National Institute for Health and Care Excellence

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Final

Chapter 34 Standardised systems of care for intra- and inter-hospital transfers

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

NICE guideline 82

December 2017

Developed by the National Guideline Centre, hosted by the Royal College of Physicians

Appendix D: Clinical evidence tables

Study	Comparison of a specialist retrieval team with current UK practice trial: Bellingan 2000[16]
Study type	Non-randomised comparative study.
Number of studies (number of participants)	1 (n=259).
Countries and setting	Conducted in United Kingdom; setting: University College London Hospitals (UCLH), UK.
Line of therapy	1st line.
Duration of study	Other: retrospective review of all transfers over 1 year.
Method of assessment of guideline condition	Adequate method of assessment/diagnosis.
Stratum	Overall.
Subgroup analysis within study	Not applicable.
Inclusion criteria	All critically ill patients who were transferred into the UCLH intensive care unit (ICU) from 1st October 1996 to 30th September 1997.
Exclusion criteria	n/a.
Recruitment/selection of patients	Patients were transferred either by the UCLH specialist team using a mobile ICU (n=168, 64.9%) or by standard emergency ambulance with a medical escort provided by the referring hospital (n=91, 35.1%). Transfer by standard ambulance occurred when the specialist team was busy or unavailable owing to training or maintenance. There was no selection policy determining which mode of transfer was used.
Age, gender and ethnicity	Age - Mean (SD): mobile ICU: 54 (19); standard ambulance: 56 (19). Gender (M:F): mobile ICU: 1/1; standard ambulance: 3/2. Ethnicity: n/a.
Further population details	1. Inter versus Intra hospital: Inter hospital (transfer into ICU of UCLH from referring hospital).
Indirectness of population	No indirectness.
Interventions	(n=168) Intervention 1: Standardised system (including checklist of both staffing and equipment) for transfer - As defined by the study. Inter-hospital transfer by specialist team using a mobile ICU. The team consisted of an ICU-trained doctor (senior SPR or consultant), nurse, driver, and medical physics technician, all trained in the transfer of ICU patients. The mobile ICU is an ambulance equipped to ICU standards (all round stretcher access, piped oxygen and air, nitric oxide, mechanical ventilation, suction, 220V power supply and multi-channel monitoring). The specialist team spent between 30 and 300 min (mean 70 min) stabilising patients in the referring hospital before transfer. Duration: retrospective review of all transfers over the course of 1 year. Concurrent medication/care: n/a.

	(n=91) Intervention 2: No standardised system for transfers - As defined by the study. Inter-hospital transfer by standard ambulance with a medical escort provided by the referring hospital (when specialist team was busy or unavailable). Duration: retrospective review of all transfers over the course of 1 year. Concurrent medication/care: n/a.
Funding	Funding not stated.
RESULTS (NUMBERS ANALYSED) AND RISK OF BIAS FOR COMPARISON: INTER-HOSPITAL TRANSFER BY SPECIALIST TEAM USING A MOBILE ICU versus INTER-HOSPITAL TRANSFER BY STANDARD AMBULANCE. Protocol outcome 1: Mortality - Actual outcome: Mortality within 6 hours of admission; Group 1: 1/168, Group 2: 4/91; 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: No indirectness ; Baseline details: no difference in baseline characteristics; Group 1 Number missing: 0; Group 2 Number missing: 0 - Actual outcome: overall ICU mortality within ICU stay; Group 1: 47/168, Group 2: 32/91; 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: No indirectness ; Baseline details: no difference in baseline characteristics; Group 1 Number missing: 0; Group 2 Number missing: 0 - Actual outcome: Mortality- HR at 1000 hours; HR 0.56 (95%CI 0.35 to 0.9) Reported; 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: No indirectness ; Baseline details: no difference in baseline characteristics; Group 1 Number missing: 0; Group 2 Number missing: 0 - Actual outcome: Mortality within 12 hours of admission; Group 1: 5/168, Group 2: 7/91; 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: No indirectness ; Baseline details: no difference in baseline characteristics; Group 1 Number missing: 0; Group 2 Number missing: 0	
Protocol outcomes not reported by the study	Avoidable adverse events; Quality of life; Length of stay; Carer/Family satisfaction; Staff satisfaction.

