National Institute of Health and Care Excellence

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Chapter 40 Escalation measures

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

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1

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Contents

1

40 Escalation measures

40.1 Introduction

Pressure in the acute hospital is not unusual but standards have been set to ensure that patients have an expectation of prompt care and review. In the acute setting the most obvious example has been the A&E 4 hour waiting target standard measure that anticipates that patients will be seen, investigated and treated to a point where they can be discharged to the community or admitted to an in-patient bed within 4 hours. It is clear that while the measurement takes place in ED, this standard is really a measure of overall system performance and when such standards are not being fulfilled there is a need to ensure that there are contingency plans in place that maintain patient care. These escalation measures are implemented disparately across the NHS and there has been little direct evidence of escalation measure that are more effective than others. This includes the time for implementation, the precise design of escalation and the areas affected by escalation. The question posed tried to identify evidence of the most effective escalation measures that should deal with surges in demand in acute medical emergencies.

40.2 Review question: What are the appropriate escalation measures to manage surges in demand to facilitate optimal patient flow?

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) at risk of an AME, or with a suspected or confirmed AME.
Intervention	Surge (natural or unnatural causes of undefined length for example, infectious disease, seasonal variation or major incidents) planning: **Structure (beds and equipment):** Greater capacity (more community beds available; more hospital beds and using private wards/hospitals). **Staff:** Planning of staff capacity for seasonal variations/extended holiday periods/for the change of house that is, new FY1 starting in August. More changes or flexible use of staff/skill mix (all staff, in and out of hospital) (for example, increasing proportion of healthcare assistants, moving staff in response to demand, having staff in reserve, senior medical support on site, additional support in the community and use of locum and agency staff). **Processes:** Triage/streaming (hear and treat and telephone response). Community triage (point of first contact) declaring a hospital internal major incident. Moving patients/diverting. Early discharge to community services. Patient education (for example, communications advising patients to stay at home). Closing down certain services (for example, elective surgery). Diversion of ambulances (to another hospital).
Comparison	No escalation measure or in combination to one another.

Outcomes	• Mortality (CRITICAL) • Avoidable adverse events as reported by study (for example, incidents - pressure sores, complaints, falls, hospital acquired infection) (CRITICAL) • Quality of life (CRITICAL) • Length of stay (IMPORTANT) • Readmission up to 30 days (IMPORTANT) • A&E 4 hour waiting target (overcrowding in non-UK studies) (CRITICAL) • Outliers/Boarders (IMPORTANT) • Staff satisfaction (IMPORTANT) • Referral to treat (RTT) (less than 18 weeks) (IMPORTANT) • Visits to hospital (IMPORTANT) • Bed occupancy (IMPORTANT)
Study design	Systematic reviews (SRs) of RCTs, RCTs, observational studies only to be included if no relevant SRs or RCTs are identified.

40.3 Clinical evidence

Five studies were included in this review; 3 cohort studies and 2 before-after studies[38,40,69,77,80] which are summarised in Table 2. Evidence from these studies is summarised in the clinical evidence summary (Table 3). Additionally, 1 modelling paper was included in this review;[117] evidence from this study is summarised in Table 5. See also the study selection flow chart in Appendix B, forest plots in Appendix C, study evidence tables in Appendix D, GRADE tables in Appendix F and excluded studies list in Appendix G.

Table 2: Summary of observational studies included in the review

Study	Intervention and comparison	Population	Outcomes	Comments
Eastman 2007[38] Before and after Conducted in the USA	Intervention 1 (n=not reported): opening of an 8200 square foot alternate site for medical care was established for 16 days to provide emergent and urgent healthcare screening and treatment of evacuees. Intervention 2 (n=not reported): previous year, when no evacuation occurred.	All potential patients of the city's primary provider of indigent care.	Mean daily visits to the city's primary provider of indigent care during the 16 days.	Alternative medical site to support 23,231 registered evacuees (10,367 of which used the facility during the 16 days). Patient safety at the alternative site reported narratively as "no safety breaches reported".
Einav 2009[40] Before and after Conducted in Israel	Intervention 1 (n=152): management of a mass casualty incident after the creation of a case manager. The role of the case manager was to accompany mass casualty patients as they were transferred within a hospital through the diagnostic/treatment pathway until a 'definitive' placement had been reached. Intervention 2 (n=379):	(n=531) patients admitted to 1 medical centre during 17 MCIs (12 before, 5 after). Age: not reported; Gender: not reported; Ethnicity: not	Mortality; length of stay.	Before period was from 2001-2003. After period from 2003-2006. Case manager level of expertise was determined by patient severity of injury and ranged from a nursing or medial trainee to a combined medical/nursing team led by a senior

Study	Intervention and comparison	Population	Outcomes	Comments
	management of mass casualty patients before the creation of a case manager.	reported.		surgeon. Length of stay was sub-grouped by severity score (number of patients not reported).
Jen 2009[69] Prospective cohort study Conducted in USA	Intervention 1 (n=345): creation of 'surge' capacity before the hospital in-patients were moved to a new facility. Three interventions included, which lasted for a week pre-move: elective operations were drawn down, number of inpatient transfers accepted from outside institutions was reduced and a multi-disciplinary discharge planning team conducted daily rounds to identify the eligibility of inpatients for expedited discharge from the hospital and ICU. Intervention 2 (n=537): management of patients at baseline (1 week period before the transition period began).	(n=882) All patients within a large metropolitan university teaching hospital for 2 weeks prior to the move to a new facility. Age: not reported; Gender: not reported; Ethnicity: not reported.	Length of stay and mortality.	New facility was opened opposite the old facility. Discharge planning team consisted of: chief medical and surgical officers, nursing unit directors and 2 ethicists.
Khanna 2014[77] Retrospective cohort study Conducted in Australia	Intervention 1 (n= not reported): highest alert level from a 4-tiered capacity alert system (Alert-4). Response to alert: all functional service units and services are asked to respond in order to streamline patient admission and discharge planning. Hospital staff are alerted of the status of occupancy via pager messages, text messages to listed mobile phones and occasionally through the hospital public address system. Examples of typical responses include the cancellation of elective surgery, prioritising discharges and related pharmacy and/or radiology requests and notifying ambulance services to prioritise transfer patients. Intervention 2	Patient record data from in-patient and ED database aggregated into hourly intervals.	Bed occupancy percentage on day 0, 1 day post capacity alert, and 2 day post capacity alert.	Total bed occupancy of the hospital was not defined. Outcome reported as percentages. Intervention and control matched on the bed occupancy level when the alert was called. The alert level on the 4-tiered system was not defined for the matched control days.

Study	Intervention and comparison	Population	Outcomes	Comments
	(n= not reported): matched control days where an Alert-4 was not implemented. Duration: full day (duration not reported).			
Kollek 2010[80] Interrupted time series Conducted in Canada	Intervention 1 (n= not reported): creation of an ambulatory influenza clinic in the fast track area of the ED staffed by family physicians. Patients previously seen in the fast-track were seen in the main area of the ED. Intervention 2 (n= not reported): management of patients before the clinic opened. Intervention 3 (n= not reported): management of patients after the clinic closed.	All visits to an ED during 2 months during the 2009 H1N1 influenza pandemic. Age: not reported; Gender: not reported; Ethnicity: not reported.	ED length of stay and admitted patient length of stay.	Total number of patients was not reported (average total of visits per day for the respective interventions was: 242,142,115). All outcomes were reported as means, no standard deviations reported.

