National Institute for Health and Care Excellence

Final

Chapter 32 Structured patient handovers

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

NICE guideline 94

March 2018

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

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ISBN: 978-1-4731-2741-8
Chapter 32 Structured patient handovers

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32.1 Introduction

Handover is the system by which the responsibility for immediate and ongoing care is transferred between healthcare professions. Changing work patterns mean that establishing standards for handover "should be a priority".[102]

Although the process of handing over between shifts has been embedded in nursing practice for many years, the changing patterns of work in the hospital setting mean that there may be different medical teams looking after groups of patients across a 24 hour period. The medical and nursing professions both recognise the importance of effective handover between shifts and between health care professionals;

"Incomplete or delayed information can compromise safety, quality and the patient's experience of health care."[78]

The Royal College of Nursing dedicate a section of The Principles of Nursing Practice[101] to communication and reporting stating;

"Evidence suggests that communication improves when nursing handover involves the patient and is carried out using a structured reporting format."[70,116]

The World Health Organisation goes as far as to recommend the use of SBAR (Situation, Background, Assessment, Recommendation) as a tool to standardise handover communications.[125] It is recognised in the literature that one system does not fit all settings and that local adaptations may be needed.

Despite the evidence and apparent agreement that handovers are improved by following a structure, the Royal College of Physicians make further recommendations which suggest that there are still improvements to be made and that this is not yet standard practice in all areas.

"Improvement and standardisation of handover are vital keys to improvement in efficiency, patient safety, and patient experience. There is a need to define common core principles for handover, which can be adapted locally. For example, a standardised proforma for written handover is essential, preferably in conjunction with face-to-face verbal handover. Furthermore, in the current technological climate, where possible, electronic handover processes should be encouraged."[102]

Although the evidence to date points to the value of structured patient handover, there may be cost implications for services if there is a need for change in shift pattern and an overlap required to allow time for handover. It is therefore important to investigate the most appropriate form of handover for best patient outcomes and the impact this may have on services.

32.2 Review question: Do structured patient handovers between healthcare professionals improve 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 or confirmed AME (in all contexts not just secondary care).
Intervention(s)	Structured (planned framework as defined by the study) between healthcare professionals between shifts in acute settings: This will include (i) set times of the day, (ii) using a structured template/proforma for

	the handover (iii) recording the information in written or electronic form. Paper-based handover; using paper to conduct the structured handover. Verbal patient handover; verbally conducting the structured handover. Electronic-based handover; using electronic means to conduct the structured handover.
Comparison(s)	Normal handover; routine unstructured handover.
Outcomes	- Mortality CRITICAL - Avoidable adverse events (prescribing errors [errors of omission or commission] cardiopulmonary resuscitation, unplanned admission to intensive care, delayed or missed investigations, delayed or missed treatments) CRITICAL - Quality of life CRITICAL - Patient and/or carer satisfaction CRITICAL - Length of stay CRITICAL - 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.

32.3 Clinical evidence

Six studies were included in the review; 1 non-randomised controlled study and 5 before-after studies[20,34,42,46,58,127] and these are summarised in Table 2 below. Evidence from these studies is summarised in the GRADE clinical evidence profile/clinical evidence summary below. 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
Emlet 2012[34] Non-randomised controlled study	A shift-work schedule with structured sign-out curriculum compared to a traditional every fourth night call schedule without sign-out curriculum.	Mixed medical and surgical ICU. n=820	Mortality; readmissions within 48 hours; ICU length of stay; family satisfaction, staff satisfaction.	The intervention involved structured sign-out plus shift scheduling.
Coon 2015[20] Before and after study	Pre and post-implementation of a standardised ICU transfer documentation checklist to supplement a verbal physician-to physician report compared to a physician-to-physician report.	Neuro-intensive ICU. n=161	ICU readmissions Rapid response team calls.	None.
Gonzalo 2014[42]	Evaluation of a standardised electronic sign-out	Patients in transition from ED to medicine ward.	Staff satisfaction.	None.

Study	Intervention and comparison	Population	Outcomes	Comments
Before and after study	tool with optional verbal communication.	n=1468		
Graham 2013A[45] Before and after study	Alteration of a shift model to facilitate face to face verbal communication between the primary and night-time covering physicians, and an electronic template linked to the hospitals discharge information system for the day to night handoff.	Internal medicine nightshifts. n=39 interns surveyed over 132 intern shifts	Avoidable adverse events – Critical data omissions, near misses, adverse events.	None.
Kerr 2016[58] Before and after study	Structured nursing handover based on the ISBAR (identify, situation, background, assessment and recommendations) handover approach modified to address deficits in nursing care practice in the ED. Key features: systematic, conducted at the bedside, involvement of the patient/relatives, viewing of charts during handover and preliminary group handover for general info about unstable patients. Notepads providing prompts about nursing care needs, treatment and disposition plan and important care elements (medication chart, vital signs, and fluid balance). Versus Handover undertaken in an enclosed area located away from	Setting: mixed adult and paediatric ED of a teaching hospital in Australia. n=126 nurse surveys n=368 medical records and patient observations	Avoidable adverse events (CRITICAL) - medications administered as prescribed.	Population indirectness (includes paediatric patients).

Study	Intervention and comparison	Population	Outcomes	Comments
	the clinical area, carried out by the nurse in charge of the outgoing shift to those on the incoming shift; generally occurring 3 times per day.			
Zou 2016[127] Before and after study	Standard nursing handoff form including patient name, medical record number, diagnosis, signs/symptoms, abnormal test results, care plan 'to do' tasks, scheduled tests/procedures, fall risk, oxygen therapy and catheter. Oral report given by outgoing nurses at nursing station, then bedside handoffs. Head nurse supervised each handoff process. Versus Verbal nursing handoffs at the nursing station at shift change time; occasionally bedside handoffs for critical patients; information transferred was incomplete and unsystematic.	Admissions to the medical unit of a tertiary general hospital in China. Pre-intervention: n=1963 Post-intervention: n=1970	Avoidable adverse events (CRITICAL) - handoffs-related errors.	None.

Table 3: Clinical evidence summary: Intensive Care Unit

Outcomes	No of Participants (studies) Follow up	Quality of the evidence (GRADE)	Relative effect (95% CI)	Anticipated absolute effects	
				Risk with Unstructured handover	Risk difference with structured handover (95% CI)
Mortality	778 (1 study)	⨁⊖⊖⊖ VERY LOW[a,b] due to risk of bias, imprecision	RR 0.71 (0.43 to 1.17)	Moderate	
				85 per 1000	26 fewer per 1000 (from 48 fewer to 14 more)
Re-admission <48hours	820 (1 study)	⨁⊖⊖⊖ VERY LOW[a,b] due to risk of bias, imprecision	RR 1.35 (0.7 to 2.63)	Moderate	
				36 per 1000	13 more per 1000 (from 11 fewer to 59 more)
ICU Length of Stay	820 (1 study)	⨁⊖⊖⊖ VERY LOW[a] due to risk of bias	-	-	The mean length of stay in the intervention groups was 2.78 lower (4.68 to 0.88 lower)
Staff satisfaction	114 (1 study)	⨁⊖⊖⊖ VERY LOW[a] due to risk of bias	RR 3.09 (1.7 to 5.61)	Moderate	
				182 per 1000	380 more per 1000 (from 127 more to 839 more)
Staff satisfaction - Attending Physician	22 (1 study)	⨁⊖⊖⊖ VERY LOW[a,b] due to risk of bias, imprecision	RR 3 (0.77 to 11.74)	Moderate	
				182 per 1000	364 more per 1000 (from 42 fewer to 1000 more)
Staff satisfaction – Fellows	32 (1 study)	⨁⊖⊖⊖ VERY LOW[a,b] due to risk of bias, imprecision	RR 0.86 (0.37 to 1.99)	Moderate	
				438 per 1000	61 fewer per 1000 (from 276 fewer to 434 more)
Staff satisfaction – Nurses	60 (1 study)	⨁⊖⊖⊖ VERY LOW[a] due to risk of bias	RR 11 (2.83 to 42.7)	Moderate	
				67 per 1000	670 more per 1000 (from 123 more to 1000 more)

(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 if the confidence interval crossed one MID or by 2 increments if the confidence interval crossed both MIDs.

Table 4: Clinical evidence summary: Neurological Care Unit

Outcomes	No of Participants (studies) Follow up	Quality of the evidence (GRADE)	Relative effect (95% CI)	Anticipated absolute effects	
				Risk with Normal handover	Risk difference with structured handover (95% CI)
ICU Readmission	261 (1 study)	⨁⊖⊖⊖ VERY LOW[a,b] due to risk of bias, imprecision	RR 1.24 (0.34 to 4.52)	Moderate	
				31 per 1000	7 more per 1000 (from 20 fewer to 109 more)
Rapid Response Team Call at 6 Months	261 (1 study)	⨁⊖⊖⊖ VERY LOW[a,b] due to risk of bias, imprecision	RR 1.98 (0.37 to 10.65)	Moderate	
				15 per 1000	15 more per 1000 (from 9 fewer to 145 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 5: Clinical evidence summary: Emergency Department

Outcomes	No of Participants (studies) Follow up	Quality of the evidence (GRADE)	Relative effect (95% CI)	Anticipated absolute effects	
				Risk with Routine handover	Risk difference with Electronic handover (95% CI)
Staff satisfaction	1136 (1 study)	⨁⊖⊖⊖ VERY LOW[a] due to risk of bias	-	-	The mean staff satisfaction in the intervention groups was 0.17 higher (0.33 lower to 0.67 higher)
Avoidable adverse events (medications administered as prescribed)	279 (1 study)	⨁⊖⊖⊖ VERY LOW[a] due to risk of bias	RR 1.01 (0.98 to 1.04)	Moderate	
				977 per 1000	10 more per 1000 (from 20 fewer to 39 more)

(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

Table 6: Clinical evidence summary: Internal Medicine

Outcomes	No of Participants (studies) Follow up	Quality of the evidence (GRADE)	Relative effect (95% CI)	Anticipated absolute effects	
				Risk with Normal handover	Risk difference with Electronic handover (95% CI)
Critical data omissions	48 (1 study)	⨁⊖⊖⊖ VERY LOW[a] due to risk of bias	Peto OR 0.04 (0.01 to 0.14)	Moderate	
				793 per 1000	660 fewer per 1000 (from 444 fewer to 756 fewer)
Near Misses	58 (1 study)	⨁⊖⊖⊖ VERY LOW[a] due to risk of bias	Peto OR 0.18 (0.04 to 0.8)	Moderate	
				231 per 1000	180 fewer per 1000 (from 37 fewer to 219 fewer)
Adverse events	58 (1 study)	⨁⊖⊖⊖ VERY LOW[a,b] due to risk of bias, imprecision	Peto OR 0.21 (0.02 to 1.78)	Moderate	
				103 per 1000	79 fewer per 1000 (from 101 fewer to 67 more)
Avoidable adverse events (handoffs related errors)	3933 (1 study)	⨁⊖⊖⊖ VERY LOW[a] due to risk of bias	RR 0.09 (0.04 to 0.23)	Moderate	
				27 per 1000	25 fewer per 1000 (from 21 fewer to 26 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 if the confidence interval crossed one MID or by 2 increments if the confidence interval crossed both MIDs.