Study	Direct transfer protocol for patients with non-ST-elevation acute coronary syndromes trial: Gallagher 2014[36]
Study type	Before and after study.
Number of studies (number of participants)	1 (n=702).
Countries and setting	Conducted in United Kingdom; setting: London Chest Hospital, a 'stand-alone' regional interventional cardiac centre serving a population of about 1.8 Million in North East London, UK. Prospective observational study of the management of patients with non-ST elevation acute coronary syndrome (NSTE-ACS) treated at the institution between October 2009 and October 2010. The study period represents the last 6 months of the previous NSTE-ACS care model and the first 6 months of the new Heart Attack Centre Extension (HAC-X).
Line of therapy	1st line.
Duration of study	Other: 6 months before + 6 months after introduction of transfer protocol.
Method of assessment of guideline condition	Adequate method of assessment/diagnosis.
Stratum	Overall.
Subgroup analysis within study	Not applicable.
Inclusion criteria	Inclusion criteria were an admission diagnosis of NSTE-ACS with chest pain within 24 h of presentation plus either an elevated blood troponin T or troponin I concentration, or ECG changes compatible with ischaemia (defined asST-segment depression ≥1 mm or T-wave inversion ≥2 mm in 2 contiguous leads, or biphasic ST/T wave segments indicative of a critical stenosis in the left anterior descending artery).
Exclusion criteria	Patients were excluded if they had contraindication to early interventional management including major medical comorbidity, unexplained anaemia (haemoglobin concentration ≤10 g/dL), acute renal failure, recent traumatic injury or loss of consciousness (except when secondary to cardiac arrhythmia), overt epsis or unexplained hypoxia.
Recruitment/selection of patients	Patients were eligible for inclusion in the study if they presented to a district general hospital (DGH) ED participating in the HAC-X project and were subsequently transferred to the Chest Hospital for further management.
Age, gender and ethnicity	Age - Mean (SD): before: 65.2 (12.6); after: 57.0 (13.9). Gender (M:F): 7/3. Ethnicity: n/a.
Further population details	1. Inter versus Intra hospital: Inter hospital (transfer from district general hospital to this regional interventional cardiac centre).
Indirectness of population	No indirectness.
Interventions	(n=311) Intervention 1: Standardised system (including checklist of both staffing and equipment) for transfer - As defined by the study. Direct transfer protocol through Heart Attack Centre-Extension. After initiation of the HAC-X pathway patients diagnosed with NSTE-ACS in the DGH ED, and meeting the inclusion criteria received protocol driven evidence-based medical therapy [Aspirin 200mg, Clopidogrel 600mg, Fondaparinux 2.5mg, and Eptifibatide bolus (180 mg/kg) as long as no contraindications] and were transferred to the Chest Hospital directly within 1 h of diagnosis.

	There was no requirement for ECG review or prior notification of the patient's transfer to the centre but clinical advice could be sought in cases of diagnostic uncertainty. If admission diagnosis of NSTE-ACS was confirmed at the centre, coronary angiography was performed; unstable patients were taken directly for coronary angiography. Stable patients had coronary angiography scheduled for later the same day, or on next available routine list. All subsequent cardiac care was undertaken at the regional cardiac centre. Patients were aimed to be discharged within 48 hours of their admission. Patients requiring surgical revascularisation remained at the centre until surgery was performed. Duration: 6 months post-induction of the scheme. Concurrent medication/care: n/a. (n=391) Intervention 2: No standardised system for transfers - As defined by the study. Previous NSTE-ACS care model which involved admission of patients to their local DGH for 'medical stabilisation' pending availability of a bed at the regional interventional cardiac centre for transfer for coronary angiography (and/or PCI). Clinical instability prompted more urgent transfer and patients were usually transferred back to their local hospital for discharge following invasive cardiac treatment. Duration: 6 months pre-induction of the scheme. Concurrent medication/care: n/a.
Funding	Funding not stated.

RESULTS (NUMBERS ANALYSED) AND RISK OF BIAS FOR COMPARISON: DIRECT TRANSFER PROTOCOL THROUGH HEART ATTACK CENTRE-EXTENSION versus PREVIOUS NSTE-ACS CARE MODEL.

Protocol outcome 1: Avoidable adverse events.
- Actual outcome: Time to coronary angiography (median) during study period; Indirectness of outcome: Serious indirectness, Comments: surrogate outcome for avoidable adverse events

Protocol outcome 2: Length of stay.
- Actual outcome: Length of hospital stay at time from registration at the DGH ED to final hospital discharge (median); Indirectness of outcome: No indirectness.

Narrative data only -

Before and after introduction of a clinical pathway for patients with suspected acute coronary syndromes.

Pre-HAC-X pathway (n=391)	Post-HAC-X pathway (n=311)	P	
Time to coronary angiography	7.2 (5.1-10.2)	1.0 (0.7-2.0)	<0.001
Length of hospital stay	9.0 (6.0-14.0)	3.0 (2.0-6.0)	<0.001

Data reported in days as median (25-75% interquartile range).

Protocol outcomes not reported by the study	Mortality; Quality of life; Carer/Family satisfaction; Staff satisfaction.