Table 3: Clinical evidence summary: Presence of a case manager versus usual care

Outcomes	No of Participants (studies) Follow up	Quality of the evidence (GRADE)	Relative effect (95% CI)	Anticipated absolute effects	
				Risk with Control	Risk difference with Presence of a case manager versus usual care (95% CI)
Mortality	531 (1 study) in-hospital	⨁⊖⊖⊖ VERY LOW[a,b] due to risk of bias, imprecision	RR 1.07 (0.28 to 4.08)	19 per 1000	1 more per 1000 (from 14 fewer to 59 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 1 MID or by 2 increments if the confidence interval crossed both MIDs.

Table 4: Clinical evidence summary: Creation of surge capacity versus usual care

Outcomes	No of Participants (studies) Follow up	Quality of the evidence (GRADE)	Relative effect (95% CI)	Anticipated absolute effects	
				Risk with Control	Risk difference with Creation of surge capacity versus usual care (95% CI)
Mortality	882 (1 study) in-hospital	⨁⊖⊖⊖ VERY LOW[a,b] due to risk of bias, imprecision	RR 0.97 (0.45 to 2.12)	30 per 1000	1 fewer per 1000 (from 16 fewer to 34 more)
Length of stay	882 (1 study) in-hospital	⨁⊖⊖⊖ VERY LOW[a] due to risk of bias	-	The mean length of stay in the control groups was 10 days	The mean length of stay in the intervention groups was 1 higher (0.7 lower to 2.7 higher)

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

Outcomes that could not be analysed using Review Manager included:

Eastman 2007: mean ED visits during the 16 day opening of an alternative medical site to support 23,231 registered evacuees (10,367 of which used the facility) compared to the previous year: ED visits during alternate site opening: 346 (36); previous year ED visits: 341 (41).

Einav 2009: mean length of stay – sub-grouped (number of patients not reported) to severely injured patients and less severely injured patients using an Injury Severity Score (no further details given); severe patients: after case manager introduction: 12.0 (4.4); before case manager introduction: 37.1 (24.7); Less severe patients: after case manager introduction: 15.3 (10.7); before case manager introduction: 30.5 (23.1).

Khanna 2014: Bed occupancy (reported as percentage) when a capacity alert was called compared to matched control days (where the initial bed occupancy was similar). Mean difference between final percentages (no n numbers): 0.6 lower in the intervention group at 1-day post capacity alert; 0.5 lower in the intervention group at 2-day post capacity alert.

Kollek 2010: mean length of ED stay during the clinic opening versus before the clinic opened (no standard deviations): during clinic: 6; before clinic: 6; mean length of ED stay during the clinic opening versus after the clinic closed (no standard deviations): during clinic: 6; after clinic: 8; mean length of stay for admitted patient during the clinic opening versus before the clinic opened (no standard deviations): during clinic: 25; before clinic: 34; mean length of stay for admitted patient during the clinic opening versus after the clinic closed (no standard deviations): during clinic: 25; after clinic: 39.

40.4 Economic and simulation model evidence

Published literature

One modelling study was and has been included in this review.[117] This is summarised in the economic evidence profile below (Table 5) and the economic evidence tables in Appendix E.

No relevant health economic studies were identified.

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

Table 5: Economic evidence profile: Escalation measures

Study	Study design	Other comments	Incremental cost	Incremental effects	Cost effectiveness
Rowan 2010[117] (UK)	Analysis of audit data with assumptions applied regarding the effect of triage of critically ill patients on mortality, avoidable admissions and bed days saved.	Intervention 1. Triage low severity patients to temporary critical care area. 2. Triage high severity patients to no critical care. 3. No triage (based on audit data)	n/a	**Percentage of admissions diverted:** Intervention 1: 56.5% Intervention 2: 14.4% **Potential CCU admission avoided in patients diverted:** Intervention 1: 42.1% Intervention 2: 14.4% **Potentially avoidable deaths in diverted patients:** Intervention 1: n/a Intervention 2: 30.0% **Percentage of CCU bed days saved:** Intervention 1: 11.1% Intervention 2: 15.4%	n/a

40.5 Evidence statements

Clinical

One study comprising 531 people evaluated the presence of a case manager compared to usual care for improving outcomes in adults and young people at risk of an AME, or with a suspected or confirmed AME. The evidence suggested there was no difference on mortality (very low quality). One study comprising 882 people evaluated the role of creation of surge capacity before hospital relocation for improving outcomes in adults and young people at risk of an AME, or with a suspected or confirmed AME. The evidence suggested that there was no effect on mortality or length of stay (very low quality).

Economic and simulation evidence

One study modelled the effect of different strategies based on a severity score during a crisis.

1. Triage low severity patients to temporary critical care area.

2. Triage high severity patients to no critical care.

Strategy 2 freed up more bed days (15.4% vs 11.1%) but there was an avoidable death rate of 30% among diverted patients with strategy 2.

40.6 Recommendations and link to evidence

Recommendations	-
Research recommendations	**RR17. Which components of a hospital escalation policy to deal with surges in demand are the most clinically and cost effective?**
Relative values of different outcomes	Mortality, quality of life, avoidable adverse events and meeting the A&E 4 hour waiting target (Emergency Department (ED) 'overcrowding' in non-UK studies) were considered by the guideline committee to be critical outcomes. Length of stay, readmission, outliers/boarders, referral-to-treat time less than 18 weeks, visits to hospital, bed occupancy and staff satisfaction were considered important outcomes.
Trade-off between benefits and harms	Five observational studies were included which looked at a variety of escalation measures. There was an expectation that an escalation measure could increase patient flow through a hospital or system, but with the possibility that this may lead to an increase in adverse patient safety events. Therefore a finding of no difference in mortality would be considered a good outcome for an escalation measure in the context of increased demand. The presence of a case manager versus no case manager during a mass casualty incident[40] suggested a benefit in reduced length of stay for both severely injured and less severely injured patients (reported narratively), with no difference in mortality. A large metropolitan university teaching hospital in the USA planning relocation implemented 'surge' capacity to assist the move of patients.[69] This included reducing elective operations, inpatient transfers and creation of a discharge planning team. The evidence suggested that the creation of surge capacity before hospital relocation suggested no difference in mortality or length of stay compared to the usual care carried out in the weeks previously. Creation of an alternative medical site during a large and sustained influx of evacuees[38] who required medical treatment appeared to prevent the increase in mean ED visits at the city's main hospital, as had occurred the previous year. The impact on patient safety at the main hospital was described narratively in that there were no safety breaches reported and there were no outcomes which evaluated the impact on patient safety at the alternative site. Opening an ambulatory influenza clinic during the H1N1 pandemic[80] suggested no difference in length of ED stay at the hospital, but a reduction in mean length of stay for admitted patients that reverted after the clinic closed. There were no outcomes which evaluated the impact on patient safety either within the ED or the ambulatory clinic. The use of a capacity alert system[77] narratively suggested a slightly reduced bed occupancy compared to matched control days over both 1 and 2 days. There were no outcomes evaluating the impact of a capacity alert on patient safety. No evidence was identified for quality of life, avoidable adverse events, meeting the A&E 4 hour waiting target, readmission, outliers/boarders, referral to treat less than 18 weeks and staff satisfaction. One modelling study was included in the review, which looked at triage of low severity patients to a temporary critical care area, triage of high severity patients away from the Critical Care Unit (CCU) entirely and no triage at all. The study used audit data of patients treated in CCUs across 148 different hospitals in the UK to assess those patients who required treatment in CCU, those who could have been treated appropriately elsewhere and those who died in CCU. These were grouped as 'critical care required', 'potentially avoidable admission' and 'death' respectively. Two triage protocols were then modelled with assumptions applied to estimate the effect on those patients who were triaged away from the CCU. Triage of low severity patients to a temporary critical care area resulted in a

