The effectiveness and variation of acute medical units: a systematic review.

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2016

TITLE PAGE

Manuscript title:

The effectiveness and variation of acute medical units: a systematic review.

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Running title:

AMUs: a systematic review

Word count for the abstract:

250

Word count for the text of the manuscript:

3973

ABSTRACT: The effectiveness and variation of acute medical units: a systematic review.

Purpose

To evaluate the evidence for the effectiveness of acute medical units (AMUs) compared with other models of care and compare the components of AMU models.

Data sources

Six electronic databases and grey literature sources searched between 1990 and 2014.

Study selection

Studies reporting on AMUs as an intervention for unplanned medical presentations to hospital with the inclusion of all outcome measures/study designs/comparators.

Data extraction

Data on study characteristics/outcomes/AMU components were extracted by one author and confirmed by a second.

Data synthesis

Seventeen studies of 12 AMUs across five countries were included. The AMU model was associated with a reduction in hospital length of stay (LOS) in all analyses ranging from 0.3 to 2.6 days; and a reduction in mortality in 12 of 14 analyses with the change ranging from a 0.1% increase to a 8.8% reduction. Evidence relating to readmissions and patient/staff satisfaction was less conclusive. There was variation in the following components of AMUs: admission criteria, entry sources, functions and consultant work patterns.

Conclusion

This review provides evidence that AMUs are associated with reductions in hospital LOS and, less convincingly, mortality compared with other models of care when implemented in European and Australasian settings. Reported estimates may be affected by residual confounding. This review

reports heterogeneity in components of the AMU model. Further work to identify what constitutes the key components of an AMU is needed to improve the quality and effectiveness of acute medical care. This is of particular importance given the escalating demand on acute services.

MAIN BODY OF TEXT: The effectiveness and variation of acute medical units: a systematic review.

Introduction

The processes by which adult patients presenting to hospital with medical emergencies are cared for in the United Kingdom (UK) have changed recently. Instead of being admitted to multiple medical wards across the hospital, the majority of these patients are initially cared for in acute medical units when they present to hospital (AMUs) (1, 2). These units were defined in a seminal paper by the Royal College of Physicians (RCP) as "a dedicated facility within a hospital that acts as the focus for acute medical care for patients who have presented as medical emergencies to hospital"(3). AMUs are an integral component of the care journey for the majority of emergency medical patients and operate as the interface between primary services (the emergency department (ED) and general practice (GP)) and the downstream medical specialty wards. These units are increasingly being adopted elsewhere, including Ireland (4), Australasia (5, 6) and other parts of Europe (7-9).

AMUs first emerged in the 1990s largely as a result of local service innovations and there is limited evidence in relation to the effectiveness of this model of care. In 2009 Scott et al undertook a review of AMUs in comparison to the admission of medical patients to multiple wards and found just nine observational studies of seven AMUs in the UK and Ireland (10). There have been a number of documents published which offer recommendations for the delivery of care in AMUs (3, 11, 12). Despite this, surveys of care delivery within AMUs have consistently reported heterogeneity with regard to AMU organisation, services and staffing (13-17). Although AMUs can be described as complex interventions and a degree of heterogeneity in the AMU model is to be expected, this variation has not been acknowledged or described in the evidence base to date.

Given these uncertainties, and in the current context of escalating demands on acute services, this systematic review firstly aims to assess the effectiveness of AMUs in comparison to other models of care for patients with medical emergencies. The second aim of this review is to examine the similarities and variation in components of published AMU models and consider implications for the evidence base.

Methods

Search strategy and information sources

Search terms

For the initial approach a scoping search was undertaken to identify how studies reporting on the care delivered in AMUs were described. Known relevant articles were reviewed, citation traced and bibliography/reference lists screened. This showed that studies reporting on AMU care were inconsistently described using controlled vocabulary terms and searches utilising this method yielded a large number of irrelevant results. The same articles were scrutinised for terms used to describe AMUs. These terms were utilised as free text searches to build the search strategy.

Limits

The search was limited to articles published from 1990 onwards given the chronology of the development of acute medicine. The search was limited to English language articles given lack of translational resources. Those relating to paediatric medicine and non-research based articles were excluded in the search strategy. Data were limited to those in the published article and authors were not contacted to seek further information.

