefit from increased number of patients referred to primary care and decreased number referred to hospital (ED or direct admission to a hospital ward). However, these two process outcomes may not necessarily result in improved patient outcomes. There was no evidence available for quality of life, conveyance (carriage) rates, number of patients seeking further contacts after initial assessment by paramedic (GP, 999, ED or 111) or re-contact rates within 7 days and staff satisfaction. However, evidence from the non-randomised study suggested that when paramedic practitioners attended the scene there was a reduction in patients referred to hospital which the committee believed usually meant that fewer patients were transferred to hospital and therefore lower rates of conveyance. The committee decided to make a strong recommendation for paramedic practitioners with enhanced education and scope of practice as there appears to be positive evidence across several outcomes.
Trade-off between net effects and costs	Advanced paramedic practitioners have higher costs (band 7 salary plus on-costs £48k) compared with standard paramedic costs at band 5 (£32k) or band 6 (£40k). However, the evidence shows that their use is associated with fewer attendances at ED, fewer admissions and possibly fewer ambulance call-outs. These savings are

Recommendations	1. Provide specialist and advanced paramedic practitioners who have extended training in assessing and treating people with medical emergencies.
Research recommendation	-
	partially offset by increased use of primary and social care services. One economic evaluation was included that showed that a paramedic practitioner scheme was cost saving overall from an NHS and personal social services perspective with equivalent QALYs. The committee recognised that this evidence would relate mainly to paramedic practitioners as opposed to emergency care practitioners who could be from a nursing or other health care professional background, as the costs of training provision would be different and hence, conclusions regarding cost-effectiveness might also be different. The committee also highlighted that the published evaluations of these schemes only considered the early period of implementation therefore, costs and benefits might not have been fully realised. The committee considered that the benefits of having paramedics with enhanced competencies was likely to off-set the initial training costs and the higher cost per hour, through the reduction in hospital admissions, ED visits, ambulance conveyance rate and re-contact rate. However, they also stressed that the quality of the initial and ongoing education is paramount to ensure the provision of a high quality and cost-effective service to fully realise these potential benefits. The committee considered the economic evidence to be supportive of the provision of ambulance services where paramedics with enhanced competencies are an integrated part of the team.
Quality of evidence	There was relatively little evidence, with only 1 RCT and 1 non-randomised study found. The RCT evidence had a moderate to low GRADE rating overall mainly due to risk of bias and imprecision. The non-randomised study, although it had large effect sizes, had a very low GRADE rating due to high risk of bias and indirectness of the outcomes to our protocol. The economic evidence was considered high quality but only partially applicable because the costs were quite dated. Also some social care costs were also included, which means that the perspective is not strictly NHS and personal social services.
Other considerations	The population in the studies focused upon older patients with a mean age of 60 years. The committee considered that this was reflective of the population that attends the Emergency Department with AME and they have high conversion rate that is, being admitted to hospital. In particular, the population considered in the evidence evaluated did not include many of the more protocol driven conditions (for example, myocardial infarction with ST-segment elevation or trauma) where pathways of care are well-defined and much less open to modification by paramedics with enhanced competencies. Whereas, enhanced competencies are more important in situations without clear pathways and in being able to make a judgement about leaving someone at home rather than conveying them to hospital. Current provision of paramedic practitioners with enhanced competencies varies between UK ambulance services nationally. In addition, some paramedic practitioners are employed full or part time in other healthcare settings, such as hospitals and GP practices. Models of service delivery for paramedic practitioners needs to take account of local geography, population demographics and availability of and access to other health and social services. Effective coordination and dispatch systems within ambulance services are also important in maximising the benefits of paramedic practitioners, given that existing algorithmic priority dispatch systems are not designed to determine cases suitable for paramedic practitioner intervention.

Recommendations	**1. Provide specialist and advanced paramedic practitioners who have extended training in assessing and treating people with medical emergencies.**
Research recommendation	-
	Although the committee felt that patients should be able to have access to paramedics with enhanced competencies, as supported by the evidence, they felt that enhanced education was not necessarily appropriate for the entire paramedic workforce as they need sufficient post qualification experience before undertaking this type of role (as per the requirements for nurse practitioners). This is a specialist area of practice and still requires a body of paramedics performing the 'standard' general paramedic role. The committee noted the possibility that promoting enhanced training could be a benefit for retaining staff as it would provide additional opportunity for career progression. Many patients attended by paramedics might not initially present as an acute medical emergency (for example, those presenting with a fall). However, following initial assessment, many patients will subsequently be classed as an acute medical emergency (for example, syncope or transient loss of consciousness). The classification of patients may be from the initial 999 call which often does not reflect the final diagnosis. It is quite common in the elderly, particularly the frail elderly population, for medical illnesses to present as simple problem or so called 'social problems'. It takes an experienced practitioner to identify this. Therefore, it is possible that the use of paramedics with enhanced education and competence could increase the conveyance rate to hospital, although in this situation it may be a beneficial outcome. The other issue with the frail elderly patient is to identify where the most appropriate place to provide on-going care is. Understanding the patient's baseline functional state due to increased knowledge and experience would enable a practitioner to leave the patient in their own place of residence and organise community care follow up. This is the likely explanation of the increase in referrals to primary care following an enhanced paramedic practitioner attendance. Assuming that this does not result in a later conveyance to hospital it should be considered a positive outcome; however, this potential increased demand must be factored into an already stretched primary care service. Practitioner staff in the research trials had quite significant additional education (several weeks dedicated higher education followed by a period of supervised practice in one trial). It will be important to replicate adequate educational input when enhanced competencies are planned and implemented in order to ensure safety profile and efficacy. It may be possible to provide some of this higher education in a multidisciplinary forum and thus combine educational resources between medical schools, hospitals, specialty colleges and the ambulance service. The evidence identified in this review looked at paramedic practitioners with enhanced training responding to patients operationally in the field usually as single responders in cars (referred to as 'see and treat'). However, paramedic practitioners may also be used in telephone advice settings ('hear and teat'). A number are also now employed in other settings such as emergency departments, GP practices, and walk-in in centres, police custody and prisons. Further detail of enhanced competencies is available from the College of Paramedics regarding the standard of training they recommend for specialist and advanced practitioners.