32.4 Economic evidence

Published literature

One economic evaluation was identified with the relevant comparison and has been included in this review.[126] This study is summarised in the economic evidence profile below (Table 7) and the economic evidence tables in Appendix E.

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

Table 7: Economic evidence profile: Structured patient handover versus usual care

Study	Applicability	Limitations	Other comments	Incremental cost	Incremental effects	Cost effectiveness	Uncertainty
Yao 2012 [126]	Partially applicable[(a)]	Potentially serious limitations[(b)]	Retrospective observational study Cost-utility analysis Population: Patients discharged from hospital to the community Two comparators: 1) Usual care 2) Structured patient handover between hospital and community (HANDOVER project) Time horizon: 1 year	**Total costs (per patient discharge):** £1.86	**QALYs (per patient discharge):** 0.0103	£180.34 per QALY gained	The study looked at different levels of effectiveness for the intervention to find changing points in cost-effectiveness at a €20,000 threshold.

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

(a) Some uncertainty regarding the applicability of resource use and costs from the Netherlands (2011) to current NHS context. Costs from multiple published studies. No discounting reported.

(b) Quality-of-life estimated by categorising adverse events and allocating to an indicative state from the EQ-5D. Health outcomes based on estimates and assumptions of preventable adverse events. Effectiveness of the intervention elicited from experts.

32.5 Evidence statements

Clinical

Intensive care unit

One study comprising 820 people evaluated the role of structured patient handover within the intensive care unit setting for improving outcomes in secondary care in adults and young people at risk of an AME, or with a suspected or confirmed AME. The evidence suggested that structured patient handovers provide a benefit in reduced mortality, length of stay and improved staff satisfaction (overall, nurse satisfaction and attending physician). However, the evidence suggested there was no effect on readmission (very low quality for all outcomes) and a reduction in staff satisfaction by fellows.

Neurointensive care unit

One study comprising 261 people evaluated the role of structured patient handover within the neurointensive care unit setting for improving outcomes in secondary care in adults and young people at risk of an AME, or with a suspected or confirmed AME. The evidence suggested that structured patient handovers have no effect on ICU readmission and avoidable adverse events defined as rapid response team call at 6 months (very low quality for both outcomes).

Emergency department

Two studies comprising 1415 people evaluated the role of structured patient handover within the emergency department setting for improving outcomes in secondary care in adults and young people at risk of an AME, or with a suspected or confirmed AME. The evidence suggested that structured patient handovers have no effect on staff satisfaction (1 study, very low quality) or avoidable adverse events defined as medications not administered as prescribed (1 study, very low quality).

Internal medicine

Two studies comprising 3991 people evaluated the role of structured patient handover within the internal medicine setting for improving outcomes in secondary care in adults and young people at risk of an AME, or with a suspected or confirmed AME. The evidence suggested that structured patient handovers may provide a benefit in reduced avoidable adverse events defined as critical data omissions, near misses, adverse events and handoffs related errors (1 study, very low quality).

Economic

One cost-utility analysis found that structured handover was cost effective compared to usual care for patients discharged from hospital to the community (ICER: £180 per QALY gained). This analysis was assessed as partially applicable with potentially serious limitations.

32.6 Recommendations and link to evidence

Recommendations	**19. Use structured handovers during transitions of care[a] and follow the recommendations on transferring patients in the NICE guideline on acutely ill patients in hospital.**
Research recommendations	**-**
Relative values of different outcomes	Mortality, avoidable adverse events (including prescribing errors, errors of omission, cardiopulmonary resuscitation, unplanned admission to intensive care, delayed or missed investigations and delayed or missed treatment), patient and/or carer satisfaction, length of stay and quality of life were considered critical outcomes by the guideline committee. Staff satisfaction was considered an important outcome by the committee.
Trade-off between benefits and harms	Six studies were considered in the clinical review. The committee noted the variation in interventions and heterogeneity in how the intervention was delivered (that is, some were structured electronic forms while other studies just documented a handover process). Therefore, the results for each study were presented by setting and not meta-analysed. **Mixed medical and Surgical ICU** The evidence suggested that structured patient handovers may provide a benefit in reduced mortality, length of stay, improved senior clinical staff satisfaction and nurse satisfaction. The evidence suggested there was no effect on readmission and a reduced staff satisfaction for fellows. The group discussed the decreased staff satisfaction of junior doctors (compared to senior doctors and nurses) with a structured handover but suggested that this may be due to the imbalanced amount of time placed on junior doctors in the handover process. Overall, the evidence suggested a benefit of structured patient handover in the intensive care unit setting. There was no evidence for quality of life or patient and/or carer satisfaction. **Neurological care unit** The evidence suggested that structured patient handovers have no effect on readmission and avoidable adverse events defined as a rapid response team. The committee noted that this evidence was from 1 small study reporting for 1 unit and both outcomes were very low quality. There was no evidence for mortality, quality of life, patient and/or carer satisfaction, staff satisfaction or length of stay. **Emergency department** The evidence suggested that structured patient handovers have no effect on staff satisfaction or avoidable adverse events defined as medications not administered as prescribed. There was no evidence for mortality, quality of life, patient and/or carer satisfaction or length of stay.

a NICE's guideline on medicines optimisation includes recommendations on medicines-related communication systems when patients move from one care setting to another, medicines reconciliation, clinical decision support, and medicines-related models of organisational and cross-sector working.

Recommendations	**19. Use structured handovers during transitions of care[a] and follow the recommendations on transferring patients in the NICE guideline on acutely ill patients in hospital.**
Research recommendations	-
	Internal Medicine The evidence suggested that structured patient handovers may provide a benefit in reduced avoidable adverse events defined as critical data omissions, near misses, adverse events and handoffs-related errors. The committee discussed the reductions in avoidable adverse events with the structured handover and suggested this may be due to the multi-factorial nature of the intervention. In this case it was a verbal (face-to-face) handover with an electronic sign-off sheet compared to no structured handover. There was no evidence for mortality, quality of life, patient and/or carer satisfaction, staff satisfaction or length of stay. Overall, the committee considered that structured handovers were associated with improvement in patient outcomes and staff satisfaction and should be part of current patient care. They discussed the evidence with regards to their own clinical experience and decided to support a strong recommendation for structured handovers for an AME population. They noted that while structured handovers could become a 'tick box' process and could lead to reduced communication both between healthcare professionals and with patients, when conducted properly a formal structure for exchanging information would improve outcomes. The committee discussed the best type of structured handover but the evidence was not strong enough to make a recommendation on a particular handover model.
Trade-off between net effects and costs	A single study conducting a cost-utility analysis was included. The intervention included an online database with handover tools, shared staff experience of handovers and online staff training. As well as the online resource, the intervention required staff time to undertake classroom education in patient handovers. The study showed structured patient handovers between the hospital and community are cost-effective at £180 per QALY, significantly under the £20,000 threshold. Quality of life was not measured in a trial. Instead quality of life scores were estimated by categorising adverse events into groups and assigning the groups to an indicative state. However, the committee felt that the intervention would have low costs and for this reason, it would only need to have a small benefit to be cost-effective. There was evidence for this in the analysis, with the study showing the intervention only needing to be 1.6% effective at reducing preventable adverse events to be cost-effective. The transition between hospital and community would most likely involve more intensive handovers than those within a hospital. Therefore, the cost-effectiveness results might be extrapolated to other areas of patient handover, such as between staff members or shifts, wards and different hospitals. There was no evidence around the type of structured patient handover, for example, electronic, paper or verbal. It seems unlikely that there would be a large difference in the cost-effectiveness of the different structures. However, there was evidence in the clinical review of change in resource use for structured patient handover. One study outlined a change in shift patterns, increasing the shift duration of junior doctors to undertake structured handovers and adding further costs to the intervention. There was also evidence that structured handovers reduced the length of stay for patients in the ICU, freeing up resources and decreasing costs as a result of the intervention. The committee concluded that there may be an increase in staff

Recommendations	19. Use structured handovers during transitions of care[a] and follow the recommendations on transferring patients in the NICE guideline on acutely ill patients in hospital.
Research recommendations	-
	time associated with structured handover but this would potentially be offset by reduced length of stay and clinical errors avoided.
Quality of evidence	**Clinical evidence** For all comparisons the clinical evidence was considered to be very low quality due to the study type (observational or before and after), risk of bias (outcome reporting) and imprecision. In particular, the subgroup noted the composite outcomes reported as adverse effects and how these were reported poorly by most studies. **Economic evidence** The included economic study was deemed partially applicable because resource use and costs were from the Netherlands. It was also assessed to have potentially serious limitations because the effectiveness of the intervention was elicited from experts, rather than being based on a trial.
Other considerations	The committee noted that electronic systems for patient handovers could provide benefits in terms of documenting and identifying trends, in data analysis and audit, sharing information between different members of the multidisciplinary team, and in preserving patient confidentiality. Important contextual modifiers may include training, shift length and the quality of electronic systems. The Professional Record Standards body[48] has published clinical standards for electronic systems for patient handovers to ensure consistency and interoperability. The committee highlighted that structured handover of care between transferring and receiving teams is well established within NHS current practice and is reinforced by related NICE guidance (CG50)[15] and the Acute Care RCP Toolkit.[102] Currently, structured handover practice takes place through a range of methods including updated written lists, electronic and verbal face-to-face and this varies between departments and hospitals. However, standardisation across trusts is not common and would be difficult to implement. It is also important to understand that the ability to deliver a structured handover does not come naturally and training is vital to ensure that the benefits are realised. Handover is not just a simple matter of imparting information. It is about providing the required information in a format that is useful and beneficial to patient care. One key issue in the training is to ensure staff understand the importance of a good handover in delivering good patient care. Electronic systems would entail some training, resources to obtain and modify or develop the system and a change in the nature of the shift. The committee noted that it is important to provide a structured handover between primary and secondary care as this is a point of escalation and that this may require different emphasis and amount of information. Therefore, there was scope for further research in this area covering the bridge between secondary and primary care.