Recommendations	-
Research recommendations	**RR17. Which components of a hospital escalation policy to deal with surges in demand are the most clinically and cost effective?**
	reduction in CCU admissions of 42.1% and a reduction in CCU bed days of 11.1%. Triage of high severity patients away from CCU resulted in a reduction in CCU admissions of 14.4% and a reduction in CCU bed days of 15.4%. There was, however, an increase in mortality as 30% of deaths were assessed as potentially avoidable that is, those assessed as 'critical care required' and were triaged away from CCU and assumed to die, accounted for 30% of all deaths. The remaining 70% were those who died in CCU anyway. The committee was unable to determine the validity of the assumption in the above paper that those patients who were assessed as 'critical care required' would die if not in the CCU. They also considered that a temporary critical care area could have an adverse effect on mortality if access or quality of provision were lower than a fully functional CCU if required. This was not assessed in the study. The committee decided that they could not use this evidence to inform a recommendation due to the serious limitations. The committee felt that the evidence was therefore unclear about whether any of these escalation measures were effective and safe enough to be recommended.
Trade-off between net effects and costs	No relevant economic evidence was identified for this question. The economic implications of escalation measures are highly dependent on the different interventions and the outcomes of the intervention. The overall effect on the cost is uncertain due to the lack of economic evidence so the committee felt that a practice recommendation could not be made and therefore chose to make a research recommendation.
Quality of evidence	Five observational studies were included. All evidence was graded at very low quality due to a very high risk of bias. In addition, the majority of evidence identified was reported narratively, for the most part due to studies not reporting total sample population numbers used in their analyses, whilst 1 study did not report standard deviations for the reported means. One modelling study was included and was assessed as partially applicable with potentially serious limitations. No economic evidence was identified.
Other considerations	The committee noted that the majority of identified evidence evaluated the effectiveness of specific interventions in response to specific difficulties, and thus could not necessarily be generalised to other settings. Often in these specific major incidents, the escalation interventions are implemented with the hope that doing so will not increase risk to patients. However, the committee was looking for generalisable approaches incorporating evidence for patient safety. The committee considered that the intervention studying the effectiveness of capacity alerts was the most generally applicable to the UK setting since these alerts trigger a comprehensive response, including cancellation of elective surgery, prioritising discharges and related pharmacy and/or radiology requests and notifying ambulance services to prioritise transfer patients or divert admissions. The committee felt that the applicability and effectiveness of each of these individual escalation measures may vary significantly across UK hospital system. Furthermore, this study only reported bed occupancy as an outcome whilst the committee agreed that escalation measures could lead to suboptimal patient outcomes, identification of which would be critical for the committee to make a balanced and informed recommendation. Current practice is for hospitals to have locally derived escalation procedures in place. This uses a stepped approach so additional measures are used as the situation

Recommendations	**-**
Research recommendations	**RR17. Which components of a hospital escalation policy to deal with surges in demand are the most clinically and cost effective?**
	worsens. The committee noted that current practice would be for an escalation policy for individual hospitals to be developed by consensus. Some hospitals in the UK and North America may also use the "Full Capacity Protocol (FCP)". The FCP is enacted when the number of admitted patients being held in the ED prohibits the evaluation and treatment of incoming patients to the ED in a timely fashion. At such times, admitted patients are placed in additional temporary beds on the wards or corridors. This approach to surge capacity has not been evaluated for efficacy and safety. It is possible that escalation measures may affect elderly patients at greater risk and reduced mobility more than other groups. Frequent moves from 1 location to another in elderly frail patients can have a detrimental impact on their health. The older population may have less access to social media so may not be aware of local issues. Lower socioeconomic groups may also be affected greater than other groups especially if it means patients would have to undertake longer journeys to receive care due to diversions being in place. CCGs are currently working with local authorities to improve the efficiency of local health services and integrate them better with social services via Sustainability and Transformation Plans (STPs). At the time of writing these plans are early in development. They should have a favourable impact on delayed discharges and may improve day-to-day or winter bed pressures, at the cost of removing significant resource from hospital care. The committee agreed that a research recommendation would be most appropriate at this point due to the lack of high quality evidence in combination with a lack of applicability to the general UK setting. They noted that escalation measures are being developed and implemented in the majority of UK hospitals. The committee agreed that a before and after study design utilised when a new policy was implemented would be straightforward to accomplish, but should ensure patient-safety outcomes are evaluated over a suitable timeframe that is, in-hospital mortality, avoidable adverse events, visits to hospital and readmission rates.