Study	Inter-hospital medical intensive care unit transfer instrument trial: Malpass 2015[53]
Study type	Before and after study.
Number of studies (number of participants)	1 (n=211).
Countries and setting	Conducted in USA; setting: development of ICU transfer instrument development, pilot testing of the ICU transfer instrument, and outcome ascertainment prior to and following the patient transfer instrument intervention by the University of Virginia, USA. Pilot testing initiated and done by physicians accepting outside hospital transfers to a closed medical ICU in a single academic tertiary referral centre. Pre-intervention data was collected over 6 months starting January 2009; post-intervention data was collected over 6 months starting January 2011. In both cases included all patients admitted to the medical ICU who were transferred from outside hospitals within the time period specified.
Line of therapy	1st line
Duration of study	Other: for 6 months before + for 6 months after induction 2 years later.
Method of assessment of guideline condition	Adequate method of assessment/diagnosis.
Stratum	Overall.
Subgroup analysis within study	Not applicable.
Inclusion criteria	The pre-intervention group included all patients admitted to the medical ICU team who were transferred from outside hospitals for 6 months starting in January 2009; the post-intervention group included all patients admitted to the medical ICU team transferred from outside hospitals for 6 months starting January 2011 (after implementation of the transfer instrument).
Exclusion criteria	n/a.
Recruitment/selection of patients	Pilot testing initiated and done by physicians accepting outside hospital transfers to a closed medical ICU in a single academic tertiary referral centre. Pre-intervention data was collected over 6 months starting January 2009; post-intervention data was collected over 6 months starting January 2011. In both cases included all patients admitted to the medical ICU who were transferred from outside hospitals within the time period specified.
Age, gender and ethnicity	Age - Mean (SD): 56.4 (16.4). Gender (M:F): 1/1. Ethnicity: n/a.
Further population details	1. Inter versus Intra hospital: Inter hospital (Inter-hospital transfer to a closed medical ICU at a tertiary referral centre).
Indirectness of population	No indirectness.
Interventions	(n=77) Intervention 1: Standardised system (including checklist of both staffing and equipment) for transfer - As defined by the study. Inter-hospital ICU transfer instrument was developed which consisted of 4 main sections: patient data, reason for transfer, treatment recommendations, and condition on arrival. It included physician and

	hospital contact info, past medical history, a history of present illness narrative highlighting complicating problems, the patient's current vital signs (e.g. airway, breathing, and circulation; notation of ventilator setting paired with the ABG, blood pressure paired with vasopressor, and vascular access), and essential test results. The second section prompted the user to notify key services that will be involved in the patient's care so that the full care team is ready to act when the patient arrives. The third section prompted and documented recommendations made to referring physician (including reasoning behind therapy choices to facilitate dialog and identify opportunities for intervention delivery before or during transport). The final section provided feedback to the process by collecting data on the patient's status on arrival to receiving hospital. The tool was to systematise communication between the units. Duration: 6 month after intervention implementation. Concurrent medication/care: n/a. (n=134) Intervention 2: No standardised system for transfers - As defined by the study. Pre-implementation of transfer instrument. No information given as to how transfers were arranged before the tool had been developed and implemented. Duration: 6 months before intervention implementation. Concurrent medication/care: n/a.
Funding	No funding.

RESULTS (NUMBERS ANALYSED) AND RISK OF BIAS FOR COMPARISON: INTER-HOSPITAL ICU TRANSFER INSTRUMENT versus PRE-IMPLEMENTATION OF TRANSFER INSTRUMENT.

Protocol outcome 1: Mortality
- Actual outcome: ICU mortality; OR 0.77 (95%CI 0.39 to 1.51); 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: No indirectness ; Baseline details: post-implementation group had higher predicted mortaity; Key confounders: unclear if adjusted for anything other than APACHE II score and predicted mortality; Group 1 Number missing: 0; Group 2 Number missing: 0

- Actual outcome: 48-hour mortality at 48 hours; OR 0.74 (95%CI 0.19 to 2.93); 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: No indirectness ; Baseline details: post-implementation group had higher predicted mortaity; Key confounders: unclear if adjusted for anything other than APACHE II score and predicted mortality; Group 1 Number missing: 0; Group 2 Number missing: 0- Actual outcome: hospital mortality; OR 0.85 (95%CI 0.46 to 1.61); 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: No indirectness ; Baseline details: post-implementation group had higher predicted mortaity; Key confounders: unclear if adjusted for anything other than APACHE II score and predicted mortality; Group 1 Number missing: 0; Group 2 Number missing: 0
Protocol outcome 2: Avoidable adverse events.
- Actual outcome: Need for emergent central line; OR 0.09 (95%CI 0.02 to 0.36); 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: No indirectness ; Baseline details: post-implementation group had higher predicted mortaity; Key confounders: unclear if adjusted for anything other than APACHE II score and predicted mortality; Group 1 Number missing:

0; Group 2 Number missing: 0 - Actual outcome: Need for emergent intubation; OR 0.18 (95%CI 0.02 to 1.46); 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: No indirectness ; Baseline details: post-implementation group had higher predicted mortaity; Key confounders: unclear if adjusted for anything other than APACHE II score and predicted mortality; Group 1 Number missing: 0; Group 2 Number missing: 0 - Actual outcome: Antibiotics changed on arrival; OR 0.48 (95%CI 0.27 to 0.86); 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: No indirectness ; Baseline details: post-implementation group had higher predicted mortaity; Key confounders: unclear if adjusted for anything other than APACHE II score and predicted mortality; Group 1 Number missing: 0; Group 2 Number missing: 0	
Protocol outcomes not reported by the study	Quality of life; Length of stay; Carer/Family satisfaction; Staff satisfaction.