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Appendices

Appendix A: Review protocol

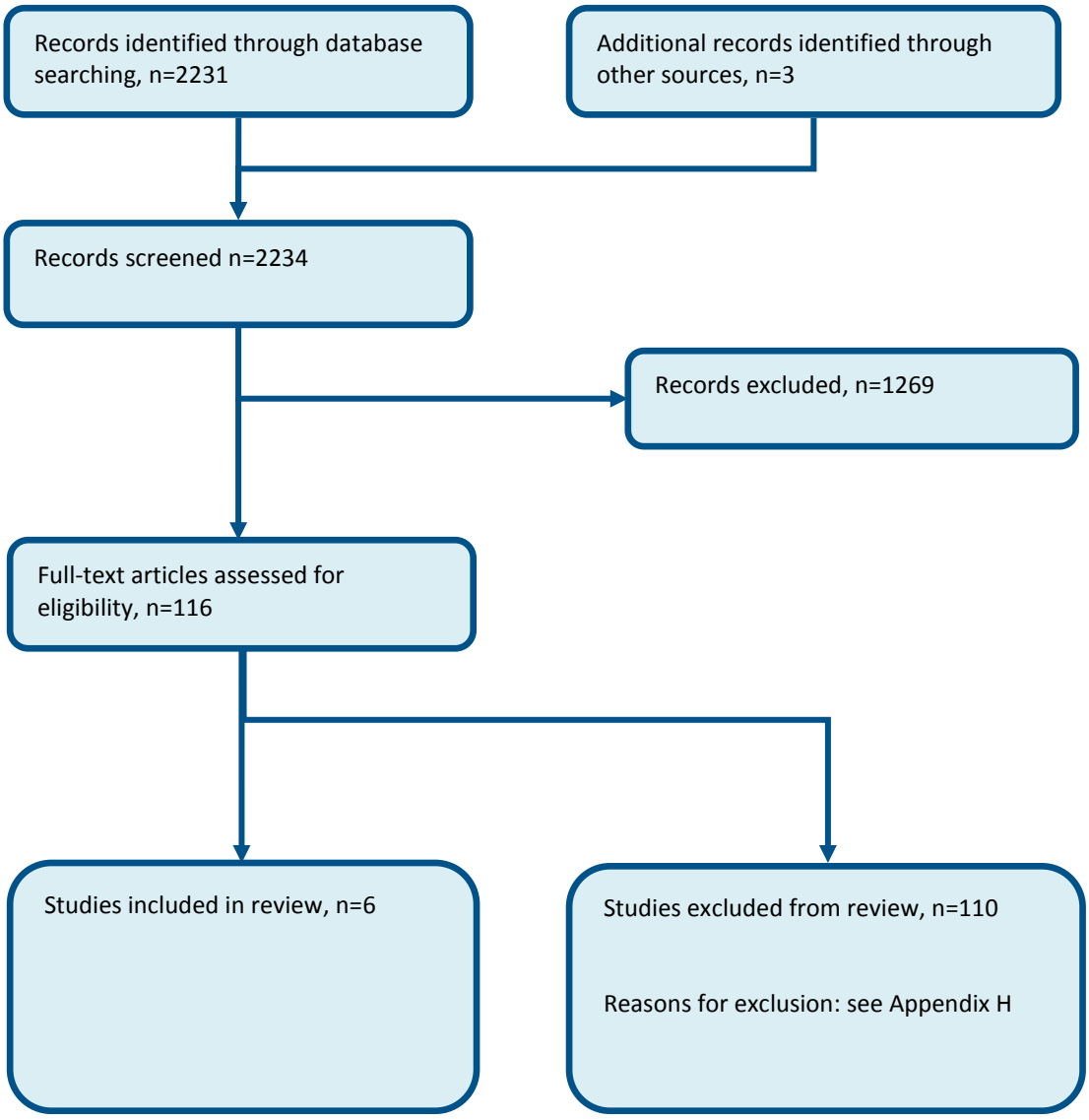
Table 8: Review protocol: Do structured patient handovers between healthcare professionals improve outcomes?

Review question	Structured patient handovers
Guideline condition and its definition	Acute medical emergencies.
Objectives	To see if structured means are better than unstructured for relaying patient information and to assess the best method for conducting handover for example, verbal, paper-based or electronic.
Review population	Adults and young people (16 years and over) with a suspected or confirmed AME (in all contexts not just secondary care).
	Adults.
	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)	Structured (planned framework as defined by the study) between healthcare professionals between shifts in acute settings; this will include (i) set times of the day, (ii) using a structured template or proforma for the handover (iii) recording the information in written or electronic form. Paper-based handover; using paper to conduct the structured handover. Verbal patient handover; verbally conducting the structured handover. Electronic-based handover; using electronic means to conduct the structured handover. Normal handover; routine unstructured handover.
Outcomes	- Mortality (Dichotomous) CRITICAL - Avoidable adverse events (prescribing errors [errors of omission or commission] cardiopulmonary resuscitation, unplanned admission to intensive care, delayed or missed investigations, delayed or missed treatments) (Dichotomous) CRITICAL - Quality of life (Continuous) CRITICAL - Patient/carer satisfaction (Continuous) CRITICAL - Length of stay (Continuous) CRITICAL - Staff satisfaction (Continuous) IMPORTANT
Study design	Systematic reviews (SRs) of RCTs, RCTs, observational studies only to be included if no relevant SRs or RCTs are identified.
Unit of randomisation	Patient Setting
Crossover study	Permitted
Minimum duration of study	Not defined
Other exclusions	Major trauma Structured reporting around major incidents (not applicable to individual) standardised criteria for admission and discharge covered by other questions.
Sensitivity/other analysis	If studies have pre-specified in their protocols that results for any of these subgroup populations will be analysed separately, then they will be included in the subgroup analysis.
Subgroup analyses if there is heterogeneity	- Frail elderly (Frail elderly; Not frail elderly); Population may differ - Critical care patients (Critical care patients; Not critical care patients);

Review question	Structured patient handovers
	Population may differ - Speciality/profession (Inter-professional handover; Profession-specific handover); May differ but may be crossover
Search criteria	Databases: Medline, Embase, the Cochrane Library Date limits for search: 2005 Language: English

Appendix B: Clinical article selection

Figure 1: Flow chart of clinical article selection for the review of patient handover



Appendix C: Forest plots

C.1 Intensive Care Unit

Figure 2: Mortality

Study or Subgroup	Structured Handover Events	Total	Unstructured Handover Events	Total	Weight	Risk Ratio M-H, Fixed, 95% CI
Emlet 2012	26	431	33	389	100.0%	0.71 [0.43, 1.17]
Total (95% CI)		**431**		**389**	**100.0%**	**0.71 [0.43, 1.17]**
Total events	26		33			

Heterogeneity: Not applicable
Test for overall effect: Z = 1.35 (P = 0.18)

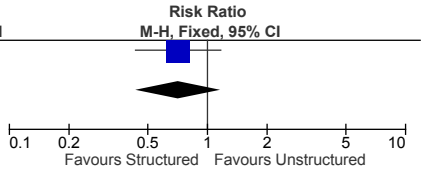


Figure 3: Readmission within 48 hours

Study or Subgroup	Structured Handover Events	Total	Unstructured Handover Events	Total	Weight	Risk Ratio M-H, Fixed, 95% CI
Emlet 2012	21	431	14	389	100.0%	1.35 [0.70, 2.63]
Total (95% CI)		**431**		**389**	**100.0%**	**1.35 [0.70, 2.63]**
Total events	21		14			

Heterogeneity: Not applicable
Test for overall effect: Z = 0.90 (P = 0.37)

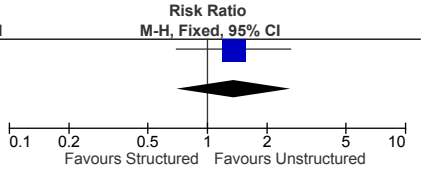


Figure 4: ICU length of stay

Study or Subgroup	Structured Handover Mean	SD	Total	Unstructured Handover Mean	SD	Total	Weight	Mean Difference IV, Fixed, 95% CI
Emlet 2012	5.65	8.7	431	8.43	17.2	389	100.0%	-2.78 [-4.68, -0.88]
Total (95% CI)			**431**			**389**	**100.0%**	**-2.78 [-4.68, -0.88]**

Heterogeneity: Not applicable
Test for overall effect: Z = 2.87 (P = 0.004)