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1 Appendices

2 Appendix A: Review protocol

3 **Table 6: Review protocol: Paramedic enhanced competencies**

Review question	Does enhancing the competencies of paramedics reduce ED demand, hospital admissions and improve patient outcomes?
Guideline condition and its definition	AME.
Objectives	To determine if enhancing the competencies of paramedics reduces ED demand, hospital admission and improves patient outcomes.
Review population	AME.
	Adults and young people (16 years and over).
	Line of therapy not an inclusion criterion.
Interventions and comparators: generic/class; specific/drug (All interventions will be compared with each other, unless otherwise stated)	Paramedics with enhanced competencies. Paramedics with standard competencies.
Outcomes	• Quality of life (Continuous) CRITICAL • Number of patients seeking further contacts after initial assessment by paramedic (GP, 999, ED or 111) or re-contact rates within 7 days (Dichotomous) CRITICAL • Mortality (Dichotomous) CRITICAL • Conveyance (carriage) rates (Dichotomous) CRITICAL • Adverse events (Dichotomous)CRITICAL • Patient and/or carer satisfaction (Dichotomous) CRITICAL • Number of hospital admissions (Dichotomous) IMPORTANT • Staff satisfaction (Dichotomous) IMPORTANT
Study design	Systematic Review RCT Quasi-RCT Non-randomised comparative study Prospective cohort study Retrospective cohort study Case control study Controlled before and after study Before and after study Non randomised study
Unit of randomisation	Patient.
Crossover study	Permitted.
Minimum duration of study	Not defined.
Subgroup analyses if there is heterogeneity	- Frail elderly (Frail elderly; Overall); different population.
Search criteria	Databases: Medline, Embase, the Cochrane Library.

	Date limits for search: No date limits. Language: English.

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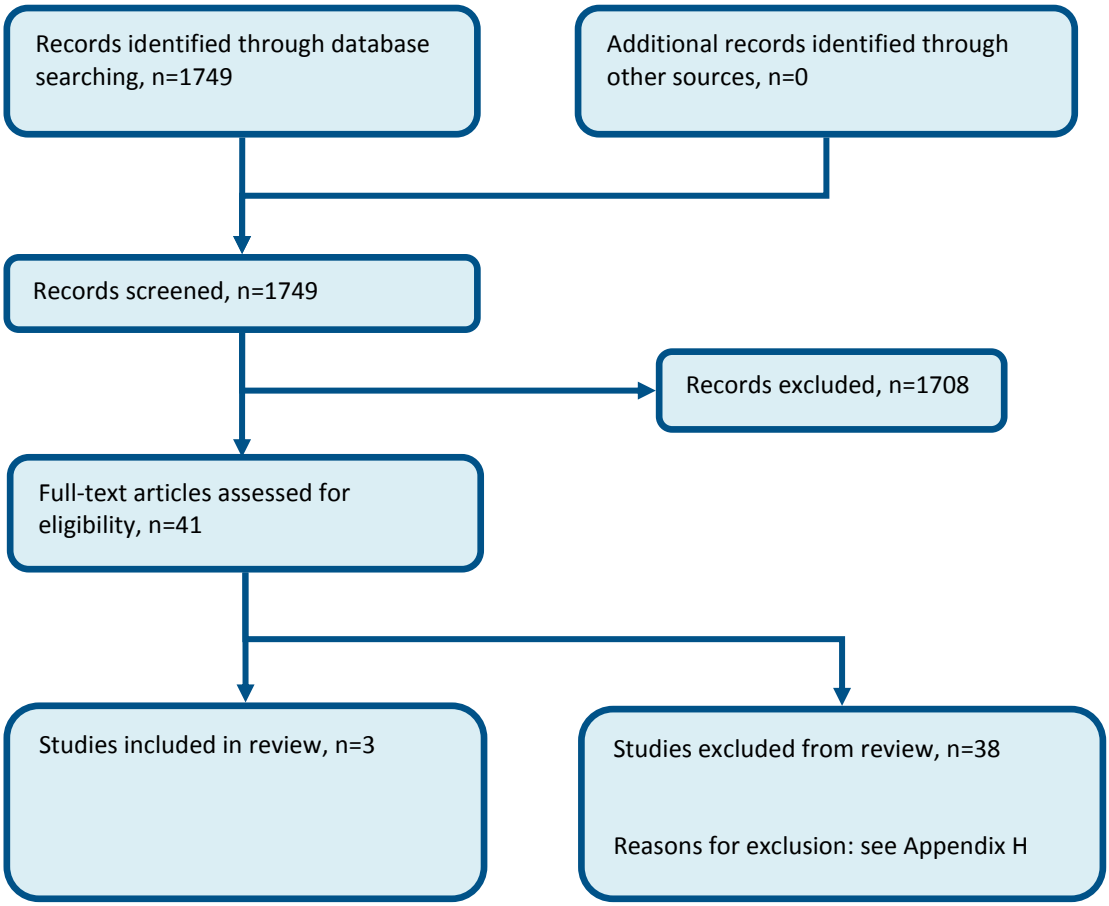
1 Appendix B: Clinical article selection