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Appendices

Appendix A: Review protocol

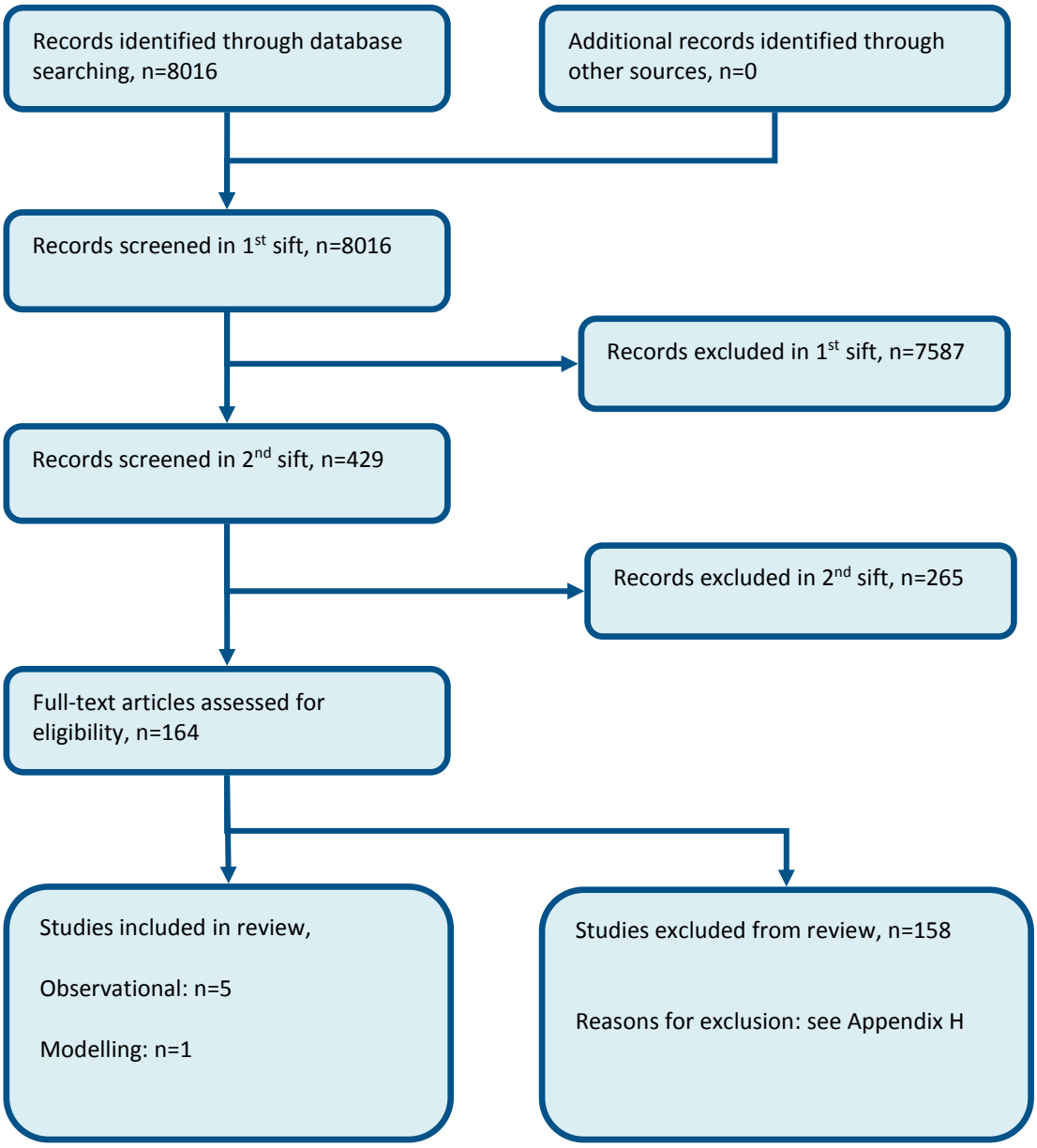
Table 6: Review protocol: Escalation measures

Review question	What are the appropriate escalation measures to manage surges in demand to facilitate optimal patient flow?
Guideline condition and its definition	Acute medical emergencies. Definition: people with suspected or confirmed acute medical emergencies or at risk of an acute medical emergency.
Review population	Adults and young people (16 years and over) with a suspected or confirmed AME in hospitals which admit patients with acute medical emergencies.
	Adults and young people (16 years and over).
	Line of therapy not an inclusion criterion.
Interventions and comparators: generic/class; specific/drug (All interventions will be compared with each other, unless otherwise stated)	Escalation in structure • Increase in beds • Use of alternative locations • Increase in equipment Escalation using staff • Increase in staffing levels • Increasing the proportion of certain staff types • Increasing community support • Use of agency staff Escalation using processes • Triage • Community triage • Diversion of current patients • Early discharge • Community education • Closing non-essential services • Diversion of incoming ambulances No escalation measure.
Outcomes	- Mortality during the study period (Dichotomous) CRITICAL - Staff satisfaction during the study period (Dichotomous) IMPORTANT - Length of stay during the study period (Continuous) IMPORTANT - Avoidable adverse events during the study period (Dichotomous) CRITICAL - Quality of life during the study period (Continuous) CRITICAL - Readmission up to 30 days during the study period (Dichotomous) IMPORTANT - A&E 4 hour waiting target met during the study period (Dichotomous) CRITICAL - Outliers/Boarders during the study period (Dichotomous) IMPORTANT - Referral to treat (RRT) > 18 weeks during the study period (Dichotomous) IMPORTANT -Hospital visits during the study period (Dichotomous) IMPORTANT -Bed occupancy during the study period (Dichotomous) IMPORTANT

Review question	What are the appropriate escalation measures to manage surges in demand to facilitate optimal patient flow?
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. Hospital. Ward.
Crossover study	Not permitted.
Minimum duration of study	Not defined.
Other exclusions	Hospitals with exclusively elective case mix (for example, cancer hospitals or private hospitals in the UK). Non-OECD countries unless Singapore, Hong Kong, or South Korea.
Subgroup analyses if there is heterogeneity	Frail (frail; non frail); effects may be different in this subgroup.
Search criteria	Databases: Medline, Embase, the Cochrane Library, HMIC. Date limits for search: 2000. Language: English.

Appendix B: Clinical article selection

Figure 1: Flow chart of clinical article selection for the review of escalation measures



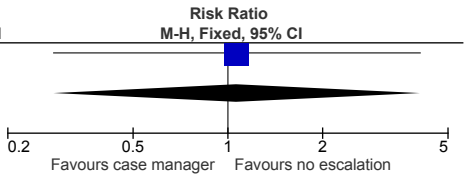
Appendix C: Forest plots

C.1 Presence of a case manager versus usual care

Figure 2: Mortality

Study or Subgroup	Case manager Events	Total	No escalation measure Events	Total	Weight	Risk Ratio M-H, Fixed, 95% CI
Einav 2009	3	152	7	379	100.0%	1.07 [0.28, 4.08]
Total (95% CI)		**152**		**379**	**100.0%**	**1.07 [0.28, 4.08]**
Total events	3		7			

Heterogeneity: Not applicable
Test for overall effect: Z = 0.10 (P = 0.92)



C.2 Creation of surge capacity versus usual care

Figure 3: Mortality

Study or Subgroup	Surge capacity Events	Total	No escalation measure Events	Total	Weight	Risk Ratio M-H, Fixed, 95% CI
Jen 2009	10	345	16	537	100.0%	0.97 [0.45, 2.12]
Total (95% CI)		**345**		**537**	**100.0%**	**0.97 [0.45, 2.12]**
Total events	10		16			

Heterogeneity: Not applicable
Test for overall effect: Z = 0.07 (P = 0.94)

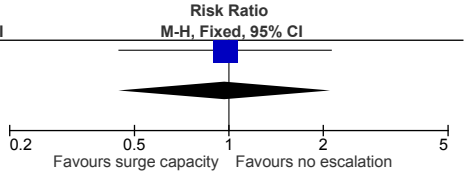
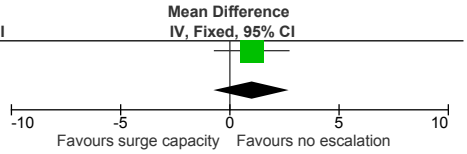


Figure 4: Length of stay

Study or Subgroup	Surge capacity Mean	SD	Total	No escalation measure Mean	SD	Total	Weight	Mean Difference IV, Fixed, 95% CI
Jen 2009	7	14	345	6	10	537	100.0%	1.00 [-0.70, 2.70]
Total (95% CI)			**345**			**537**	**100.0%**	**1.00 [-0.70, 2.70]**