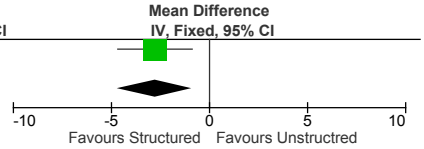


Figure 5: Staff satisfaction

Study or Subgroup	Structured Handover Events	Total	Unstructured Handover Events	Total	Weight	Risk Ratio M-H, Fixed, 95% CI
1.4.1 Attending Physican						
Emlet 2012	6	11	2	11	18.2%	3.00 [0.77, 11.74]
Subtotal (95% CI)		**11**		**11**	**18.2%**	**3.00 [0.77, 11.74]**
Total events	6		2			

Heterogeneity: Not applicable
Test for overall effect: Z = 1.58 (P = 0.11)

1.4.2 Fellows						
Emlet 2012	6	16	7	16	63.6%	0.86 [0.37, 1.99]
Subtotal (95% CI)		**16**		**16**	**63.6%**	**0.86 [0.37, 1.99]**
Total events	6		7			

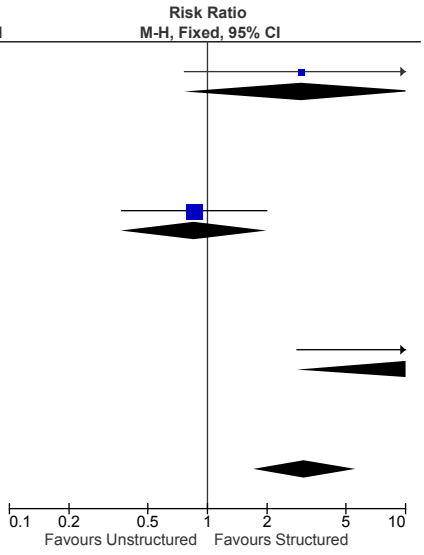
Heterogeneity: Not applicable
Test for overall effect: Z = 0.36 (P = 0.72)

1.4.3 Nurses						
Emlet 2012	22	30	2	30	18.2%	11.00 [2.83, 42.70]
Subtotal (95% CI)		**30**		**30**	**18.2%**	**11.00 [2.83, 42.70]**
Total events	22		2			

Heterogeneity: Not applicable
Test for overall effect: Z = 3.47 (P = 0.0005)

Total (95% CI)		**57**		**57**	**100.0%**	**3.09 [1.70, 5.61]**
Total events	34		11			

Heterogeneity: Chi² = 12.28, df = 2 (P = 0.002); I² = 84%
Test for overall effect: Z = 3.71 (P = 0.0002)
Test for subgroup differences: Chi² = 10.30, df = 2 (P = 0.006), I² = 80.6%



C.2 Neuroscience Unit

Figure 6: ICU Readmission

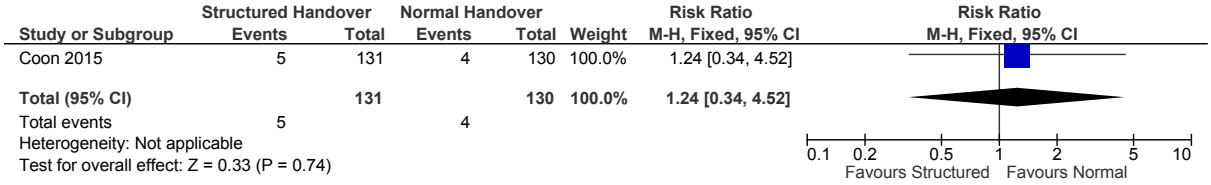
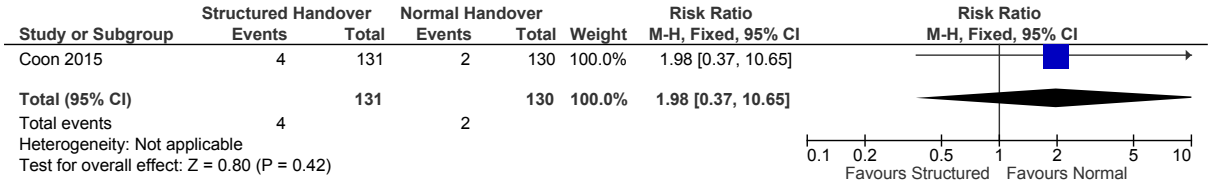


Figure 7: Rapid response team call



C.3 Emergency Department

Figure 8: Staff satisfaction

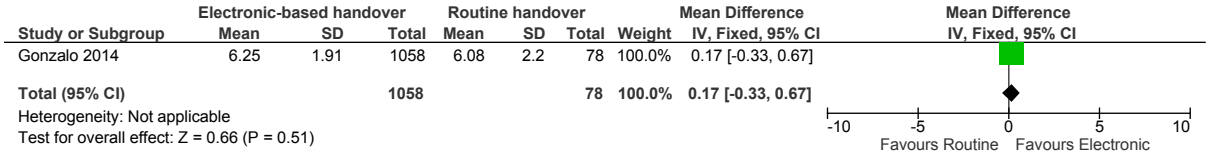
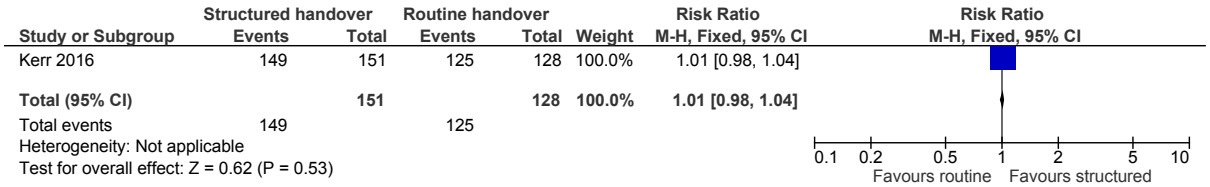


Figure 9: Avoidable adverse events (medications administered as prescribed)



C.4 Internal Medicine

Figure 10: Critical omissions

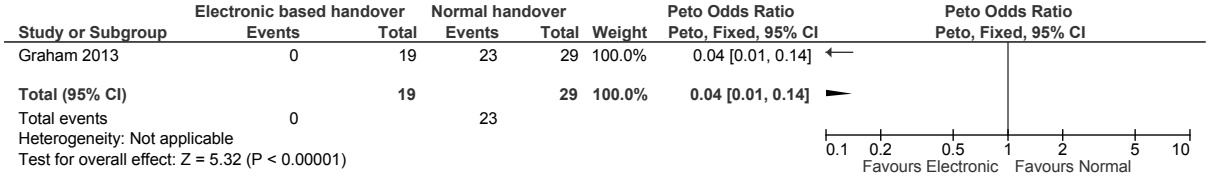


Figure 11: Near misses

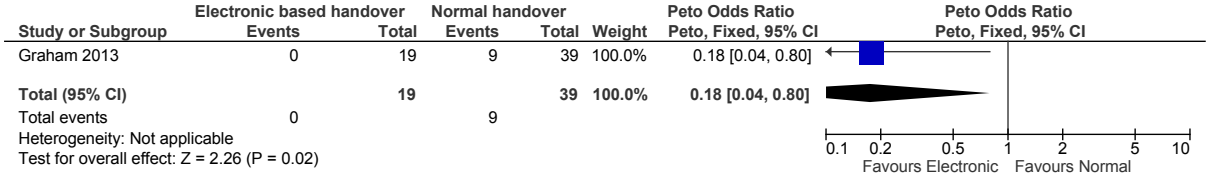


Figure 12: Adverse effects

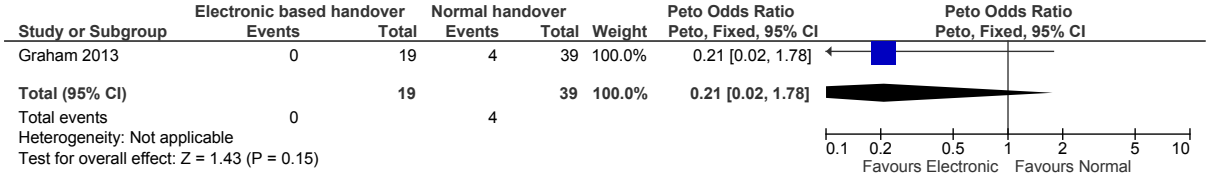
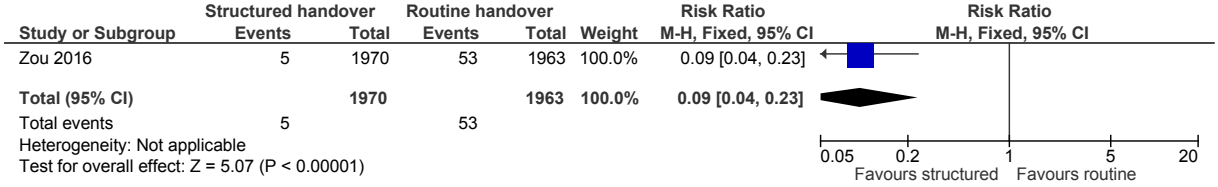


Figure 13: Avoidable adverse events (handoffs related errors)



Appendix D: Clinical evidence tables

Study	Emlet 2012[34]
Study type	Non-randomised comparative study
Number of studies (number of participants)	(n=820)
Countries and setting	Conducted in USA; Setting: Intensive care unit (mixed medical and surgical)
Line of therapy	Not applicable
Duration of study	Intervention time: 8 months
Method of assessment of guideline condition	Adequate method of assessment/diagnosis
Stratum	Overall
Subgroup analysis within study	Not applicable
Inclusion criteria	Not reported
Exclusion criteria	Not reported
Recruitment/selection of patients	Not reported
Age, gender and ethnicity	Age - Other: Not reported. Gender (M:F): Not reported. Ethnicity: Not reported
Further population details	1. Critical care patients: Critical care patients (mixed medical-surgical unit). 2. Frail elderly: Not applicable/Not stated/Unclear 3. Speciality/profession: Inter-professional handover (19 fellows in a Multidisciplinary Critical Care Training Programme; ICU nurses).
Indirectness of population	No indirectness
Interventions	(n=431) Intervention 1: Structured (planned framework as defined by the study) between healthcare professionals between shifts in acute settings - this will include (i) set times of the day, (ii) using a structured template/proforma for the handover (iii) recording the information in written or electronic form. The intervention schedule consisted of 12-hour shifts with 1 hour overlap between day and night shifts to allow for a 30 minute structured sign-out while walking through the ICU. The intervention schedule was designed with best evidence for circadian-based shift scheduling design; forward cycling shifts with short strings of nights. Sign-out curriculum and clinical cases were developed from Agency for Healthcare Research and Quality Patient Safety Web resources, Veterans Administration Patient Safety Web resources, and previously published papers. Prior to the beginning of intervention period, the 4 fellows were given a 2 hour interactive workshop on structured sign out and expectations, and also given special