Figure 1: Flow chart of clinical article selection for the review of paramedic enhanced competencies



Appendix C: Forest plots

C.1 Enhanced competencies versus standard competencies

Figure 2: Mortality at 28 days – RCT

Study or Subgroup	Enhanced Events	Enhanced Total	Standard Events	Standard Total	Weight	Risk Ratio M-H, Fixed, 95% CI
Mason, 2007	68	1549	74	1469	100.0%	0.87 [0.63, 1.20]
Total (95% CI)		**1549**		**1469**	**100.0%**	**0.87 [0.63, 1.20]**
Total events	68		74			

Heterogeneity: Not applicable
Test for overall effect: Z = 0.84 (P = 0.40)

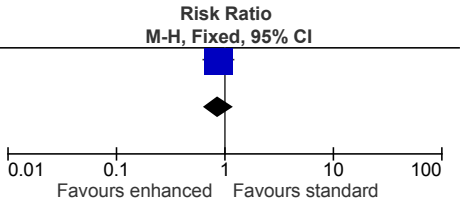


Figure 3: Number of hospital admissions (0-28 days) - RCT

Study or Subgroup	Enhanced Events	Enhanced Total	Standard Events	Standard Total	Weight	Risk Ratio M-H, Fixed, 95% CI
Mason, 2007	626	1549	683	1469	100.0%	0.87 [0.80, 0.94]
Total (95% CI)		**1549**		**1469**	**100.0%**	**0.87 [0.80, 0.94]**
Total events	626		683			

Heterogeneity: Not applicable
Test for overall effect: Z = 3.36 (P = 0.0008)

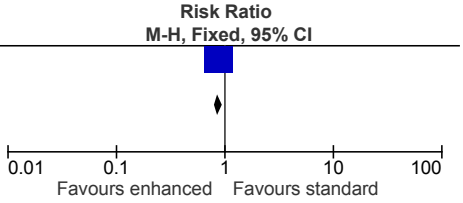


Figure 4: ED attendance (0-28 days) – RCT

Study or Subgroup	Enhanced Events	Enhanced Total	Standard Events	Standard Total	Weight	Risk Ratio M-H, Fixed, 95% CI
Mason, 2007	970	1549	1286	1469	100.0%	0.72 [0.69, 0.75]
Total (95% CI)		**1549**		**1469**	**100.0%**	**0.72 [0.69, 0.75]**
Total events	970		1286			

Heterogeneity: Not applicable
Test for overall effect: Z = 15.26 (P < 0.00001)

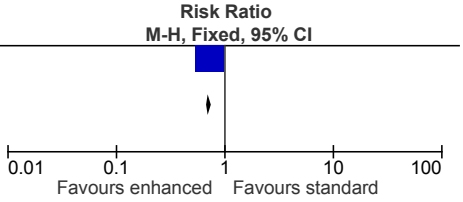


Figure 5: Unplanned emergency department attendance - RCT

Study or Subgroup	Enhanced Events	Enhanced Total	Standard Events	Standard Total	Weight	Risk Ratio M-H, Fixed, 95% CI
Mason, 2008	133	1118	86	907	100.0%	1.25 [0.97, 1.62]
Total (95% CI)		**1118**		**907**	**100.0%**	**1.25 [0.97, 1.62]**
Total events	133		86			

Heterogeneity: Not applicable
Test for overall effect: Z = 1.73 (P = 0.08)

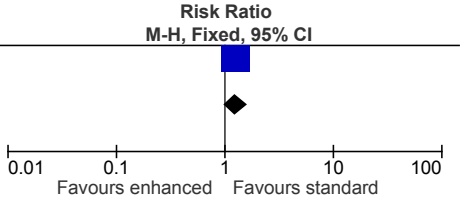


Figure 6: Patient satisfaction (very satisfied with care) - RCT

Study or Subgroup	Enhanced Events	Enhanced Total	Standard Events	Standard Total	Weight	Risk Ratio M-H, Fixed, 95% CI
Mason, 2007	656	1549	528	1469	100.0%	1.18 [1.08, 1.29]
Total (95% CI)		**1549**		**1469**	**100.0%**	**1.18 [1.08, 1.29]**
Total events	656		528			

Heterogeneity: Not applicable
Test for overall effect: Z = 3.59 (P = 0.0003)