Heterogeneity: Not applicable
Test for overall effect: Z = 1.15 (P = 0.25)



Appendix D: Clinical evidence tables

Study	Eastman 2007[38]
Study type	Retrospective cohort study.
Number of studies (number of participants)	1 (n=not reported).
Countries and setting	Conducted in USA; setting: off-site alternative medical care site.
Line of therapy	Not applicable.
Duration of study	16 days.
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	All registered evacuees following Hurricane Katrina.
Age, gender and ethnicity	Age - Other: not reported. Gender (M:F): not reported. Ethnicity: not reported.
Further population details	1. Frail: Not applicable/Not stated/Unclear
Indirectness of population	No indirectness.
Interventions	(n= not reported). Intervention 1: Escalation in structure - use of alternative locations. Opening of an 8200 square foot alternate site for medical care was established to provide emergent and urgent healthcare screening and treatment of evacuees (23,231 registered, 10,367 received care during the 16 days). Duration: 16 days. Concurrent medication/care: usual care. (n= not reported). Intervention 2: Escalation in structure - use of alternative locations. Previous year, when no evacuation occurred. Duration: 16 days. Concurrent medication/care: usual care.
Funding	Funding not stated.
RESULTS (NUMBERS ANALYSED) AND RISK OF BIAS FOR COMPARISON: USE OF ALTERNATIVE LOCATIONS versus NO ESCALATION MEASURE. Protocol outcome 1: Visits to hospital. - Actual outcome: mean daily visits to the city's primary provider of indigent care during the 16 days (no total n numbers reported); Group 1: mean 346 (36); Group 2:	

Study	Eastman 2007[38]
mean 341 (41); Risk of bias: All domain – very high, Selection – High, Blinding - Low, Incomplete outcome data - High, Outcome reporting - Low, Measurement - Low, Incomplete outcome data – high, Crossover - Low, Subgroups - Low; Indirectness of outcome: no indirectness	
Protocol outcomes not reported by the study	Mortality during the study period; Staff satisfaction during the study period; Length of stay during the study period; Avoidable adverse events during the study period; Quality of life during the study period; Readmission during the study period; Outliers/Boarders during the study period; Referral to treat (RRT) > 18 weeks during the study period.

Study	Einav 2009[40]
Study type	Before and after study.
Number of studies (number of participants)	1 (n=531).
Countries and setting	Conducted in Israel; setting: single medical centre in Jerusalem.
Line of therapy	1st line.
Duration of study	Other: 5 years (2 years before, 3 years after)
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	All casualties from 17 mass casualty incidents (12 before, 5 after) who were treated at the medical centre.
Age, gender and ethnicity	Age: not reported. Gender (M:F): not reported. Ethnicity: not reported.
Further population details	1. Frail: Not applicable/Not stated/Unclear.
Extra comments	Study MCI is defined as sufficient size to activate the Jerusalem District Emergency Medical System. All MCIs also fulfilled Israel Ministry of Health criteria for an MCI: the arrival of over 10 casualties or more than 4 severely injured casualties to the hospital within a brief period of time.
Indirectness of population	No indirectness.
Interventions	(n=152) Intervention 1: Escalation using staff - increasing the proportion of certain staff types. Management of a mass casualty incident after the creation of a case manager. The role of the case manager was to accompany mass casualty patients as they were transferred within a hospital through the diagnostic/treatment pathway. Duration: until a 'definitive' placement had been reached. Concurrent medication/care: usual care.

Study	Einav 2009[40]
	(n=379) Intervention 2: No escalation measure. Duration: not applicable. Concurrent medication/care: usual care.
Funding	Funding not stated
RESULTS (NUMBERS ANALYSED) AND RISK OF BIAS FOR COMPARISON: INCREASING THE PROPORTION OF CERTAIN STAFF TYPES versus NO ESCALATION MEASURE Protocol outcome 1: Mortality during the study period. - Actual outcome: Mortality in-hospital; Group 1: 3/152, Group 2: 7/379; Risk of bias: All domain - Very high, Selection - Very high, Blinding - High, Incomplete outcome data - Low, Outcome reporting - Low, Measurement - Low, Crossover - Low; Indirectness of outcome: No indirectness Protocol outcome 2: Length of stay during the study period. - Actual outcome: Mean length of stay for severely injured patients (no total n numbers reported): Group 1: 12.0 (4.4); Group 2: 37.1 (24.7); Risk of bias: All domain - Very high, Selection - Very high, Blinding - High, Incomplete outcome data - Very high, Outcome reporting - Low, Measurement - High, Crossover - Low, Subgroups - Very high; Indirectness of outcome: No indirectness - Actual outcome: Mean length of stay for less severely injured patients (no total n numbers reported): Group 1: 15.3 (10.7); Group 2: 30.5 (23.1); Risk of bias: All domain - Very high, Selection - Very high, Blinding - High, Incomplete outcome data - Very high, Outcome reporting - Low, Measurement - High, Crossover - Low, Subgroups - Very high; Indirectness of outcome: No indirectness	
Protocol outcomes not reported by the study	Avoidable adverse events during the study period; Quality of life during the study period; Readmission during the study period; A&E 4 hour waiting target met during the study period; Outliers/Boarders during the study period; Referral to treat (RRT) > 18 weeks during the study period.

Study	Jen 2009[69]
Study type	Prospective cohort study.
Number of studies (number of participants)	1 (n=882).
Countries and setting	Conducted in USA; setting: tertiary academic hospital with a level I trauma centre.
Line of therapy	Not applicable.
Duration of study	Intervention time: 14 days.
Method of assessment of guideline condition	Adequate method of assessment/diagnosis.
Stratum	Overall.
Subgroup analysis within study	Not applicable
Inclusion criteria	Not reported.

Study	Jen 2009[69]
Exclusion criteria	Not reported.
Recruitment/selection of patients	All in-patients.
Age, gender and ethnicity	Age: not reported. Gender (M:F): not reported. Ethnicity: not reported.
Further population details	1. Frail: Not applicable/Not stated/Unclear.
Indirectness of population	No indirectness.
Interventions	(n=345) Intervention 1: Escalation in structure - increase in beds. Creation of 'surge' capacity before the hospital in-patients were moved to a new facility. Three interventions included, which lasted for a week pre-move. Elective operations were drawn down, number of inpatient transfers accepted from outside institutions was reduced, and a multi-disciplinary discharge planning team conducted daily rounds to identify the eligibility of inpatients for expedited discharge from the hospital and ICU. Duration: 1 week. Concurrent medication/care: preparation for move (no details on change of care given). (n=537) Intervention 2: No escalation measure. Management of patients at baseline (1 week period before the transition period began). Duration: 1 week. Concurrent medication/care: usual care.
Funding	No funding.
RESULTS (NUMBERS ANALYSED) AND RISK OF BIAS FOR COMPARISON: INCREASE IN BEDS versus NO ESCALATION MEASURE. Protocol outcome 1: Mortality during the study period. - Actual outcome: Mortality in-hospital: Group 1: 10/345, Group 2: 16/537; Risk of bias: All domain – very high, Selection - Very high, Blinding - High, Incomplete outcome data - Low, Outcome reporting - Low, Measurement - Low, Crossover - Low; Indirectness of outcome: no indirectness Protocol outcome 2: Length of stay during the study period. - Actual outcome: length of stay in-hospital: Group 1: 7 (14), Group 2: 6 (10); Risk of bias: All domain – very high, Selection - Very high, Blinding - High, Incomplete outcome data - Low, Outcome reporting - Low, Measurement - Low, Crossover - Low; Indirectness of outcome: no indirectness	
Protocol outcomes not reported by the study	Staff satisfaction during the study period; Avoidable adverse events during the study period; Quality of life during the study period; Readmission during the study period; A&E 4 hour waiting target met during the study period; Outliers/Boarders during the study period; Referral to treat (RRT) > 18 weeks during the study period.