Study	**Decreasing door-to-balloon times through streamlined protocol trial: Reimer 2013[66]**
Study type	Non-randomised comparative study.
Number of studies (number of participants)	1 (n=133).
Countries and setting	Conducted in USA; setting was a 1300-bed Midwest tertiary care centre that serves as a regional referral centre in Northeast Ohio, USA. Two cohorts were analysed after implementation of a streamlined referral protocol to improve door-to-balloon times for patients with acute STEMI (ST segment elevation myocardial infarction): patients transferred using the streamlined protocol and patients referred through the traditional referral process. The cardiac catheterisation laboratory is fully staffed weekdays, with on-call staffing for nights and weekends. The hospital operates a hospital-based critical care transport (CCT) team consisting of 2 helicopters and 1 ground ambulance that operate 24 hours a day 7 days a week. All CCT crews are staffed with an acute care nurse practitioner and critical care registered nurse and/or critical care paramedic.
Line of therapy	1st line.
Duration of study	Intervention time: 1 year.
Method of assessment of guideline condition	Adequate method of assessment/diagnosis.
Stratum	Overall.
Subgroup analysis within study	Not applicable.
Inclusion criteria	All patients undergoing transport by helicopter or ground for acute STEMI to the Cleveland Clinic for emergent PCI by the hospital-based CCT team from July 2009 through to June of 2010 were eligible for the study.
Exclusion criteria	n/a.

Recruitment/selection of patients	A hospital-based CCT log was used to track all streamlined cases for acute STEMI. The hospital also had an acute myocardial infarction (AMI) database to identify door-to-balloon times which includes only patients with a referring diagnosis of STEMI and a positive cardiac catheterisation defined as coronary artery occlusion deemed to be associated with an acute coronary syndrome by the interventional cardiologist. Only cases that had complete data entered into the CCT STEMI log and AMI database were included for analysis.
Age, gender and ethnicity	Age - Median (IQR): streamlined: 55 (49-64); traditional: 61 (50-72). Gender (M:F): 1/2. Ethnicity: White: streamlined (65%); traditional transfer (77%).
Further population details	1. Inter versus Intra hospital: Inter hospital (patients transferred for acute STEMI to the clinic for emergent PCI).
Indirectness of population	No indirectness.
Interventions	(n=54) Intervention 1: Standardised system (including checklist of both staffing and equipment) for transfer - As defined by the study. Streamlined referral protocol. The traditional protocol was reviewed to identify areas for improvement by the transport team and cardiology management team. The abbreviated streamlined protocol was then developed: Referring facilities were provided with a contact telephone number linked directly to a CCT coordinator via a hotline dedicated to streamlined referrals. Upon receiving a hotline request, to coordinator obtained patient information, location, and simultaneously dispatches the aircraft. The coordinator also instructs the referring hospital to fax the patient's electrocardiogram to the coronary care unit and a demographic sheet to the hospital transfer centre. The aircraft is dispatched without regard for bed availability and without accepting physician communication before dispatch. While the transport is taking place, the coordinator activates the catheterisation laboratory to reserve a table or to activate the on-call team and then contacts the on-call cardiologist to inform them of the referral and information regarding the referring facility. Duration: 1 year. Concurrent medication/care: n/a. (n=79) Intervention 2: No standardised system for transfers - As defined by the study. The traditional protocol processed time-sensitive patient transfer requests the same as all other transfer requests. It consisted of 21 steps with an average time to complete of 42 minutes, ranging from 23 to 64 minutes. Duration: 1 year. Concurrent medication/care: n/a.
Funding	Funding not stated.

RESULTS (NUMBERS ANALYSED) AND RISK OF BIAS FOR COMPARISON: STREAMLINED REFERRAL PROTOCOL versus TRADITIONAL REFERRAL PROTOCOL.

Protocol outcome 1: Avoidable adverse events.
- Actual outcome: door-to-balloon time (as surrogate for avoidable adverse events); Indirectness of outcome: Serious indirectness.

Protocol outcome 2: Length of stay
- Actual outcome: total time patient spent in referring ED, including time for arrival of transport team; Indirectness of outcome: No indirectness.

Narrative data only.
Before and after introduction of a streamlined transfer.

	Traditional transfer (n=79)	Streamlined transfer (n=54)	P
Emergency department	60 (45-84)	55 (44-67)	0.07
Door-to-balloon time	122 (99-157)	101 (88-128)	0.001

Data reported in minutes as median (25-75% interquartile range). Emergency department time is total time patient spent in referring department, including time waiting for arrival of transport team. Door-to-balloon time is total time from presentation at outside ED to percutaneous coronary intervention.

Protocol outcomes not reported by the study	Mortality; Quality of life; Carer/Family satisfaction; Staff satisfaction.