Study	Emlet 2012[34]
	access to a feature called sign-out in the electronic medical record so that information could be saved securely and sign-out lists could be generated to assist in communication. Only fellows during the intervention periods had access to the sign-out feature in the electronic medical record. This 2 hour session reviewed content and structure of a problem-orientated sign-out with anticipatory guidance, expectations for sign-out while walking through the unit, and hands on instruction on how to create and print sign-out list. Weekly monitoring was performed by electronic survey of fellows during intervention blocks requesting feedback on quality and if sign-out was given as instructed: verbally, face-to-face while walking through ICU with printed, computer-generated sign-out lists. Directed feedback (positive or negative) was given bimonthly. Duration was 32 weeks (periods alternated between 4 and 8 week blocks of time). Concurrent medication/care: Shift scheduling. Comments: number of participants= number of admissions. (n=389) Intervention 2: Normal handover - Routine unstructured handover. The control schedule consisted of an overnight call every fourth night, where the total continuous hours worked during call was not >30 hours. No education on sign-out was provided during call periods, and no quality assurance of sign-out was monitored. Usual practice consisted of a brief verbal description of patients to the fellow on call with handwritten notes at the fellow's discretion. Duration was 32 weeks (periods alternated between 4 and 8 week blocks of time). Concurrent medication/care: none.
Funding	Funding not stated

RESULTS (NUMBERS ANALYSED) AND RISK OF BIAS FOR COMPARISON: STRUCTURED HANDOVER versus ROUTINE UNSTRUCTURED HANDOVER

Protocol outcome 1: Mortality
- Actual outcome: Mortality at 8 months; Group 1: 26/431, Group 2: 33/389; Risk of bias: All domain - High, Selection - High, Blinding - High, Incomplete outcome data - Low, Outcome reporting - Low, Measurement - Low, Crossover - Low, Comments - Single centre study, small sample size, non-randomised design; Indirectness of outcome: Serious indirectness, Comments: Intervention also comprised shift scheduling

Protocol outcome 2: Avoidable adverse events (prescribing errors (errors of omission or commission) cardiopulmonary resuscitation, unplanned admission to intensive care, delayed or missed investigations, delayed or missed treatments)
- Actual outcome: Readmission <48 hours at 8 months; Group 1: 21/431, Group 2: 14/389; Risk of bias: All domain - High, Selection - High, Blinding - High, Incomplete outcome data - Low, Outcome reporting - Low, Measurement - Low, Crossover - Low, Comments - Single centre study, small sample size, non-randomised design; Indirectness of outcome: Serious indirectness, Comments: Intervention also comprised shift scheduling
Protocol outcome 3: Patient and/or carer satisfaction
- Protocol outcome 3: Patient and/or carer satisfaction

Study	Emlet 2012[34]
- Actual outcome: Family satisfaction score at 8 months. Group 1: 24 (15, 41), Group 2: 22 (15, 39). Minimum and maximum scores are in brackets. At the time of study the Critical Care Family Needs Index was the only previously validated survey to measure family needs. The Critical Care Family Needs Index is scored such that a minimum value of 18 would denote that family needs were met, whereas a maximum value of 57 would denote that family needs were not met. Risk of bias: All domain - High, Selection - High, Blinding - High, Incomplete outcome data - Low, Outcome reporting - Low, Measurement - Low, Crossover - Low, Comments - Single centre study, small sample size, non-randomised design; Indirectness of outcome: Serious indirectness, Comments: Intervention also comprised shift scheduling Protocol outcome 4: Length of stay - Actual outcome: ICU length of stay at 8 months; Group 1: mean 5.65 days (SD 8.7); n=431, Group 2: mean 8.43 days (SD 17.2); n=389; Risk of bias: All domain - High, Selection - High, Blinding - High, Incomplete outcome data - Low, Outcome reporting - Low, Measurement - Low, Crossover - Low, Comments - Single centre study, small sample size, non-randomised design; Indirectness of outcome: Serious indirectness, Comments: Intervention also comprised shift scheduling Protocol outcome 5: Staff satisfaction - Actual outcome: Final vote- attending at 8 months; Group 1: 6/11, Group 2: 2/11; Risk of bias: All domain - High, Selection - High, Blinding - High, Incomplete outcome data - Low, Outcome reporting - Low, Measurement - Low, Crossover - Low, Comments - Single centre study, small sample size, non-randomised design; Indirectness of outcome: Serious indirectness, Comments: Intervention also comprised shift scheduling - Actual outcome: Final vote- fellows at 8 months; Group 1: 6/16, Group 2: 7/16; Risk of bias: All domain - High, Selection - High, Blinding - High, Incomplete outcome data - Low, Outcome reporting - Low, Measurement - Low, Crossover - Low, Comments - Single centre study, small sample size, non-randomised design; Indirectness of outcome: Serious indirectness, Comments: Intervention also comprised shift scheduling - Actual outcome: Final vote- nurses at 8 months; Group 1: 22/30, Group 2: 2/30; Risk of bias: All domain - High, Selection - High, Blinding - High, Incomplete outcome data - Low, Outcome reporting - Low, Measurement - Low, Crossover - Low, Comments - Single centre study, small sample size, non-randomised design; Indirectness of outcome: Serious indirectness, Comments: Intervention also comprised shift scheduling	
Protocol outcomes not reported by the study	Quality of life.

Study	Coon 2015[20]
Study type	Before and after study.
Number of studies (number of participants)	(n=261)
Countries and setting	Conducted in USA; Setting: Neurosciences ICU.
Line of therapy	Not applicable.
Duration of study	Intervention + follow up: 6 months.
Method of assessment of guideline condition	Adequate method of assessment/diagnosis.
Stratum	Overall.

Study	Coon 2015[20]
Subgroup analysis within study	Not applicable.
Inclusion criteria	Not reported.
Exclusion criteria	Not reported.
Recruitment/selection of patients	Consecutive patients.
Age, gender and ethnicity	Age - Mean (range): Pre-implementation: 65 (24-77), Post-implementation: 63 (23-84). Gender (M:F): Pre-implementation: 55F; Post-implementation: 70F. Ethnicity: not reported.
Further population details	1. Critical care patients: Critical care patients (Neurointensive ICU). 2. Frail elderly: Not applicable/Not stated/Unclear. 3. Speciality/profession: Profession-specific handover (Physicians).
Indirectness of population	No indirectness
Interventions	(n=131) Intervention 1: Structured (planned framework as defined by the study) between healthcare professionals between shifts in acute settings - this will include (i) set times of the day, (ii) using a structured template/proforma for the handover (iii) recording the information in written or electronic form. Creation of an ICU documentation checklist, including details on: medication reconciliation, urinary catheter, prophylaxis, vitals/cares, consults and follow-up. Duration: 3 months. Concurrent medication/care: none. (n=130) Intervention 2: Normal handover - Routine unstructured handover. Pre implementation handover. Duration: 3 months. Concurrent medication/care: none
Funding	No funding

RESULTS (NUMBERS ANALYSED) AND RISK OF BIAS FOR COMPARISON: THIS WILL INCLUDE (I) SET TIMES OF THE DAY, (II) USING A STRUCTURED TEMPLATE / PROFORMA FOR THE HANDOVER (III) RECORDING THE INFORMATION IN WRITTEN OR ELECTRONIC FORM versus ROUTINE UNSTRUCTURED HANDOVER

Protocol outcome 1: Avoidable adverse events (prescribing errors (errors of omission or commission) cardiopulmonary resuscitation, unplanned admission to intensive care, delayed or missed investigations, delayed or missed treatments) at Define
- Actual outcome: ICU readmissions at 6 months; Group 1: 5/131, Group 2: 4/130; Risk of bias: All domain - High, Selection - High, Blinding - High, Incomplete outcome data - Low, Outcome reporting - Low, Measurement - Low, Crossover - Low, Comments - before and after study; incomplete reporting of results; Indirectness of outcome: No indirectness
- Actual outcome: Rapid response team calls at 6 months; Group 1: 4/131, Group 2: 2/130; Risk of bias: All domain - High, Selection - High, Blinding - High, Incomplete outcome data - Low, Outcome reporting - Low, Measurement - Low, Crossover - Low, Comments - before and after study; incomplete reporting of results; Indirectness of outcome

Study	Coon 2015[20]
Protocol outcomes not reported by the study	Mortality; Quality of life; Patient and/ or carer satisfaction; Length of stay; Staff satisfaction.