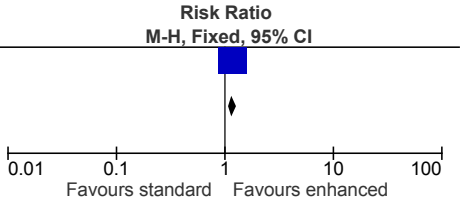
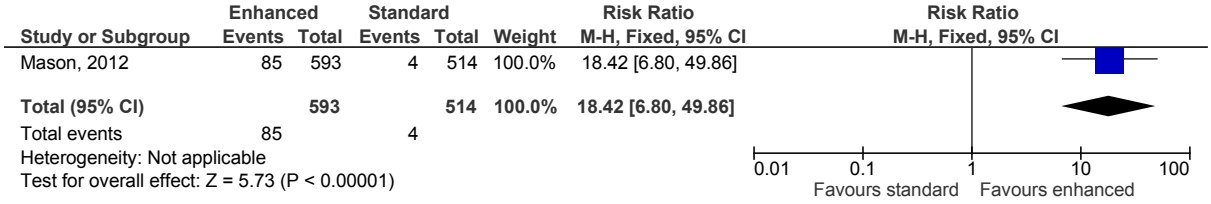
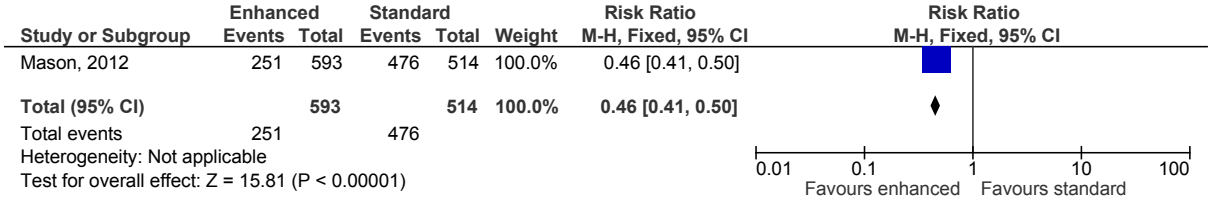


Figure 7: Number referred to primary care – quasi-experimental study



1

Figure 8: Number referred to hospital (ED or direct admission to a hospital ward) – quasi-experimental study



2

3

Appendix D: Clinical evidence tables

Study	Mason 2007[27]
Study type	RCT (cluster randomised controlled trial).
Number of studies (number of participants)	1 (n=3018; 56 clusters).
Countries and setting	Conducted in England; setting: large urban area.
Line of therapy	1st line.
Duration of study	Intervention time: intervention + follow-up (3 days and 28 days after the incident).
Method of assessment of guideline condition	Adequate method of assessment/diagnosis.
Stratum	Overall.
Subgroup analysis within study	Not applicable.
Inclusion criteria	Patients aged 60 and above were eligible for inclusion when the call to the ambulance service originated from a Sheffield postcode between 8am and 8pm, with a presenting complaint that fell within the scope of practice of the paramedic practitioners.
Exclusion criteria	Not reported.
Recruitment/selection of patients	Patients were recruited from 1 September 2003 to 26 September 2004. During each week, a paramedic practitioner based in the ambulance control room identified eligible calls by the presenting complaint and notified a paramedic practitioner in the community (during intervention weeks) or in the emergency department (during control weeks). All identified patients were approached face to face either in the community or in the emergency department for written consent to follow-up. To avoid unnecessary burden on participants, patients who had more than one eligible episode were recruited only for their first episode.
Age, gender and ethnicity	Age: mean (SD): 82.6 (8.3). Gender (Females): 2192 (72.6%) Ethnicity: not reported.
Further population details	Presenting complaint Fall: 2682 (88.9%) Haemorrhage: 171 (5.7%) Acute medical condition: 164 (5.4)
Indirectness of population	No indirectness.
Interventions	(n=1549) Intervention 1: the paramedic practitioner service being active (intervention). A paramedic practitioner based

	in the ambulance control room identified eligible calls by the presenting complaint and notified a paramedic practitioner in the community (during intervention weeks). (n=1469) Intervention 2: the paramedic practitioner service being inactive (control), when the standard 999 service was available. During inactive weeks, the paramedic practitioners were removed from operational duties within the ambulance service and undertook research duties including obtaining patients' consent and follow-up.
Funding	Academic or government funding
RESULTS (NUMBERS ANALYSED) AND RISK OF BIAS FOR COMPARISON: PARAMEDIC PRACTITIONER IN THE COMMUNITY (DURING INTERVENTION WEEKS) VERSUS PARAMEDIC PRACTITIONER IN THE EMERGENCY DEPARTMENT (DURING CONTROL WEEKS). Protocol outcome 1: Number of hospital admissions - Actual outcome: Hospital admission 0-28 days: Group 1: 626/1549, Group 2: 683/1469;. Risk of bias: All domain - high, Selection - low, Blinding - high, Incomplete outcome data - low, Outcome reporting - Low, Measurement - Low, Crossover - Low; Indirectness of outcome: No indirectness Protocol outcome 2: Re-contact rate - - Actual outcome: ED attendance (0-28 days): Group 1: 970/1549, Group 2: 1286/1469; Risk of bias: All domain - high, Selection - low, Blinding - high, Incomplete outcome data - low, Outcome reporting - Low, Measurement - Low, Crossover - Low; Indirectness of outcome: No indirectness Protocol outcome 3: Patient satisfaction - Actual outcome: Very satisfied with care; Group 1: 656/1549, Group 2: 528/1469; Risk of bias: All domain - high, Selection - low, Blinding - high, Incomplete outcome data - low, Outcome reporting - Low, Measurement - Low, Crossover - Low; Indirectness of outcome: No indirectness Protocol outcome 4: Mortality - Actual outcome: Mortality at 28 days; Group 1: 68/1549, Group 2: 74/1469; Risk of bias: All domain - high, Selection - low, Blinding - high, Incomplete outcome data - low, Outcome reporting - Low, Measurement - Low, Crossover - Low; Indirectness of outcome: No indirectness	
Protocol outcomes not reported by the study	Quality of life; Conveyance(carriage) rates; Number of patients seeking further contacts after initial assessment by paramedic (GP, 999, ED or 111) OR Re-contact rates within 7 days; Adverse events; Number of hospital admissions; Staff satisfaction.