Study	**Effects of ambulance transport trial: Waddell 1975[77]**
Study type	Non-randomised comparative study.
Number of studies (number of participants)	1 (n=66).
Countries and setting	Conducted in United Kingdom; setting: transfers of critically ill patients to the intensive therapy unit of the Western Infirmary in Glasgow, UK, via ambulance from other hospitals over the course of 6 years. Time period of data collection for intensive therapy unit 'flying squad' not reported.
Line of therapy	1st line.
Duration of study	Not clear: no information given.
Method of assessment of guideline condition	Adequate method of assessment/diagnosis.
Stratum	Overall.
Subgroup analysis within study	Not applicable.
Inclusion criteria	Retrospective review of ambulance transfers to the Western Infirmary ICU; only ‘adequate’ records reported. Prospective data collection of eligible patients for transfers via intensive therapy unit 'flying squad'.
Exclusion criteria	Patients for whom no adequate records were available or who were deemed unsuitable for transfer.
Recruitment/selection of patients	Retrospective review of ambulance transfers to the Western Infirmary ICU; only adequate records reported. Prospective data collection of eligible patients for transfers via intensive therapy unit 'flying squad'.
Age, gender and ethnicity	Age - Mean (SD): flying squad 57; standard ambulance 42 (SDs not provided). Gender (M:F): 3/2. Ethnicity: n/a.
Further population details	1. Inter versus Intra hospital: Inter hospital.

Indirectness of population	No indirectness.
Interventions	(n=20) Intervention 1: Standardised system (including checklist of both staffing and equipment) for transfer - As defined by the study. The intensive therapy unit 'flying squad' consisted of 1 or 2 members of a 'shock team'. When the intensive therapy unit received a request for a transfer the flying squad travelled to the referring hospital, set up monitoring equipment, and began treatment. They accompanied the patient in an ambulance of standard design and continued treatment on arrival at the unit. Average ambulance ride was 12 minutes and the total time from bed to bed 33 minutes. Duration: unclear. Concurrent medication/care: n/a. (n=46) Intervention 2: No standardised system for transfers - As defined by the study. Transfers by standard ambulance from other hospitals to ICU of Glasgow Western Infirmary. Duration: 6 years. Concurrent medication/care: n/a.
Funding	Funding not stated.

RESULTS (NUMBERS ANALYSED) AND RISK OF BIAS FOR COMPARISON: TRANSFERS VIA INTENSIVE THERAPY UNIT 'FLYING SQUAD' versus TRANSFERS VIA STANDARD AMBULANCE.

Protocol outcome 1: Mortality.
- Actual outcome: Mortality within 24 hours of transfer within 24 hours of transfer; Group 1: 1/20, Group 2: 3/46; Risk of bias: All domain - Very high, Selection - Very high, Blinding - High, Incomplete outcome data - Low, Outcome reporting - High, Measurement - Low, Crossover - Low; Indirectness of outcome: No indirectness ; Baseline details: flying squad patients much older and differences in clinical conditions; Key confounders: illness secerity, age etc.; Group 1 Number missing: 0; Group 2 Number missing: 0
- Actual outcome: Final mortality; Group 1: 9/20, Group 2: 18/46; Risk of bias: All domain - Very high, Selection - Very high, Blinding - High, Incomplete outcome data - Low, Outcome reporting - High, Measurement - Low, Crossover - Low; Indirectness of outcome: No indirectness ; Baseline details: flying squad patients much older and differences in clinical conditions; Key confounders: illness secerity, age etc.; Group 1 Number missing: 0; Group 2 Number missing: 0

Protocol outcome 2: Avoidable adverse events.
- Actual outcome: Delayed hypotension; Group 1: 4/20, Group 2: 7/46; Risk of bias: All domain - Very high, Selection - Very high, Blinding - High, Incomplete outcome data - Low, Outcome reporting - High, Measurement - Low, Crossover - Low; Indirectness of outcome: No indirectness ; Baseline details: flying squad patients much older and differences in clinical conditions; Key confounders: illness secerity, age etc.; Group 1 Number missing: 0; Group 2 Number missing: 0

Protocol outcomes not reported by the study	Quality of life; Length of stay; Carer/Family satisfaction; Staff satisfaction.