Study	Gonzalo 2014[42]
Study type	Before and after study.
Number of studies (number of participants)	(n= not reported).
Countries and setting	Conducted in USA; Setting: Academic medical centre.
Line of therapy	Not applicable.
Duration of study	Intervention + follow up: 1 year.
Method of assessment of guideline condition	Method of assessment/diagnosis not stated.
Stratum	Overall.
Subgroup analysis within study	Not applicable.
Inclusion criteria	An electronic handoff tool (eSignout) was added to the pre-existing ED dashboard functionality that included (i) standardised fields for ED-based physician and nursing manual entry of sign out information, (ii) an automated page to the recipient ward-based physician send by the ED-based physician through the dashboard once the sign out information is ready for review and (iii) ability for the recipient ward-based physician to either electronically 'accept' the patient using the eSignout tool.
Exclusion criteria	N/A
Recruitment/selection of patients	Not reported.
Age, gender and ethnicity	Age: Not reported. Gender (M:F):42:38 (before implementation); 880:508 (following implementation). Ethnicity: Not reported.
Further population details	1. Critical care patients; 2. Frail elderly; 3. Speciality/profession.
Indirectness of population	No indirectness.
Interventions	(n=1388) Intervention 1: Electronic-based handover - using electronic means to conduct the structured handover. eSignout was added to the pre-existing ED dashboard functionality that included (i) standardised fields for ED-based physician and nursing manual entry of sign out information, (ii) an automated page to the recipient ward-based physician send by the ED-based physician through the dashboard once the sign out information is ready for review and (iii) ability for the recipient ward-based physician to either electronically 'accept' the patient using the eSignout tool (thereby commencing the patient transfer from ED to medicine ward) or, alternatively, to automatically page the sending ED-based physician for verbal communication if eSignout information was believed insufficient or requiring

Study	Gonzalo 2014[42]
	clarification. Following verbal communication, the ward-based physician would then electronically 'accept' the patient via eSignout, initiating the patient transfer. Duration: 1 year. Concurrent medication/care: Not reported. Comments: number of participants is number of surveys. (n=80) Intervention 2: Normal handover - routine unstructured handover. Verbal communication between sending ED-based physician and recipient ward-based physician mandatory prior to patient transfer. Duration: unclear. Concurrent medication/care: not reported. Comments: number of participants is number of surveys.
Funding	Funding not stated.
RESULTS (NUMBERS ANALYSED) AND RISK OF BIAS FOR COMPARISON: USING ELECTRONIC MEANS TO CONDUCT THE STRUCTURED HANDOVER versus ROUTINE UNSTRUCTURED HANDOVER. Protocol outcome 1: Staff satisfaction. - Actual outcome: The overall sign-out process at 1 year; Group 1: mean 6.25 (SD 1.91); n=1058, Group 2: Group 2: mean 6.08 (SD 2.20); n= 78 Risk of bias: All domain - High, Selection - High, Blinding - High, Incomplete outcome data - High, Outcome reporting - Low, Measurement - Low, Crossover - Low, Comments - Before and after study; differential missing data rate between groups.; Indirectness of outcome: No indirectness	
Protocol outcomes not reported by the study	Mortality; Avoidable adverse events (prescribing errors [errors of omission or commission] cardiopulmonary resuscitation, unplanned admission to intensive care, delayed or missed investigations or delayed or missed treatments); Quality of life; Patient and/or carer satisfaction; Length of stay.

Study	Graham 2013[46]
Study type	Before and after study.
Number of studies (number of participants)	(n=period 1: 39 night shifts, ~2700 handoffs. Period 4: 19 night shifts, ~1300 handoffs).
Countries and setting	Conducted in USA; Setting: urban teaching hospital.
Line of therapy	Not applicable.
Duration of study	Intervention time: 1 year.
Method of assessment of guideline condition	Method of assessment/diagnosis not stated.
Stratum	Overall.
Subgroup analysis within study	Not applicable.
Inclusion criteria	Define.

Study	Graham 2013[46]
Exclusion criteria	Define.
Recruitment/selection of patients	Not reported.
Age, gender and ethnicity	Age - Mean (SD): Period 1: 26.9 (1.6); Period 4: 27.2 (1.1). Gender (M:F): Period 1:68%F; Period 3: 39%F. Ethnicity: not reported.
Further population details	1. Critical care patients; 2. Frail elderly; 3. Speciality/profession.
Extra comments	Period 1 was baseline (no interventions). Period 2 in the study was after the implementation of shift scheduling alone. Period 3 was after shift scheduling and the electronic template in place, but a few months before Period 4, which was with shift scheduling and the electronic template in place (1 year after baseline). The analysis is therefore between periods 1 and 4.
Indirectness of population	No indirectness.
Interventions	(n=19) Intervention 1: Electronic-based handover - using electronic means to conduct the structured handover. An electronic template was created for the handoff that linked to the hospital's clinical information system and provided cues for appropriate content, including a summary assessment of the patient, past medical history, current medication list, active problems, current clinical status at the time of handoff, 'contingency planning' where the primary team provided anticipatory guidance for events that were likely to occur overnight, and a task list to be completed during the overnight shift. Duration: unclear. Concurrent medication/care: prior to the implementation of the electronic template, the shift model was altered to facilitate face to face verbal communication between the primary and night time coverage physicians. By asking the night float teams to arrive 1.5 hours earlier, and requiring the primary teams to remain in the hospital until their arrival, the intermediary handoff was removed. Comments: number of participants is number of shifts represented. The intervention is represented by the term 'period 4' in the study. (n=39) Intervention 2: Normal handover - routine unstructured handover. At baseline, day to night handoff was a 'double handoff' whereby the primary physicians handed off to an intermediary physician, so that they could leave the hospital earlier and preserve duty hour limits. A second handoff occurred between the intermediary and night-time coverage physician when the night shift began. The written handoff used a simple free text box linked to each of the patients in the hospital's clinical information system, with no structure for content. Duration: unclear. Concurrent medication/care: none. Comments: Number of participants is number of shifts represented. The routine unstructured handover is represented by the term 'period 1' in the study.
Funding	Other (Health Resources and Services Administration training grant; Midcareer Investigator Award in Patient-Orientated Research from the National Institute on Aging (K24AG035075); Harvard Catalyst (NIH Award #ULI RR

Study	Graham 2013[46]
	025758) and financial contributions from Harvard University and its affiliated academic health care centres.).
RESULTS (NUMBERS ANALYSED) AND RISK OF BIAS FOR COMPARISON: USING ELECTRONIC MEANS TO CONDUCT THE STRUCTURED HANDOVER versus ROUTINE UNSTRUCTURED HANDOVER Protocol outcome 1: Avoidable adverse events (prescribing errors (errors of omission or commission) cardiopulmonary resuscitation, unplanned admission to intensive care, delayed or missed investigations, delayed or missed treatments) at Define. - Actual outcome: Critical data omissions at 1 year; Group 1: 0/19, Group 2: 23/39; Risk of bias: All domain - High, Selection - High, Blinding - High, Incomplete outcome data - Low, Crossover - Low, Comments - Before and after study; survey responses used for outcome reporting; intervention also incluuded shift scheduling; Indirectness of outcome: No indirectness - Actual outcome: Near misses at 1 year; Group 1: 0/19, Group 2: 9/39; Risk of bias: All domain - High, Selection - High, Blinding - High, Incomplete outcome data - Low, Crossover - Low, Comments - Before and after study; survey responses used for outcome reporting; intervention also incluuded shift scheduling; Indirectness of outcome: No indirectness - Actual outcome: Adverse events at 1 year; Group 1: 0/19, Group 2: 4/39; Risk of bias: All domain - High, Selection - High, Blinding - High, Incomplete outcome data - Low, Crossover - Low, Comments - Before and after study; survey responses used for outcome reporting; intervention also incluuded shift scheduling; Indirectness of outcome: No indirectness	
Protocol outcomes not reported by the study	Mortality; Quality of life; Patient and/or carer satisfaction; Length of stay; Staff satisfaction.

Study	Kerr 2016[58]
Study type	Before and after study.
Number of studies (number of participants)	1 (n=not reported).
Countries and setting	Conducted in Australia; Setting: Mixed adult and paediatric ED of a teaching hospital in Melbourne, Australia.
Line of therapy	Not applicable.
Duration of study	Other: 5 day pre-implementation phase and 5 day post-implementation phase
Method of assessment of guideline condition	Method of assessment/diagnosis not stated.
Stratum	Overall.
Subgroup analysis within study	Not applicable.
Inclusion criteria	Not reported.
Exclusion criteria	Not reported.
Recruitment/selection of patients	Review of ED patient records and direct observation.
Age, gender and ethnicity	Age - Other: Gender (M:F): Not reported. Ethnicity: Not reported.
Further population details	1. Critical care patients: Not applicable/Not stated/Unclear.

Study	Kerr 2016[58]
	2. Frail elderly: Not applicable/Not stated/Unclear. 3. Speciality/profession: profession-specific handover (nurse handover).
Indirectness of population	Serious indirectness: Mixed adult and paediatric ED.
Interventions	(n=151) Intervention 1: Structured (planned framework as defined by the study) between healthcare professionals between shifts in acute settings - this will include (i) set times of the day, (ii) Using a structured template/proforma for the handover (iii) recording the information in written or electronic form. Structured nursing handover based on the ISBAR (identify, situation, background, assessment, recommendations) handover approach, modified to address deficits in nursing care practice in the ED. Key features: systematic, conducted at the bedside, involvement of patients/relatives, viewing of charts during handover, preliminary group handover for general information about unstable patients, notepads providing prompts about nursing care needs, treatment and disposition plan and important care elements (medication chart, vital signs, fluid balance). Duration: 5 days. Concurrent medication/care: not reported. (n=128) Intervention 2: Normal handover - Routine unstructured handover. Handover undertaken in an enclosed area located away from the clinical area, carried out by the nurse in charge of the outgoing shift to those on the incoming shift; generally occurring 3 times a day. Duration: 5 days. Concurrent medication/care: not reported.
Funding	Other (Nurses Board of Victoria Legacy Limited fund).
RESULTS (NUMBERS ANALYSED) AND RISK OF BIAS FOR COMPARISON: THIS WILL INCLUDE (I) SET TIMES OF THE DAY, (II) USING A STRUCTURED TEMPLATE / PROFORMA FOR THE HANDOVER (III) RECORDING THE INFORMATION IN WRITTEN OR ELECTRONIC FORM versus ROUTINE UNSTRUCTURED HANDOVER Protocol outcome 1: Avoidable adverse events (prescribing errors (errors of omission or commission) cardiopulmonary resuscitation, unplanned admission to intensive care, delayed or missed investigations, delayed or missed treatments) - Actual outcome: medications administered as prescribed at 5 days; Group 1: 149/151, Group 2: 125/128; Risk of bias: All domain - High, Selection - High, Blinding - High, Incomplete outcome data - Low, Outcome reporting - Low, Measurement - Low, Crossover - Low, Subgroups - Low; Indirectness of outcome: No indirectness	
Protocol outcomes not reported by the study	Mortality; Quality of life; Patient/carer satisfaction; Length of stay; Staff satisfaction.