1

Study	**Mason 2008** [28]
Study type	RCT (cluster-randomised controlled trial).

Number of studies (number of participants)	1 (n=3018 in the study, n= 2,025 analysed). This study is part of the study Mason 2007. The study analysed patient who went on to have an unplanned ED attendance in the 7 days after discharge from care at the index episode.
Countries and setting	Conducted in UK; setting: large urban area.
Line of therapy	1st line.
Duration of study	Intervention time: Intervention + follow-up.
Method of assessment of guideline condition	Adequate method of assessment/diagnosis.
Stratum	Overall.
Subgroup analysis within study	Not applicable.
Inclusion criteria	Patients were eligible for inclusion into the trial if they presented to the emergency medical services (EMS) with a call originating from a UK Sheffield zip code between September 1, 2003 and September 26, 2004; the call was made between 08:00 and 20:00 hours; the patient was aged 60 years or over; and they had a presenting complaint that fell within the scope of practice of the paramedic practitioners (PPs) working within the scheme.
Exclusion criteria	Not reported.
Recruitment/selection of patients	During each week, a PP based in the EMS control room identified calls eligible for PP assessment by presenting complaint and notified a PP in the community (intervention weeks) or in the ED (control weeks). All identified patients were approached face-to-face for written consent to follow-up. Patients who had more than 1 eligible episode during the trial period were recruited for their first episode only. Subsequent episodes were logged, but patients were not re-recruited for trial purposes.
Age, gender and ethnicity	Age: mean (SD): 82.6 (8.3). Gender (Females): 2192 (72.6%). Ethnicity: not reported.
Further population details	Presenting complaint Fall: 2682 (88.9%) Haemorrhage: 171 (5.7%) Acute medical condition: 164 (5.4)
Indirectness of population	No indirectness.
Interventions	(n=1549) Intervention 1: the paramedic practitioner service being active (intervention). A paramedic practitioner based in the ambulance control room identified eligible calls by the presenting complaint and notified a paramedic practitioner in the community (during intervention weeks). (n=1469) Intervention 2: the paramedic practitioner service being inactive (control) when the standard 999 service was available. During inactive weeks, the paramedic practitioners were removed from operational duties within the

	ambulance service, and undertook research duties including obtaining patients' consent and follow-up.
Funding	Academic or government funding.
RESULTS (NUMBERS ANALYSED) AND RISK OF BIAS FOR COMPARISON: PARAMEDIC PRACTITIONER IN THE COMMUNITY (DURING INTERVENTION WEEKS) VERSUS PARAMEDIC PRACTITIONER IN THE EMERGENCY DEPARTMENT (DURING CONTROL WEEKS) Protocol outcome 1: Re-contact rate - Actual outcome: Unplanned emergency department attendance; Group 1: 133/1118, Group 2: 86/907; Risk of bias: All domain - very high, Selection - low, Blinding - high, Incomplete outcome data - low, Outcome reporting - Low, Measurement - Low, Crossover - Low; Indirectness of outcome: serious indirectness	
Protocol outcomes not reported by the study	Mortality; Quality of life; Conveyance(carriage) rates; Number of patients seeking further contacts after initial assessment by paramedic (GP, 999, ED, 111) OR Re-contact rates within 7 days; Patient and/or carer satisfaction; Adverse events; Number of hospital admissions; Staff satisfaction.

1

Study	**Mason 2012** [30]
Study type	Quasi experimental intervention trial.
Number of studies (number of participants)	1 (n=5525); Ambulance service only (n=1107).
Countries and setting	Conducted in the UK; setting: emergency and urgent care.
Line of therapy	1st line
Duration of study	Intervention time: intervention +follow-up.
Method of assessment of guideline condition	Adequate method of assessment/diagnosis.
Stratum	Overall.
Subgroup analysis within study	Not applicable.
Inclusion criteria	All patients presenting with urgent or emergency complaints that were eligible to be seen by the ECPs and presented to either the intervention or control services between May 2006 and August 2007 were included in the trial. The patients ECPs were eligible to see were determined by the setting in which they operated and local protocols developed by individual services.
Exclusion criteria	Not reported.