Study	Khanna 2014[77]
Study type	Retrospective cohort study.

Study	Khanna 2014[77]
Number of studies (number of participants)	1 (n= not reported).
Countries and setting	Conducted in Australia; setting: large metropolitan public hospital.
Line of therapy	Not applicable.
Duration of study	Intervention time: 24 months.
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	Patient record data from in-patient and ED database aggregated into hourly intervals.
Age, gender and ethnicity	Age - Other: not reported. Gender (M:F): not reported. Ethnicity: not reported.
Further population details	1. Frail: Not applicable/Not stated/Unclear.
Indirectness of population	No indirectness.
Interventions	(n= not reported). Intervention 1: Escalation using processes - early discharge. Highest alert level from a 4-tiered capacity alert system (Alert-4). Response to alert: all functional service units and services are asked to respond in order to streamline patient admission and discharge planning. Hospital staff are alerted of the status of occupancy via pager messages, text messages to listed mobile phones and occasionally through the hospital public address system. Examples of typical responses include the cancellation of elective surgery, prioritising discharges and related pharmacy and/or radiology requests and notifying ambulance services to prioritise transfer patients. Duration: of capacity alert not reported. Concurrent medication/care: usual care. (n= not reported). Intervention 2: Escalation using processes - early discharge. Matched control days where an Alert-4 was not implemented. Duration: full day (duration not reported). Concurrent medication/care: usual care. Comments: control day was matched by bed occupancy.
Funding	Funding not stated
RESULTS (NUMBERS ANALYSED) AND RISK OF BIAS FOR COMPARISON: EARLY DISCHARGE versus NO ESCALATION MEASURE. Protocol outcome 1: Bed occupancy during the study period. - Actual outcome: Mean hospital bed occupancy percentage on day 0 post capacity alert: Group 104.9 (103.9 – 105.9); Group 2: 104.7 (104.5 – 104.9); Risk of bias: All domain – very high, Selection - Very high, Blinding - low, Incomplete outcome data - Low, Outcome reporting - Low, Measurement - Low, Crossover - Low; Indirectness	

Study	Khanna 2014[77]
of outcome: no indirectness- Actual outcome: Mean hospital bed occupancy percentage on day 1 post capacity alert: Group 103.9 (102.6 – 105.1); Group 2: 104.5 (103.7 – 105.2); Risk of bias: All domain – very high, Selection - Very high, Blinding - low, Incomplete outcome data - Low, Outcome reporting - Low, Measurement - Low, Crossover - Low; Indirectness of outcome: no indirectness- Actual outcome: Mean hospital bed occupancy percentage on day 2 post capacity alert: Group 102.9 (101.6 – 104.2); Group 2: 103.4 (102.3 – 104.5); Risk of bias: All domain – very high, Selection - Very high, Blinding - low, Incomplete outcome data - Low, Outcome reporting - Low, Measurement - Low, Crossover - Low; Indirectness of outcome: no indirectness	
Protocol outcomes not reported by the study	Mortality during the study period; Staff satisfaction during the study period; Length of stay during the study period; Avoidable adverse events during the study period; Quality of life during the study period; Readmission during the study period; A&E 4 hour waiting target met during the study period; Outliers/Boarders during the study period; Referral to treat (RRT) > 18 weeks during the study period.

Study	Kollek 2010[80]
Study type	Before and after study (interrupted time-series).
Number of studies (number of participants)	1 (n= not reported).
Countries and setting	Conducted in Canada; setting: emergency department in a community hospital.
Line of therapy	1st line.
Duration of study	Other: 1 week pre-intervention; 2 week intervention; 1 week post-intervention.
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	All visits.
Age, gender and ethnicity	Age: not reported. Gender (M:F): not reported. Ethnicity: not reported.
Further population details	1. Frail: Not applicable/Not stated/Unclear
Indirectness of population	No indirectness.
Interventions	(n= not reported). Intervention 1: Escalation in structure - use of alternative locations. Creation of an ambulatory influenza clinic in the fast track area of the ED staffed by family physicians. Patients previously seen in the fast-track were seen in the main area of the ED. Patients assessed using a modified triage system (no details given). Duration: 2 weeks. Concurrent medication/care: usual care.

Study	Kollek 2010[80]
	(n= not reported). Intervention 2: No escalation measure. Management of patients before the clinic opened. Duration: 1 week. Concurrent medication/care: usual care. (n= not reported). Intervention 3: No escalation measure. Management of patients after the clinic closed. Duration: 1 week. Concurrent medication/care: usual care.
Funding	Funding not stated.
RESULTS (NUMBERS ANALYSED) AND RISK OF BIAS FOR COMPARISON: USE OF ALTERNATIVE LOCATIONS versus NO ESCALATION MEASURE. Protocol outcome 1: Length of stay during the study period. - Actual outcome: Mean length of stay within the ED: Group 1: 6; Group 2: 6 (no SDs reported); Risk of bias: All domain – very high, Selection - Very high, Blinding - low, Incomplete outcome data - Low, Outcome reporting - Low, Measurement - Low, Crossover - Low; Indirectness of outcome: no indirectness- Actual outcome: Mean admitted length of stay in-hospital: Group 1: 34; Group 2: 25 (no SDs reported); Risk of bias: All domain – very high, Selection - Very high, Blinding - low, Incomplete outcome data - Low, Outcome reporting - Low, Measurement - Low, Crossover - Low; Indirectness of outcome: no indirectness - Actual outcome: Mean length of stay within the ED: Group 1: 6; Group 3: 8 (no SDs reported); Risk of bias: All domain – very high, Selection - Very high, Blinding - low, Incomplete outcome data - Low, Outcome reporting - Low, Measurement - Low, Crossover - Low; Indirectness of outcome: no indirectness - Actual outcome: Mean admitted length of stay in-hospital: Group 1: 34; Group 3: 39 (no SDs reported); Risk of bias: All domain – very high, Selection - Very high, Blinding - low, Incomplete outcome data - Low, Outcome reporting - Low, Measurement - Low, Crossover - Low; Indirectness of outcome: no indirectnessindirectness.	
Protocol outcomes not reported by the study	Mortality during the study period; Staff satisfaction during the study period; Avoidable adverse events during the study period; Quality of life during the study period; Readmission during the study period; A&E 4 hour waiting target met during the study period; Outliers/Boarders during the study period; Referral to treat (RRT) > 18 weeks during the study period.