Study	Zou 2016[127]
Study type	Before and after study.
Number of studies (number of participants)	1 (n=3933)
Countries and setting	Conducted in China; Setting: Medical unit of a tertiary general hospital in China.
Line of therapy	Not applicable.

Study	Zou 2016[127]
Duration of study	Other: 1 year pre-intervention and 1 year post-intervention.
Method of assessment of guideline condition	Unclear method of assessment/diagnosis: not reported.
Stratum	Overall: N/A.
Subgroup analysis within study	Not applicable.
Inclusion criteria	Not reported.
Exclusion criteria	Not reported
Recruitment/selection of patients	Unclear.
Age, gender and ethnicity	Age - --: Not reported. Gender (M:F): Not reported. Ethnicity: Not reported.
Further population details	1. Critical care patients: Not applicable/Not stated/Unclear. 2. Frail elderly: Not applicable/Not stated/Unclear. 3. Speciality/profession: profession-specific handover.
Extra comments	Admissions included patients with gastroenterological and endocrinological diseases such as pancreatitis, gastrointestinal bleeding, cirrhosis, liver cancer and diabetes.
Indirectness of population	No indirectness: no indirectness.
Interventions	(n=1970) Intervention 1: Structured (planned framework as defined by the study) between healthcare professionals between shifts in acute settings - this will include (i) set times of the day, (ii) using a structured template/proforma for the handover (iii) recording the information in written or electronic form. Standard nursing handover form including patient name, medical record number, diagnosis, signs/symptoms, abnormal test results, care plan 'to do' tasks, scheduled tests/procedures, fall risk, oxygen therapy and catheter. Oral report given by outgoing nurses at nursing station, then bedside handoffs. Head nurse supervised each handoff process. Duration October 2012 - September 2013. Concurrent medication/care: Not reported. (n=1963) Intervention 2: Normal handover - Routine unstructured handover. Verbal nursing handoffs at the nursing station at shift change time; occasionally bedside handoffs for critical patients; information transferred was incomplete and unsystematic. Duration October 2013 - September 2014. Concurrent medication/care: Not reported.
Funding	Funding not stated.

RESULTS (NUMBERS ANALYSED) AND RISK OF BIAS FOR COMPARISON: THIS WILL INCLUDE (I) SET TIMES OF THE DAY, (II) USING A STRUCTURED TEMPLATE / PROFORMA FOR THE HANDOVER (III) RECORDING THE INFORMATION IN WRITTEN OR ELECTRONIC FORM versus ROUTINE UNSTRUCTURED HANDOVER

Protocol outcome 1: Avoidable adverse events (prescribing errors (errors of omission or commission) cardiopulmonary resuscitation, unplanned admission to intensive

Study	Zou 2016[127]
care, delayed or missed investigations, delayed or missed treatments). - Actual outcome: Handoffs related errors at 1 year; Group 1: 5/1970, Group 2: 53/1963; Risk of bias: All domain - High, Selection - High, Blinding - High, Incomplete outcome data - Low, Outcome reporting - Low, Measurement - Low, Crossover - Low, Subgroups - Low; Indirectness of outcome: No indirectness	
Protocol outcomes not reported by the study	Mortality; Quality of life; Patient/carer satisfaction; Length of stay; Staff satisfaction.

Appendix E: Economic evidence tables

Study	Yao 2012[126]			
Study details	**Population & interventions**	**Costs**	**Health outcomes**	**Cost effectiveness**
Economic analysis: CUA (health outcome: QALY) **Study design:** Retrospective cohort analysis without multivariate regression **Approach to analysis:** Analysis on effect of structured patient handover on preventable adverse events. QoL was assigned by grouping adverse events by severity **Perspective:** Netherlands health system **Time horizon:** 1 year **Treatment effect duration[(a)]:** 1 year **Discounting:** Costs: n/a ; Outcomes: n/a	**Population:** Patients discharged from hospital to the community **Cohort settings:** Start age: n/a Male: n/a **Intervention 1:** Usual care **Intervention 2:** Structured patient handover between hospital and community (HANDOVER project)	**Total costs (per patient discharge):** Intervention 1: Intervention 2: Incremental (2−1): £1.86 (95% CI: NR; p=NR) **Currency & cost year:** 2011 Euros (presented here as 2011 UK pounds[(b)]) **Cost components incorporated:** Intervention cost (HANDOVER), admission and readmission associated with adverse event to ED, GP visit	**QALYs (per patient discharge):** Intervention 1: Intervention 2: Incremental (2−1): 0.0103 (95% CI: NR; p=NR)	**ICER (Intervention 2 versus Intervention 1):** £180.34 per QALY gained **Analysis of uncertainty:** The study looked at a base case of 21% effectiveness of the intervention whereby it is 21% effective at reducing preventable adverse events. The intervention was found to be dominant at 100% effectiveness, increase in QALYs and cost saving. The study also found that this dominance is lost when effectiveness drops below 24.3% and is no longer cost-effective, at a €20,000 threshold, if the effectiveness of the intervention drops below 1.6%.
Data sources				
Health outcomes: EQ-5D scores were estimated by categorising adverse events into groups and assigning the groups to an indicative state. **Quality-of-life weights:** EQ-5D UK tariff **Cost sources:** Published sources (to be added to references).				
Comments				
Source of funding: Framework Programme of the European Commission; National Institute of Health Research (NIHR); ESPSRC MATCH project; NIHR Collaborations for Leadership in Applied Health Research and Care (CLAHRC) for Birmingham and Black Country **Applicability and limitations:** Some uncertainty regarding the applicability				

of resource use and costs from the Netherlands (2011) to current NHS context. Costs from multiple published studies. No discounting reported. Quality-of-life estimated by categorising adverse events and allocating to an indicative state from the EQ-5D. Health outcomes based on estimates and assumptions of preventable adverse events. Effectiveness of the intervention elicited from experts. **Other:** Converting the threshold from Euros to UK pounds would show greater favour for the intervention with the current €20,000 threshold used in the analysis converting to £16,853, less than the £20,000 threshold used.

Overall applicability[(c)]: Partially applicable **Overall quality[(d)]:** Potentially serious limitations

Abbreviations: CUA: cost-utility analysis; 95% CI: 95% confidence interval; 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; QALYs: quality-adjusted life years; QoL: Quality-of-life.

(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) Converted using 2011 purchasing power parities.[81]

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

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

Appendix F: GRADE tables

Table 9: Clinical evidence profile: Intensive care unit

Quality assessment							No of patients		Effect		Quality	Importance
No of studies	Design	Risk of bias	Inconsistency	Indirectness	Imprecision	Other considerations	Structured	Unstructured	Relative (95% CI)	Absolute		
Mortality												
1	observational studies	serious[1]	no serious inconsistency	no serious indirectness	very serious[2]	none	26/389 (6.7%)	8.5%	RR 0.71 (0.43 to 1.17)	26 fewer per 1000 (from 48 fewer to 14 more)	⊕OOO VERY LOW	CRITICAL
Re-admission <48hours												
1	observational studies	serious[1]	no serious inconsistency	no serious indirectness	very serious[2]	none	21/431 (4.9%)	3.6%	RR 1.35 (0.7 to 2.63)	13 more per 1000 (from 11 fewer to 59 more)	⊕OOO VERY LOW	CRITICAL
Length of Stay (Better indicated by lower values)												
1	observational studies	serious[1]	no serious inconsistency	no serious indirectness	no serious imprecision	none	431	389	-	MD 2.78 lower (4.68 to 0.88 lower)	⊕OOO VERY LOW	IMPORTANT
Staff satisfaction												
1	observational studies	serious[1]	no serious inconsistency	no serious indirectness	no serious imprecision	none	34/57 (59.6%)	18.2%	RR 3.09 (1.7 to 5.61)	380 more per 1000 (from 127 more to 839 more)	⊕OOO VERY LOW	IMPORTANT
Staff satisfaction - Attending Physician												
1	observational studies	serious[1]	no serious inconsistency	no serious indirectness	serious[2]	none	6/11 (54.5%)	18.2%	RR 3 (0.77 to 11.74)	364 more per 1000 (from 42 fewer to 1000 more)	⊕OOO VERY LOW	IMPORTANT

Staff satisfaction – Fellows												
1	observational studies	serious[1]	no serious inconsistency	no serious indirectness	very serious[2]	none	6/16 (37.5%)	43.8%	RR 0.86 (0.37 to 1.99)	61 fewer per 1000 (from 276 fewer to 434 more)	⊕OOO VERY LOW	IMPORTANT
Staff satisfaction – Nurses												
1	observational studies	serious[1]	no serious inconsistency	no serious indirectness	no serious imprecision	none	22/30 (73.3%)	6.7%	RR 11 (2.83 to 42.7)	670 more per 1000 (from 123 more to 1000 more)	⊕OOO VERY LOW	IMPORTANT

[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 10: Clinical evidence profile: Neurology Unit

Quality assessment							No of patients		Effect		Quality	Importance
No of studies	**Design**	**Risk of bias**	**Inconsistency**	**Indirectness**	**Imprecision**	**Other considerations**	**Structured**	**Unstructured**	**Relative (95% CI)**	**Absolute**		
ICU Readmission												
1	observational studies	serious[1]	no serious inconsistency	no serious indirectness	very serious[2]	none	5/131 (3.8%)	3.1%	RR 1.24 (0.34 to 4.52)	7 more per 1000 (from 20 fewer to 109 more)	⊕OOO VERY LOW	CRITICAL
Rapid Response Team Call at 6 Months												
1	observational studies	serious[1]	no serious inconsistency	no serious indirectness	very serious[2]	none	4/131 (3.1%)	1.5%	RR 1.98 (0.37 to 10.65)	15 more per 1000 (from 9 fewer to 145 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: Emergency Department