Recruitment/selection of patients	Not reported.
Age, gender and ethnicity	Age: mean (SD): 49.4 (30.8). Gender (males): 981 (41.6%) Ethnicity: not reported.
Further population details	Not reported.
Indirectness of population	30% of the population were children or trauma patients.
Interventions	Overall: (n=2363) Intervention 1: Five matched pairs of intervention Emergency Care Practitioners (ECP): ambulance, care home, minor injury unit, urgent care centre and GP out-of-hours. The services included: ECPs working as single responder to 999 calls, ECPs responding to direct calls to service from nursing and residential homes, ECPs working in a minor injury unit based in a shopping centre, ECPs working in a GP led primary care out of hours (OOHs) service, ECP led 24 hour Urgent Care Centre based in a community hospital, ECPs working alongside nurse practitioners in a walk-in-centre (WIC) and ECPs working alongside nurse practitioner in a minor's clinic in an emergency department (ED). (n=3162) Intervention 2: control. Usual care services. The services included: Ambulances crewed by standard paramedic/technician response responding to 999 calls, ambulance crewed by standard paramedic/technician response responding to 999 calls from nursing and residential homes, emergency nurse practitioners working in minor injury unit based in community hospital, GPs led out of hours (OOHs) primary care service, nurse led 24 hour casualty based in a small infirmary, nurse practitioner led walk-in centre (WIC) and nurse practitioner led minor clinic within an emergency department (ED). Ambulance service: (n=593) Intervention 1: Emergency Care Practitioner working as a single responder to ambulance service '999' calls. (n=514) Intervention 2: Standard paramedic/technician ambulance responding to ambulance service '999' calls.
Funding	Academic or government funding.
RESULTS (NUMBERS ANALYSED) AND RISK OF BIAS FOR COMPARISON: Protocol outcome 1: Number of hospital admissions: - Actual outcome: Referred to hospital (ED referral or direct admission to hospital ward): Group 1: 251/593, Group 2: 476/514; Risk of bias: All domain - very high, Selection - high, Blinding - high, Incomplete outcome data - low, Outcome reporting - Low, Measurement - Low, Crossover - Low; Indirectness of outcome: serious indirectness	

Protocol outcome 1: Number of patients seeking further contacts after initial assessment by paramedic (GP, 999, ED, 111) Or Re-contact rates within 7 days) - Actual outcome: Referred to primary care; Group 1: 85/593, Group 2: 4/514; Risk of bias: All domain - very high, Selection - high, Blinding - high, Incomplete outcome data - low, Outcome reporting - Low, Measurement - Low, Crossover - Low; Indirectness of outcome: serious indirectness	
Protocol outcomes not reported by the study	Mortality; Quality of life; Conveyance (carriage) rates; Adverse events; Staff satisfaction.

1

Appendix E: Economic evidence tables

Study	Dixon 2009[15]			
Study details	**Population & interventions**	**Costs**	**Health outcomes**	**Cost effectiveness**
Economic analysis: CUA (health outcome: QALYs) **Study design:** cluster randomised controlled trial with randomisation at the level of the service where weeks were allocated randomly to either the intervention or the control. Dispatch and patient recruitment were undertaken by a paramedic practitioner (see also Mason 2007[27] and Mason 2008[28] in the clinical review). **Approach to analysis:** economic evaluation alongside the clinical trial, with within-trial analysis of resource use, costs and QALYs**.** Complete-case analysis used as the base case. **Perspective:** UK NHS **Follow-up**: 28 days **Treatment effect duration**[(a)]**:** 28 days	**Population:** Elderly patients (> 60 years) with a presenting complaint that fell within the scope of practice of the paramedic practitioner (PP) working within the scheme. **Cohort settings:** Mean age: NR Male: NR **Intervention 1: (n= 1549)** Usual care where Paramedic practitioner (PP) scheme was inactive and standard 999-service in operation. This meant that the paramedic practitioner is removed from operational duties within the ambulance service. The PP based in the ambulance control room identifies the calls eligible for PP assessment and refer them to a PP based in the ED for follow-up. **Intervention 2: (n=1469)** PP scheme active, with the PP attending to calls from patients presenting with complaints within the PP scope of practice, which includes presentations with falls, lacerations, epistaxis, minor burns and foreign bodies. The additional skills they possessed included local anaesthetic	**Total costs (mean per patient) for complete case analysis:** Intervention 1: NR Intervention 2: NR Incremental (2−1):- £680 (95% CI: NR; p=NR) **Total costs (mean per patient):** Intervention 1: £2,641 Intervention 2: £2,102 Incremental (2−1):- £551 (95% CI: -£1,170 to £67; p=NR) **Currency & cost year:** 2004 UK pounds. **Cost components incorporated:** Training, PP time, other emergency responders' time, ED visits, inpatient admissions, social care assessment, primary and community care costs, and nursing/residential	**QALYs (mean per patient) for complete case analysis:** Intervention 1: NR Intervention 2: NR Incremental (2−1): -0.0003 (95% CI: NR; p=NR) **QALYs (mean per patient):** Intervention 1: 0.039 Intervention 2: 0.038 Incremental (2−1): -0.001 (95% CI: -0.003 to +0.000; p=NR)	**ICER (Intervention 1 versus Intervention 2):** £2,266,667 per QALY gained (da)[(b)] 95% CI: NR Probability Intervention 2 cost-effective (£20K threshold): > 95% **Analysis of uncertainty:** Sensitivity analysis using higher unit cost for PP time showed that the incremental cost saving reduced to £92. Another sensitivity analysis using multiple imputations to address the problem of missing data resulted in a reduction of the probability that the intervention is cost effective at £20,000 per QALY gained threshold to 73%, with the incremental cost saving reduced to £162.