Study (subsidiary papers)	Inter-hospital transport via a mobile intensive care unit trial: Wiegersma 2011[80] (Ligtenberg 2005[52])
Study type	Before and after study.
Number of studies (number of participants)	2 (n=174).
Countries and setting	Conducted in Netherlands; setting: consecutive transfers via mobile ICU to the University of Groningen affiliated ICU and the ICU of the Scheper Hospital, Emmen, Netherlands, from 14 regional hospitals in the north-eastern region of the Netherlands between March and December 2009. These data were compared to consecutive transfers of ICU patients via standard ambulance to the same ICU from 18 regional hospitals in the north-eastern part of the Netherlands over a 14 month period (not specified but must be pre-2005).
Line of therapy	1st line
Duration of study	Other: 14 months standard transfer + 10 months mobile ICU.
Method of assessment of guideline condition	Adequate method of assessment/diagnosis.
Stratum	Overall.
Subgroup analysis within study	Not applicable.
Inclusion criteria	All consecutive transfers of ICU patients during the pre-defined study periods. Only patients admitted to the ICU are transferred by MICU.
Exclusion criteria	n/a.
Recruitment/selection of patients	Main indication for transfer was the need for higher intensity of care or advanced therapy; for example renal replacement therapy. Main diagnoses at transfer were respiratory problems, sepsis, and multi-organ failure. Shortage of ICU capacity was cited as the reason for transport on only a few occasions.
Age, gender and ethnicity	Age - Mean (SD): mobile ICU 59.8 (15.6); standard ambulance 54.7 (1.7). Gender (M:F): 1/1. Ethnicity: n/a.
Further population details	1. Inter versus Intra hospital: Inter hospital.
Indirectness of population	No indirectness.
Interventions	(n=74) Intervention 1: Standardised system (including checklist of both staffing and equipment) for transfer - As defined by the study. Mobile ICU transfer. A specifically designed large-volume mobile ICU and a specialised retrieval team were used to transfer critically ill patients. A stratified protocol clarification was sent to all referring ICUs in the region, explaining the procedure of transfer. Before working in the mobile ICU team all ICU nurses and intensivists completed a scenario-based training in skills-lab. Transfers between 8am and midnight 7 days a week. The referring intensivist had to consult the MICU-coordinator, who completes a MICU transport form with patient characteristics and study data. After authorisation of the transfer by the MICU-physician and the supervising staff member of the accepting ICU, the MICU sets out to transfer the critically ill patient. Upon arrival at the referring ICU, the MICU-team stabilises and prepares the patient for transfer. The APACHE II score (measure of severity of illness) was being

	determined for the patient. Duration: 10 months. Concurrent medication/care: n/a. (n=100) Intervention 2: No standardised system for transfers - as defined by the study. Standard ambulance transfer. Patients were transferred after telephone consultation with the supervising staff member of the receiving ICU, who authorised the admission. The referring hospital was advised to stabilise the patient as much as possible and to send a skilled physician with the patient. The transfer was done by standard ambulance of the referring hospital. The patient was accompanied by an ICU nurse in 23% and by a physician in 57% of transports. Duration: 14 months. Concurrent medication/care: n/a.
Funding	Funding not stated
RESULTS (NUMBERS ANALYSED) AND RISK OF BIAS FOR COMPARISON: MOBILE ICU TRANSFER versus STANDARD AMBULANCE TRANSFER. Protocol outcome 1: Avoidable adverse events. - Actual outcome: Incidents during transfer (excluding technical failure - but including staff management or inadequate preparation) at 10 and 14 months; OR 0.13 (95%CI 0.06 to 0.32); Risk of bias: All domain - Very high, Selection - Very high, Blinding - High, Incomplete outcome data - Low, Outcome reporting - High, Measurement - Low, Crossover - Low; Indirectness of outcome: No indirectness ; Baseline details: not matched; separate audit data compared; Group 1 Number missing: 0; Group 2 Number missing: 0 - Actual outcome: Incidents during transfer (technical failure) at 10 and 14 months; Group 1: 9/74, Group 2: 10/100; Risk of bias: All domain - Very high, Selection - Very high, Blinding - High, Incomplete outcome data - Low, Outcome reporting - High, Measurement - Low, Crossover - Low; Indirectness of outcome: No indirectness ; Baseline details: not matched; separate audit data compared; Group 1 Number missing: 0; Group 2 Number missing: 0	
Protocol outcomes not reported by the study	Mortality; Quality of life; Length of stay; Carer/Family satisfaction; Staff satisfaction.

Appendix E: Economic evidence tables

No studies were included.

Appendix F: GRADE tables

Table 10: Clinical evidence profile: Standardised system versus standard ambulance transfer

Quality assessment							No of patients		Effect		Quality	Importance
No of studies	Design	Risk of bias	Inconsistency	Indirectness	Imprecision	Other considerations	Mobile ICU versus standard transfer	Control	Relative (95% CI)	Absolute		
Adverse incidents (staff management issues or inadequate preparation) - Staff management issues or inadequate preparation												
1	observational studies	very serious[1]	no serious inconsistency	no serious indirectness	no serious imprecision	None	0/74 (0%)	24%	Peto OR 0.13 (0.06 to 0.32)	201 fewer per 1000 (from 148 fewer to 221 fewer)	⊕OOO VERY LOW	CRITICAL
Adverse incidents (technical failures) - Technical failures												
1	observational studies	very serious[1]	no serious inconsistency	no serious indirectness	very serious[2]	None	9/74 (12.2%)	10%	RR 1.22 (0.52 to 2.84)	22 more per 1000 (from 48 fewer to 184 more)	⊕OOO VERY LOW	CRITICAL
Adverse events (delayed hypotension) - Adverse events (delayed hypotension)												
1	observational studies	very serious[1]	no serious inconsistency	no serious indirectness	very serious[2]	None	4/20 (20%)	15.2%	RR 1.31 (0.43 to 3.99)	47 more per 1000 (from 87 fewer to 454 more)	⊕OOO VERY LOW	CRITICAL
Mortality HR (over 1000 hours)												
1	observational studies	very serious[1]	no serious inconsistency	no serious indirectness	serious[2]	None	-	0%	HR 0.56 (0.35 to 0.9)	-	⊕OOO VERY LOW	CRITICAL
Mortality - Overall ICU mortality												
1	observational studies	very serious[1]	no serious inconsistency	no serious indirectness	serious[2]	None	47/168 (28%)	35.2%	RR 0.8 (0.55 to 1.15)	70 fewer per 1000 (from 158 fewer to	⊕OOO VERY	CRITICAL