Quality assessment							No of patients		Effect		Quality	Importance
No of studies	Design	Risk of bias	Inconsistency	Indirectness	Imprecision	Other considerations	Electronic	Routine	Relative (95% CI)	Absolute		
Staff satisfaction (Better indicated by higher values)												
1	observational studies	serious[1]	no serious inconsistency	no serious indirectness	no serious imprecision	none	1058	78	-	MD 0.17 higher (0.33 lower to 0.67 higher)	⊕OOO VERY LOW	IMPORTANT
Avoidable adverse events (medications administered as prescribed)												
1	observational studies	serious[1]	no serious inconsistency	no serious indirectness	no serious imprecision	none	149/151 (98.7%)	97.7%	RR1.01 (0.98 to 1.04)	10 more per 1000 (from 20 fewer to 39 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

Table 12: Clinical evidence profile: Internal Medicine

Quality assessment							No of patients		Effect		Quality	Importance
No of studies	Design	Risk of bias	Inconsistency	Indirectness	Imprecision	Other considerations	Electronic	Routine	Relative (95% CI)	Absolute		
Critical data omissions												
1	observational studies	serious[1]	no serious inconsistency	no serious indirectness	no serious imprecision	none	0/19 (0%)	79.3%	Peto OR 0.04 (0.01 to 0.14)	660 fewer per 1000 (from 444 fewer to 756 fewer)	⊕OOO VERY LOW	CRITICAL
Near Misses												

1	observational studies	serious[1]	no serious inconsistency	no serious indirectness	no serious imprecision	none	0/19 (0%)	23.1%	Peto OR 0.18 (0.04 to 0.8)	180 fewer per 1000 (from 37 fewer to 219 fewer)	⊕OOO VERY LOW	CRITICAL
Adverse events												
1	observational studies	serious[1]	no serious inconsistency	no serious indirectness	very serious[2]	none	0/19 (0%)	10.3%	Peto OR 0.21 (0.02 to 1.78)	79 fewer per 1000 (from 101 fewer to 67 more)	⊕OOO VERY LOW	CRITICAL
Avoidable adverse events (handoffs related errors)												
1	observational studies	serious[1]	no serious inconsistency	no serious indirectness	no serious imprecision	none	5/1970 (0.25%)	2.70%	RR 0.09 (0.04 to 0.23)	25 fewer per 1000 (from 21 fewer to 26 fewer)	⊕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 13: Studies excluded from the clinical review

Reference	Reason for exclusion
Abraham 2012[2]	Incorrect comparison (paper based versus paper based handover tools)
Abraham 2014[4]	No useable outcomes
Abraham 2014[3]	Systematic review (incorrect PICO)
Ah-kye 2015[5]	Incorrect population (trauma patients)
Ahmed 2012[6]	Incorrect population and study design (before and after study; acute surgical admissions)
Anderson 2015[7]	Systematic review (incorrect PICO)
Anon 2015[49]	Systematic review (incorrect PICO)
AORN2016[1]	Evidence appraisal of a RCT Salzwedel 2013- the study has been excluded due to incorrect population (post-anaesthesia patients)
Arora 2009[8]	Systematic review (incorrect PICO)
Barnes 2011[9]	No relevant outcomes
Berkenstadt 2008[10]	No relevant outcomes
Blaz 2012[11]	Systematic review (no references included)
Bost 2010[12]	Incorrect study design (qualitative)
Brown 2015[13]	No relevant outcomes
Bump 2012[14]	Incorrect comparison (does not compare handover types (standard sign out versus additional training.)
Christie 2009[16]	Narrative review
Chu 2009[17]	Incorrect study design (survey)
Cohen 2010[18]	Systematic review (no relevant outcomes)
Collins 2011[19]	Systematic review (incorrect PICO)
Cornell 2014[21]	No relevant outcomes
Craig 2012[22]	No relevant outcomes
Curtis 2013[23]	No relevant outcomes
Dawson 2013[24]	Systematic review (incorrect PICO)
Dhillon 2011[25]	Incorrect population (surgical patients)
Dixon 2015A[26]	Incorrect population (surgical patients)
Donnelly 2012[28]	Incorrect population (not AME); no relevant outcomes
Donnelly 2014[27]	Incorrect population (not AME)
Dowding 2001[29]	No useable outcomes
Downey 2013[30]	Incorrect population (trauma patients)
DRACHZAHAVY2015[31]	No useable outcomes
DuBosh 2014[32]	No useable outcomes
Dufault 2010[33]	Systematic review (incorrect PICO)
Evans 2014[35]	Incorrect study design (narrative review)

Reference	Reason for exclusion
Field 2011[36]	Incorrect setting (nursing homes)
Flanagan 2009[37]	Incorrect study design (survey)
Flemming 2013[38]	Systematic review (incorrect PICO)
Foster 2012[39]	Systematic review (incorrect PICO)
Gakhar 2010[40]	No relevant outcomes
Gardiner 2015[41]	Systematic review (incorrect PICO)
Govier2012A [43]	Incorrect study design (audit)
GRAAN2016[44]	No useable outcomes.
Halm 2013[47]	Systematic review (incorrect PICO)
Hesselink 2012[50]	Incorrect population (patient discharge from hospital to primary care)
Hill 2015[51]	Incorrect intervention (inter-hospital transfer)
Iedema 2012[52]	Incorrect study design (survey)
Jensen 2013[53]	Systematic review (incorrect PICO)
Johnson 2016[54]	Comparator not defined
Kaufmnan 2013[55]	Incorrect population (mainly children and neonates)
Keebler 2016[56]	Systematic review (references screened)
Keenan 2006[57]	Description of handover tool only.
Kessler 2013[59]	Incorrect study design (narrative review)
Kitson 2014[60]	Incorrect study design (narrative review)
Kochendorfer 2010[61]	Incorrect intervention (electronic rounding report)
KUHN2016[62]	Surgical patients – patients admitted to neurosurgical service
Lamond 2000[63]	Looking at the information content of handover, not comparing types of handover.
Lee 1996[64]	Pre-1995 study
Li 2013[65]	Systematic review (incorrect PICO)
Malekzadeh 2013[66]	No useable outcomes
Manser 2011[68]	Incorrect study design (narrative review)
Manser 2013[67]	Incorrect study design (narrative review)
Mardis 2016[69]	Systematic review (references screened)
Matic 2011[71]	Incorrect study design (narrative review)
Moller 2013[73]	Incorrect population (surgical patients)
Moseley 2012[74]	Incorrect population (neurology inpatients)
MCQUILLAN2014[72]	Incorrect population- Paediatric patients
Mueller 2016[75]	Incorrect population (paediatric patients)
Nakagawa 2016[76]	Study abstract
Nakhleh 2006[77]	Incorrect population (surgical patients)

Reference	Reason for exclusion
O'Byrne 2008[79]	Incorrect study design (narrative review)
Ong 2011[80]	Systematic review (incorrect PICO)
Palmer 2014[82]	Incorrect intervention (checklist to encourage the completion of outstanding tasks before shift change on Friday evening)
Patel 2014[83]	Comparator not defined
Patterson 2010[85]	Incorrect study design (narrative review)
Patterson 2012[84]	Incorrect study design (narrative review)
Payne 2012[86]	Incorrect study design (before and after study); no useable outcomes
Petrovic 2012[87]	Comparator not defined
Phillips 2009[88]	Incorrect study design (observations and interviews). No comparison group stated.
Pincavage 2013[89]	Incorrect population (primary care setting)
Poore 2012[90]	Incorrect population (surgical patients)
Pothier 2005[91]	No relevant outcomes
Pucher 2015[92]	Incorrect population (surgical patients)
Raduma-Tomas 2011[93]	Systematic review (incorrect PICO)
RAITEN2015[94]	Review -scanned for relevant references
Raptis 2009[95]	No useable outcomes
Reid 2005[96]	Incorrect study design (audit)
Riesenberg 2009[99]	Systematic review (incorrect PICO)
Riesenberg 2009[98]	Systematic review (incorrect PICO)
Riesenberg 2010[97]	Systematic review (incorrect PICO)
Robertson 2014[100]	Systematic review (incorrect PICO)
Ryan 2011[103]	No extractable outcomes (length of stay reported as median and interquartile range)
Salzwedel 2013[104]	Incorrect population (post-anaesthesia patients)
Starmer 2014[110]	Incorrect population (paediatrics)
Segall 2012[106]	Incorrect population (surgical patients)
SEGALL2016 [105]	Inappropriate study design- surveys, interviews and focus groups
Siefferman 2012[107]	Incorrect population (rehab patients)
Singer 2006[108]	Incorrect study design (narrative review)
Staggers 2013[109]	Systematic review (incorrect PICO)
Stephens 2015[111]	Incorrect population (surgical patients)
Talbot 2007[112]	No useable outcomes
Thompson 2011[113]	No useable outcomes
Timko 2015[115]	Incorrect population (substance misuse)
Till 2014[114]	No relevant outcomes

Reference	Reason for exclusion
USHER2016 [117]	Inappropriate intervention- transfer between hospitals (inter-hospital hand-offs)
Van Eaton 2005[118]	No relevant outcomes
Van Eaton 2010[119]	Incorrect population (more than 50% surgical patients, trauma and paediatrics)
Van Sluisveld 2015[120]	Systematic review (incorrect PICO)
Vines 2014[121]	Systematic review (incorrect PICO)
Walton 2015[122]	No relevant outcomes
Williamson 2015[123]	Incorrect population (surgical patients); comparator not defined
Wood 2015[124]	Systematic review (incorrect PICO)

Appendix H: Excluded economic studies

No economic studies were excluded.