Discounting: Costs: n/a; Outcomes: n/a	techniques, wound care, suturing, neurological, cardiovascular and respiratory system examination and protocol-led dispensing. The PP based in the ambulance control room identifies the calls eligible for PP assessment and refer them to a PP based in the community.	care costs.		
Data sources				
Health outcomes: clinical data relating to the initial episode were collected from the hospital patient administration system (PAS data) and ED and ambulance records. Follow-up data were collected from patients using the EQ-5D questionnaire at 28 days. **Quality-of-life weights:** the EQ-5D UK tariff was used to as the source of QoL weights. **Cost sources:** Both local and national sources were used for cost data including NHS reference costs, PSSRU Sheffield teaching hospital and South Yorkshire ambulance service records.				
Comments				
Source of funding: public funding body (Health foundation) **Applicability and limitations:** There is some uncertainty regarding the applicability of the costs and resource use from 2004 to current NHS context. Some social care costs were also included which means that the perspective is not strictly NHS and PSS. Estimates of effectiveness are based on a single RCT so by definition is not reflective of the whole body of evidence in this area. Baseline data on quality of life were assumed equal and not actually measured in the study. Large percentage of missing data which may reduce the power of the analysis to detect differences. Limited number of sensitivity analyses was presented.				
Overall applicability[(c)]: partially applicable **Overall quality[(d)]:** minor limitations				

Abbreviations: 95% CI: 95% confidence interval; CUA: cost–utility analysis; da: deterministic analysis; EQ-5D: Euroqol 5 dimensions (scale: 0.0 [death] to 1.0 [full health], negative values mean worse than death); ICER: incremental cost-effectiveness ratio; NR: not reported; PP: paramedic practitioner; QALYs: quality-adjusted life years.

(a) For studies where the time horizon is longer than the treatment duration, an assumption needs to be made about the continuation of the study effect. For example, does a difference in utility between groups during treatment continue beyond the end of treatment and if so for how long.

(b) Calculated by NGC. Intervention 2 is less costly and less effective.

(c) Directly applicable/Partially applicable/Not applicable.

(d) Minor limitations/Potentially serious limitations/Very serious limitations.

Appendix F: GRADE tables

Table 7: Clinical evidence profile: enhanced versus standard - RCT

Quality assessment							No of patients		Effect		Quality	Importance
No of studies	Design	Risk of bias	Inconsistency	Indirectness	Imprecision	Other considerations	Enhanced versus standard - RCT	Control	Relative (95% CI)	Absolute		
Mortality at 28 days												
1	randomised trials	serious[1]	no serious inconsistency	no serious indirectness	serious[2]	None	68/1549 (4.4%)	5%	RR 0.87 (0.63 to 1.2)	6 fewer per 1000 (from 19 fewer to 10 more)	⊕⊕OO LOW	CRITICAL
Number of hospital admissions (0-28 days)												
1	randomised trials	serious[1]	no serious inconsistency	no serious indirectness	no serious imprecision	None	626/1549 (40.4%)	46.5%	RR 0.87 (0.8 to 0.94)	60 fewer per 1000 (from 28 fewer to 93 fewer)	⊕⊕⊕O MODERATE	IMPORTANT
ED attendance (0-28 days)												
1	randomised trials	serious[1]	no serious inconsistency	no serious indirectness	no serious imprecision	None	970/1549 (62.6%)	87.5%	RR 0.72 (0.69 to 0.75)	245 fewer per 1000 (from 219 fewer to 271 fewer)	⊕⊕⊕O MODERATE	IMPORTANT
Unplanned emergency department attendance												
1	randomised trials	serious[1]	no serious inconsistency	no serious indirectness	serious[2]	None	133/1118 (11.9%)	9.5%	RR 1.25 (0.97 to 1.62)	24 more per 1000 (from 3 fewer to 59 more)	⊕⊕OO LOW	IMPORTANT
Patient satisfaction - very satisfied with care												

1	randomised trials	serious[1]	no serious inconsistency	no serious indirectness	serious[2]	None	656/1549 (42.3%)	35.9%	RR 1.18 (1.08 to 1.29)	65 more per 1000 (from 29 more to 104 more)	⊕⊕OO LOW	CRITICAL

1 1 Downgraded by 1 increment if the majority of the evidence was at high risk of bias, and downgraded by 2 increments if the majority of the evidence was at very high risk of bias.
2 2 Downgraded by 1 increment if the confidence interval crossed 1 MID or by 2 increments if the confidence interval crossed both MIDs.