Appendix E: Economic evidence tables

Study	Rowan 2010[117]			
Study details	**Population & interventions**	**Costs**	**Health outcomes**	**Cost effectiveness**
Economic analysis: n/a **Study design:** Analysis of audit data with assumptions applied regarding the effect of triage on mortality, avoidable admissions and bed days saved. **Approach to analysis:** Modelling the effect of triage based on a severity score with assumptions applied as to the change in outcome of different classes (see population) of patients if diverted away from CCU after triage. **Perspective:** UK NHS **Time horizon:** Death or discharge **Treatment effect duration:** n/a **Discounting:** n/a	**Population:** Patients admitted to general critical care units in England, Wales and Northern Ireland. Classified as either 'potentially avoidable admissions', 'critical care required' or 'death'. **Cohort settings:** N: 74,510 Mean age: 58.8 years Male: 55.4% **Intervention[(a)]:** 1. Triage low severity patients to temporary critical care area. 2. Triage high severity patients to no critical care. 3. No triage (based on audit data)	n/a	**Percentage of admissions diverted:** Intervention 1 56.5% Intervention 2 14.4% **Potential CCU admission avoided in patients diverted:** Intervention 1 42.1% Intervention 2 14.4% **Potentially avoidable deaths in diverted patients:** Intervention 1 Not assessed. Intervention 2 30.0% **Percentage of CCU bed days saved:** Intervention 1 11.1% Intervention 2 15.4%	n/a
Data sources				
Health outcomes: Mortality taken from audit data from national CMP database. **Quality-of-life weights:** n/a **Cost sources:** n/a				
Comments				
Source of funding: NIHR HTA programme. **Applicability and limitations:** The effect on mortality of delayed transfer in those diverted to temporary critical care but who were classified as 'requiring critical care' could not be assessed. Avoidable deaths could only be assumed for those who survived in critical care but were diverted away from critical care after triage. The population assessed were patients in critical care units across 148 hospitals between 1st January 2007 and 31st March 2009 and does not necessarily represent a surge population. It does indicate the potential for decreasing bed occupancy but does not take into account the effect on mortality for the extended population.				

Abbreviations: CCU: critical care unit; n/a: not applicable; NR: not reported.

(a) Severity score (0-12) based on systolic blood pressure, temperature, heart rate, respiratory rate, neurological status and FiO_2. A score (between 0 and 3) is applied to various levels (between 2 and 4 levels for each variable) and the sum of the scores is calculated to give the severity score. Low severity is defined as a score from 0-3; High severity defined as 6-12.

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

Appendix F: GRADE tables

Table 7: Clinical evidence profile: Presence of a case manager versus usual care

Quality assessment							No of patients		Effect		Quality	Importance
No of studies	Design	Risk of bias	Inconsistency	Indirectness	Imprecision	Other considerations	Presence of a case manager versus usual care	Control	Relative (95% CI)	Absolute		
Mortality (follow-up in-hospital)												
1	observational studies	very serious[1]	no serious inconsistency	no serious indirectness	very serious[2]	none	3/152 (2%)	1.9%	RR 1.07 (0.28 to 4.08)	1 more per 1000 (from 14 fewer to 59 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 8: Clinical evidence profile: Creation of surge capacity versus usual care

Quality assessment							No of patients		Effect		Quality	Importance
No of studies	Design	Risk of bias	Inconsistency	Indirectness	Imprecision	Other considerations	Creation of surge capacity versus usual care	Control	Relative (95% CI)	Absolute		
Mortality (follow-up in-hospital)												
1	observational studies	very serious[1]	no serious inconsistency	no serious indirectness	very serious[2]	none	10/345 (2.9%)	3%	RR 0.97 (0.45 to 2.12)	1 fewer per 1000 (from 16 fewer to 34 more)	⊕OOO VERY LOW	CRITICAL
Length of stay (follow-up in-hospital; Better indicated by lower values)												

1	observational studies	very serious[1]	no serious inconsistency	no serious indirectness	no serious imprecision	none	345	537	-	MD 1 higher (0.7 lower to 2.7 higher)	⊕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.

Appendix G: Excluded clinical studies

Table 9: Studies excluded from the clinical review

Study	Exclusion reason
Anon2015J[1]	News article
Achour 2015[2]	Editorial
Ashcraft 2001[3]	Study design (descriptive)
Asplin 2006[4]	Modelling paper containing no relevant clinical data. Methodological study
Association of women's health 2012[5]	Study design (descriptive)
Atack 2012[6]	Incorrect interventions. Staff training outcomes
Aylwin 2006[7]	Study design (cross-sectional)
Bachman 2014[8]	Unable to locate a copy
Back 2010[9]	Focus on evacuation. Systematic review: literature search not sufficiently rigorous
Baker 2009[10]	Study design (descriptive)
Bar-el 2013[11]	Study design (descriptive)
Barishansky 2009[12]	Study design (descriptive)
Belmont 2004[13]	Study design (descriptive)
Bissell 2004[14]	Incorrect interventions. No escalation measures - only comparison of mortality from several disasters
Bland 2007[15]	Incorrect interventions. Training document
Brady 2006[16]	News article
Branson 2008[17]	Literature review
Brazle 2001[18]	Study design (descriptive)
Brice 2007[19]	Study design (descriptive)
Buono 2007[20]	Pre-hospital triage with no hospital outcomes
Burrington-brown 2002[21]	Study design (descriptive)
Challen 2006[22]	Incorrect interventions. Theoretical escalation measure
Charney 2012[23]	Not review population. Paediatrics
Chase 2012[24]	Modelling paper containing no relevant clinical data. Forecasting surge events
Chenoweth 2006[25]	News article
Cheung 2012[26]	Modelling paper containing no relevant clinical data. Comparison of 2 influenza specific triage tools
Cheung 2012[27]	Modelling paper containing no relevant clinical data. Comparison of 2 influenza specific triage tools
Christian 2012[28]	Study design (case study)
Collins2016[29]	Incorrect population - surgical
Cryer 2010[30]	Incorrect interventions. Mass casualty Incident - all interventions and outcomes were pre-hospital
Culley 2014[31]	Systematic review: no papers of interest
Curcio 2010[32]	No escalation measure
Davis 2005[33]	Cross-sectional