										53 more)	LOW	
Mortality - 6 hour mortality												
1	observational studies	very serious[1]	no serious inconsistency	no serious indirectness	serious[2]	None	1/168 (0.6%)	4.4%	RR 0.14 (0.02 to 1.19)	38 fewer per 1000 (from 43 fewer to 8 more)	⊕OOO VERY LOW	CRITICAL
Mortality - 12 hour mortality												
1	observational studies	very serious[1]	no serious inconsistency	no serious indirectness	serious[2]	None	5/168 (3%)	7.7%	RR 0.39 (0.13 to 1.18)	47 fewer per 1000 (from 67 fewer to 14 more)	⊕OOO VERY LOW	CRITICAL
Mortality - Final mortality												
1	observational studies	very serious[1]	no serious inconsistency	no serious indirectness	very serious[2]	None	9/20 (45%)	39.1%	RR 1.15 (0.63 to 2.1)	59 more per 1000 (from 145 fewer to 430 more)	⊕OOO VERY LOW	CRITICAL
Mortality - Mortality within 24 hours of transfer												
1	observational studies	very serious[1]	no serious inconsistency	no serious indirectness	very serious[2]	None	1/20 (5%)	6.5%	RR 0.77 (0.08 to 6.93)	15 fewer per 1000 (from 60 fewer to 385 more)	⊕OOO VERY LOW	CRITICAL

[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 increments if other factors suggest additional very high risk of bias.
[2] Downgraded by 1 increment if the confidence interval crossed 1 MID or by 2 increments if the confidence interval crossed both MIDs.

Table 11: Clinical evidence profile: ICU transfer checklist versus no transfer checklist

Quality assessment							No of patients		Effect		Quality	Importance
No of studies	**Design**	**Risk of bias**	**Inconsistency**	**Indirectness**	**Imprecision**	**Other considerations**	**ICU transfer checklist versus no transfer checklist**	**Control**	**Relative (95% CI)**	**Absolute**		
Adverse events - adjusted OR - Need for emergent central line												
1	observational	very	no serious	no serious	no serious	none	-	0%	OR 0.09 (0.02	-	⊕OOO	CRITICAL

	studies	serious[1]	inconsistency	indirectness	imprecision				to 0.36)		VERY LOW	
Adverse events - adjusted OR - Need for emergent intubation												
1	observational studies	very serious[1]	no serious inconsistency	no serious indirectness	very serious[2]	none	-	0%	OR 0.18 (0.02 to 1.46)	-	⊕OOO VERY LOW	CRITICAL
Adverse events - adjusted OR - Antibiotics changed on arrival												
1	observational studies	very serious[1]	no serious inconsistency	no serious indirectness	serious[2]	none	-	0%	OR 0.48 (0.27 to 0.86)	-	⊕OOO VERY LOW	CRITICAL
Mortality - adjusted OR - Hospital mortality												
1	observational studies	very serious[1]	no serious inconsistency	no serious indirectness	very serious[2]	none	-	0%	OR 0.85 (0.46 to 1.61)	-	⊕OOO VERY LOW	CRITICAL
Mortality - adjusted OR - ICU mortality												
1	observational studies	very serious[1]	no serious inconsistency	no serious indirectness	very serious[2]	none	-	0%	OR 0.77 (0.39 to 1.51)	-	⊕OOO VERY LOW	CRITICAL
Mortality - adjusted OR - 48-hour mortality												
1	observational studies	very serious[1]	no serious inconsistency	no serious indirectness	very serious[2]	none	-	0%	OR 0.74 (0.19 to 2.93)	-	⊕OOO VERY LOW	CRITICAL

[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 increments if other factors suggest additional very high risk of bias

[2] Downgraded by 1 increment if the confidence interval crossed 1 MID or by 2 increments if the confidence interval crossed both MIDs.