3 **Table 8: Clinical evidence profile: enhanced versus standard – Non-randomised study (Quasi-experimental study)**

Quality assessment							No of patients		Effect		Quality	Importance
No of studies	**Design**	**Risk of bias**	**Inconsistency**	**Indirectness**	**Imprecision**	**Other considerations**	**Enhanced versus standard - NRS**	**Control**	**Relative (95% CI)**	**Absolute**		
Number referred to hospital (ED or direct admission to a hospital ward)												
1	observational studies	very serious[1]	no serious inconsistency	serious[2]	no serious imprecision	none	251/593 (42.3%)	92.6%	RR 0.46 (0.41 to 0.5)	500 fewer per 1000 (from 463 fewer to 546 fewer)	⊕OOO VERY LOW	IMPORTANT
Number referred to primary care												
1	observational studies	very serious[1]	no serious inconsistency	serious[2]	no serious imprecision	none	85/593 (14.3%)	0.8%	RR 18.42 (6.8 to 49.86)	139 more per 1000 (from 46 more to 391 more)	⊕OOO VERY LOW	IMPORTANT

4 1. *All non-randomised studies automatically downgraded due to selection bias. Studies may be further downgraded by 1 increment if other factors suggest additional high risk of bias, or 2*
5 *increments if other factors suggest additional very high risk of bias.*
6
7 2 Downgraded by 1 increment as outcome is indirect.

1 Appendix G: Excluded clinical studies

2 **Table 9: Studies excluded from the clinical review**

Reference	Reason for exclusion
Angelache 1987[3]	No data presented. Foreign language paper. Not a relevant population – pregnant women.
Anon 1995[1]	Unable to locate.
Anon 2014A[2]	No data which can be analysed.
Arreolarisa 2000[4]	No relevant outcomes. Not a relevant population – trauma patients.
Arreolarisa 2007[5]	Population does not match protocol – trauma patients.
Barr 2011[6]	Not appropriate study design – magazine article.
Brown 2011[7]	Not appropriate study design – article. No data presented.
Caffrey 2014[8]	Not appropriate study design – literature review.
Campbell 2008[9]	Not a relevant intervention – paramedics administering drugs in the Emergency department.
Cantor 2012[10]	Not relevant – looks at hospital transfer of MI patients. No control group.
Clarke 2014[11]	No control group. No relevant outcomes.
Cooper 2007[13]	Not relevant intervention – leadership skills. No relevant outcomes
Cooper 2004[12]	Not appropriate study design – qualitative study.
Cooper 2009[14]	Not appropriate study design – literature review
Dixon 2009[15]	Cost effectiveness from the Mason RCTs.
Dyson 2014[16]	Systematic review looking at experience rather than enhanced competencies.
Evans 2014[17]	Systematic review with inadequate quality assessment or studies.
Filatova 1974[18]	Not a relevant population – study conducted in Russia. Foreign language paper.
Frandsen 1991[19]	Observational study n<500.
Gilovan 1987[20]	Not a relevant population – study conducted in Romania. Foreign language paper.
Gray 2008A[21]	Not about competencies of staff, about differences in outcomes for elderly patients and people with breathing difficulties.
Haynes 1999[22]	No relevant outcomes.
Nicholl 1998[32]	Population does not match protocol – serious trauma patients.
Jayamaran 2014[23]	Population does not match protocol – trauma patients.
Lemay 2006[24]	Not a relevant comparison, about ACP's using STEMI tool.
Lewis 1979[25]	US study. Not relevant for UK context as do not have a physician on ambulance.
Mason 2006[26]	Not appropriate study design – non-comparative.
Mason 2007A[29]	Observational study, n<250. No multivariate analysis.
Mitchell 1997[31]	Observational study n<500. No multivariate analysis.
Ohara 2012[33]	No relevant outcomes. Reviewed case notes and developed a quality and safety care score which is only outcome.
Rowley 1987[34]	Not a relevant comparison, not standard paramedic.
Sanghavi 2015[35]	Not relevant to the UK.
Smith 2013[36]	Not relevant. Laboratory study.

Reference	Reason for exclusion
Spoor 1977[37]	Unable to locate
Spoor 1981[38]	No relevant outcomes.
Stiell 2007[39]	Not relevant to the UK.
Sukumuran 2005[40]	Population does not match protocol – trauma patients.
Tohira 2014[41]	Unable to locate.
Wright 1985[42]	Not relevant. Costs of training and description of training.

Appendix H: Excluded economic studies

Table 10: Studies excluded from the economic review

Reference	Reason for exclusion
Mason 2007A[29]	This study was assessed as partially applicable with very serious limitations. The study is conducted in 3 settings, only 1 of which is applicable to the current review (999 setting). It is not clear whether the usual care provided in the 999 setting is by paramedics with standard competencies. Additionally, ECPs in the study could have a background as a paramedic or nurse or other health care professional, with differences in training costs and subsequent incremental costs. There is some uncertainty regarding the applicability of the costs and resource use from 2004 to current NHS context. EQ-5D is reported to have been used but no detailed data on QALYs are provided. The study also has serious limitations as it is an observational study with limited adjustment for confounders. Estimates of effectiveness are from 1 study, so by definition, do not reflect all evidence in this area. Very limited data is presented for the cost analysis with no information on nature or quantities of resources used and their unit costs. The source of unit costs for the health services used, other than personnel time, is not clear. The authors reported that cost data were available only for 56 patients, so the cost analysis is not sufficiently powered. Only a difference in cost is reported with no details of how this estimate was arrived at. Sensitivity analysis is reported.