Study	Exclusion reason
Dayton 2008[34]	Study design (cross-sectional)
Disaster response 2007[35]	Study design (descriptive)
Downey 2010[36]	No protocol outcomes reported
Doyle 2006[37]	Modelling paper containing no relevant clinical data. Vaccination strategies
Ecri institute 2008[39]	Library service unable to obtain a copy
Epley 2006[41]	Evacuation co-ordination
Erich 2007[42]	News article
Fagbuyi 2011[43]	Not review population. Paediatric hospital (treats some adults but not stated how many, unlikely to be 75%)
Farrar 2010[44]	Study design (descriptive)
Fawcett 2000[45]	Modelling paper containing no relevant clinical data. Methodological study
Fineberg 2014[46]	Study design (descriptive)
Franc 2015[47]	Modelling paper containing no relevant clinical data. Methodological study
Gabler 2013[48]	No escalation measure
Gebbie 2007[49]	Study design (descriptive)
Glick 2007[50]	Study design (descriptive)
Goddard 2006[51]	Study design (descriptive)
Gold 2005[52]	Study design (descriptive). Incorrect interventions. Evacuation following disaster
Golob 2005[53]	Study design (descriptive)
Goodacre 2013[55]	Non-comparative pilot study
Goodacre 2015[54]	Protocol and non-comparative pilot study
Gray 2007[56]	Study design (descriptive)
Hall 2013[57]	Study design (case study)
Hammad 2012[58]	Literature review
Hammond 2005[59]	Study design (descriptive)
Hampton 2007[60]	News article
Hanley 2008[61]	Incorrect interventions. Staff training outcomes
Hick 2004[62]	Literature review
Hirshberg 2005[64]	Modelling paper containing no relevant clinical data. Incorrect population: assessing trauma workload
Hirshberg 2010[63]	Modelling paper containing no relevant clinical data. Incorrect population: assessing trauma workload
Hoard 2005[65]	Modelling paper containing no relevant clinical data. Methodological study
Hsu 2004[66]	Systematic review: no papers of interest
Hsu 2004[67]	Systematic review: no papers of interest
Hupert 2007[68]	Modelling paper containing no relevant clinical data. Incorrect population: exclusively trauma care
Jenkins 2008[70]	Literature review
Jha 2016[71]	Brief report; no protocol outcomes reported
Kako 2012[72]	Systematic review: no papers of interest

Study	Exclusion reason
Kallman 2011[73]	Study design (descriptive)
Kanno 2006[74]	Modelling paper containing no relevant clinical data. No escalation measure
Kanter 2015[75]	Modelling paper containing no relevant clinical data. Assessing the effect of triage predictor performance on mortality.
Kelen 2009[76]	Modelling paper containing no relevant clinical data. No relevant outcome
Kleber 2013[78]	Staff training outcomes
Koh 2006[79]	Literature review
Kwok 2015[81]	No outcomes of interest
Lam 2006[82]	Literature review
Lee 2000[83]	No protocol outcomes
Lindsey 2005[84]	Study design (descriptive)
Lynch 2009[85]	Study design (descriptive)
Maloney 2007[86]	Not review population. Paediatric
Mathias 2009[87]	News article
Matteson 2006[88]	Incorrect interventions. Vaccination clinic
Maunder 2010[89]	Staff training outcomes
Mechem 2007[90]	Library services unable to obtain a copy
Menon 2005[91]	Non-comparative study
Michaels 2013[92]	Case series
Morton 2015a[93]	Systematic review: No eligible papers
Moseley 2010[94]	Modelling paper containing no relevant clinical data. No relevant outcomes
Myles 2012[95]	Study design (diagnostic accuracy)
Nager 2009[96]	Modelling paper containing no relevant clinical data. No relevant outcomes
Nap 2007[98]	Statistical model - antiviral intervention
Nap 2008[97]	Modelling paper containing no relevant clinical data. No relevant outcomes
Nishizawa 2016[99]	Incorrect intervention
O'connor 2004[100]	Study design (descriptive)
O'connor 2006[101]	Study design (news article)
O'keefe 2004[102]	Study design (descriptive)
Olafson 2015[103]	Non-comparative study
Patrick 2008[104]	Incorrect intervention (scheduling of appointments)
Paul 2006[105]	Incorrect population (surgical)
Peleg 2009[106]	Study design (descriptive)
Perrin 2006[107]	Study design (descriptive)
Perry 2006[108]	Study design (descriptive)
Pershad 2012[109]	Not review population. Paediatric
Peters 2013[110]	Incorrect interventions. No escalation measure
Posner 2003[111]	No escalation measure
Powell 2012[112]	Study design (descriptive)
Powers 2007[113]	Library service unable to locate a copy

Study	Exclusion reason
Roccaforte 2007[114]	Literature review
Romano 2005[115]	Study design (escalation)
Roth 2009[116]	Study design (descriptive)
Rozovsky 2002[118]	Study design (descriptive)
Rubin 2010[119]	Literature review
Rutter 2014[120]	Not review population. Measures surge at primary care facilities
Sanchez 2007[121]	Study design (descriptive)
Sanchez 2007[122]	Study design (descriptive)
Satterthwaite 2012[123]	No extractable data
Savoia 2009[125]	Systematic review: no papers of interest
Savoia 2013[124]	Systematic review: no papers of interest
Scarfone 2011[126]	Not review population. Paediatric
Schull 2006[127]	Study design (case study)
Scott 2011[128]	No escalation measure
Shahpori 2011[129]	Modelling paper containing no relevant clinical data. Incorrect comparison: influenza triage tool in regional population and influenza population
Sheeley 2007[130]	Conference abstract
Shih 2012[131]	Non-comparative study
Sloan 2011[132]	Study design (descriptive)
Smith 2010[133]	Study design (descriptive)
Smith 2014[134]	Study design (descriptive)
Sobieraj 2007[135]	Modelling paper containing no relevant clinical data. Incorrect population: does not account for non-influenza patients competing for resources
Soremekun 2011[136]	Modelling paper containing no relevant clinical data. No relevant outcomes
Spaulding 2012[137]	Non-comparative study
Stein 2008[138]	Incorrect interventions. Training document
Stein 2012[139]	Modelling paper containing no relevant clinical data. Methodological study
Steinhauer 2002[140]	Study design (descriptive)
Stukel 2008[141]	No escalation measure
Tawfik 2014[142]	No escalation measure
Taylor 2003[144]	Study design (descriptive)
Taylor 2006[143]	Case series
Tham 2004[145]	Study design (cross-sectional)
Timbie 2012[146]	Systematic review: all relevant papers ordered for assessment
Timbie 2012[146]	Systematic review: no papers of interest
Tsai 2004[147]	Study design (cross-sectional)
Upshur 2005[148]	Study design (descriptive)
Utley 2011[149]	Modelling paper containing no relevant clinical data. Model inputs no clearly defined
Van genugten 2003[150]	Statistical model - antiviral and vaccination intervention
Verni 2012[151]	Study design (descriptive)

Study	Exclusion reason
Vidondo 2009[152]	Modelling paper containing no relevant clinical data. Incorrect intervention: Influenza specific
Voelker 2006[153]	News article
Watson 2013[154]	Systematic review: methods are not adequate/unclear
Wilgis 2008[155]	Study design (descriptive)
Williams 2008[157]	Systematic review: no papers of interest
Williams 2015[156]	Modelling paper containing no relevant clinical data. Non-comparative study
Wingate 2007[158]	Study design (descriptive)
Wu 2013[159]	Systematic review: no papers of interest
Wyatt 2003[160]	Study design (descriptive)
Wynn 2012[161]	Study design (descriptive)
Zane 2004[162]	Study design (descriptive)
Zhou 2011[163]	Modelling paper containing no relevant clinical data. No escalation measure

Appendix H: Excluded health economic studies

No relevant studies identified.