Appendix G: Excluded clinical studies

Table 12: Studies excluded from the clinical review

Study	Exclusion reason
AAGBI2206[74]	Guidelines for Anaesthetists in referring units. Screened for relevant references.
AAGBI2009[75]	Safety guideline. Screened for relevant references.
Aghababian 1991[7]	No comparison, no data Narrative review
Aguirre 2008[8]	No relevant comparison
Ailsby 1987[9]	No comparison, no data Description of guidelines for the transport of critically ill patients
Anonymous 1989[1]	No relevant comparison/intervention, no relevant outcomes Description of 4 physical patient transfer systems
Anonymous 1993[3]	No comparison, no data Commentary
Anonymous 1993A[2]	No comparison, no data Description of guidelines for the transfer of critically ill patients
Anonymous 2003F[4]	No comparison, no data Description of minimum standards for transfer
Anonymous 2011[5]	No comparison, no data Commentary
Anonymous 2013F[6]	No comparison, no data Narrative review
Ayers 2012[11]	No comparison, no data Commentary
Australasian College for Emergency Medicine 2003[10]	No comparison, no data Description of a standardised system/checklist for transfers
Bae 2010[12]	No relevant outcomes Effects of emergency medical service hospital notification on transfer and processing times
Barry 2006[13]	No comparison, no data Description of a transfer mattress
Baruch 2010[14]	Data not in analysable format Pilot study with very low patient numbers (n=19)
Beckmann 2004[15]	No comparison Description of the type of incidents and factors contributing to the incidents occurring during patient transfer
Belway 2006[17]	Systematic review
Boyko 1994[20]	No comparison, no data Description of guidelines
Brown 2015 [21]	No relevant extractable outcomes
Brunsveld-Reinders 2015[22]	No comparison, no data Description of the development and piloting of a checklist for transport

Study	Exclusion reason
Burney 1995[23]	Not relevant comparison. Study compares aeromedical transport staffed with physician/nurse with nurse/nurse
Burney 1992[24]	Not relevant comparison. Study compares aeromedical transport staffed with physician/nurse with nurse/nurse
Choi 2012[25]	Data cannot be extracted in a meaningful way Before and after study of implementation of transport checklist
Colardyn 1993[26]	No comparison, no data Narrative review
Comeau 2015 [27]	No relevant extractable outcomes
Dawkins 1983[29]	No comparison, no data Commentary
Dershin 1993[30]	No comparison, no relevant outcomes Case study only of a patient transportation system within a hospital
Etxebarria 1998[31]	No relevant comparison Study about the use of a scoring system rather than the standardisation of the transfer process
Fan 2006[32]	Systematic review
Fanara 2010[33]	Narrative review
Gebremichael2000[37]	No comparison
Gore 1983[38]	No comparison Evaluation of a cardiac transport system
Gray 2004[39]	No comparison, no data Narrative review
Gupta 2004[40]	No comparison, no data Description of guidelines
Hamilton 1994[41]	No relevant comparison Narrative review presenting some data from other studies
Havill 1995[42]	No relevant comparison, incomplete data
Hendrich 2005[43]	No relevant outcomes, no comparison Study documents processes, labour, time and costs of transferring patients between nursing units in the hospital
Henry 2005[44]	No data Pilot study with very low numbers (n<250)
Hindmarsh 2012[45]	No comparison, no relevant data Description of a checklist and initial small audit
Iwashyna 2012[47]	No comparison, no data Description of a conceptual framework for transfer
Jarden 2010[48]	Narrative review and description of the development of a transfer tool No data, no comparison
Koppenberg 2002[50]	No data Narrative review
Kue 2011[51]	No relevant comparison/intervention Before and after study comparing aborted versus completed intra-hospital transfers by a specialised team
Manari [54]	No relevant comparison

Study	Exclusion reason
	Retrospective study comparing directly admitted patients (i.e. no transfer) with transferred patients
Manataki 2016 [55]	Incorrect study design – narrative study
Martin 2012[56]	No comparison, no data Narrative review
Mazza 2008[57]	No comparison Not from OECD country (Brazil)
Nerland 1978[59]	No comparison, no data Commentary
Newton 2015[60]	No data Description of an inter-hospital transfer centre model
Ohashi 2008[61]	No comparison, no data Description of an electronic vital sign-monitoring system for patient transfers
Ong 2011[62]	Review of failures in handoff communication during transfers
Petre 1989[63]	No relevant intervention/comparison, no data Description of a physical patient transport system
Pope 2003[64]	No comparison, no relevant data Narrative review including case study
Ridley 1989[67]	No relevant comparison Retrospective study comparing directly admitted patients (i.e. no transfer) with transferred patients
Roland 2010[68]	No comparison, no data Description of a physical transport system for critically ill obese patients
Russell 2015 [69]	Incorrect intervention
Sethi 2014[70]	No comparison, no data Not from OECD country (India)
Sivaram 1996[71]	No relevant outcomes, data cannot be extracted Establishment of a communication system for transfers between 2 specific hospitals
Steenson 1989[72]	No relevant comparison or data Description of a quality assured structured transport system
Swickard 2014[73]	No comparison, no data Description of adopting a triage model for patient care to critical care transport including 2 case studies
Uusaro 2002[76]	No relevant comparison and no relevant outcomes (compares vital signs before versus after the transport)
Watanabe 1991[79]	No comparison, no data Description of an intra-hospital transport service development
Warren 2004[78]	No comparison, no data Description of guidelines for safe transport
Wu 2007[81]	No comparison, no data Narrative review
Yamamoto 1988[82]	No data Description of an information system for patient transfer

Appendix H: Excluded health economic studies

No studies were excluded.