Databases

Six databases were searched: MEDLINE, Cumulative Index to Nursing and Allied Health Literature (CINAHL), Health Management Information Consortium, Web of Science including conference proceedings, Proquest for dissertations and theses and the Cochrane Controlled Trials Register.

Identification of studies from other sources

Google scholar, Google with a 'gov.uk' limit and OpenGrey were searched using the same free text terms and date limits as described above. The first 200 entries from Google scholar and the first 100 with Google with a gov.uk limit were included in the total for screening. An additional 84 articles were identified from hand searching.

Screening

Duplicate and title screening were undertaken by the lead author and abstract screening was undertaken by the lead author and a second independent reviewer.

Eligibility criteria

Inclusion and exclusion criteria were based on the PICOS framework (population, intervention, comparator, outcome and study design) (18), with the population of the review being unscheduled acute medical patients, the intervention being the AMU model and with no restrictions placed on the comparators/controls (other than a comparator group being present), outcomes or study designs.

Quality assessment

The Strengthening the Reporting of Observational studies in Epidemiology Initiative recommendations (STROBE) (19) were used in conjunction with the Preferred Reporting of Items for Systematic Reviews and Meta-Analyses (PRISMA) (18) guidance to construct a template for assessing study quality (Supplementary Table 1). The minimum standard for inclusion was a score which equated to at least partial reporting on each of the components.

Study selection and data extraction

Full text screening and quality assessment were undertaken by two authors. Data extraction into pre-prepared tables was undertaken by one author and checked by a second. Conflicts were resolved through discussion. The data items sought from each study are summarised in Tables 1-4 and Supplementary Table 2).

Results

A PRISMA diagram detailing the identification, screening and eligibility assessment shown in Figure 1. The search conducted on the 13th October 2014 identified a total of 2,965 studies. Following duplicate, title and abstract screening there were 33 studies identified for full text screening, of which 17 were included in the review. Reasons for exclusion are shown in Figure 1. All studies eligible for inclusion were deemed of sufficient methodological quality. The quality assessment scores are detailed in Supplementary Table 2.

Summary of included studies

Study characteristics are summarised in Table 1 and Supplementary Table 2. The studies spanned a period from 1993 to 2012. Sixteen of these evaluated AMUs in single-centre studies. One study evaluated patient satisfaction of acute medical care across National Health Service (NHS) England. Five studies related to the same single AMU in an Irish hospital (20-24) and as such the total number of AMUs was 12.

The unit of analysis in six studies was episodes of care, in four was patients and five studies analysed both episodes and patients. The unit of analysis was not stated in two studies. A total of 139,205 patients and 930,747 episodes were studied. Five studies were undertaken in the UK, six in Ireland, four in Australia and one each in Denmark and The Netherlands.

Study design

All included studies adopted an observational non-longitudinal approach comparing the outcomes of a group of patients cared for in an AMU model to a group of patients cared for in a non-AMU model. The non-AMU model involved the admission of patients to multiple medical wards in all but one of the studies offering detail on this. Watt et al compared the assessment of medical patients in the AMU with that in the emergency department (ED) (4).

In 13 studies the AMU group was compared to a historical non-AMU group who had accessed care prior to the establishment of the AMU. Two studies compared the AMU group to a non-AMU group receiving care within a concurrent time period (4, 25). Two studies compared both historical and concurrent groups (26, 27).

Five studies adjusted for potential confounding between the groups by using more complex statistical methods. Li et al undertook propensity score matching (28); Moore et al presented monthly time series analysis with adjustment for other factors such as overall downward secular trend and seasonal variation from the establishment of the AMU in 1999 to the end of the study period in 2003 (29); Sullivan et al adjusted their analysis of patient satisfaction for age and gender (25); Suthers et al used multiple linear regression (27) and Rooney et al used logistic regression (24) to adjust for potential confounders.

Study populations

The study populations were determined by the AMU admission criteria and the pathways of entry to the AMU (e.g. ED or community) (Table 1). Admission criteria variously excluded cardiology patients (patients with acute coronary syndrome, acute chest pain of probable cardiac origin or admitted to coronary care units), geriatric medicine patients, patients admitted with acute stroke, and those requiring critical care. One study included both medical and surgical admissions (8). One AMU admitted only general medical patients who had been assessed as not being suitable for subspecialty care (30).

With regard to the patient pathway into the AMU, patients received an initial assessment in the ED before admission to six AMUs. In two AMUs, patients were accepted from both the ED and directly from the community. One AMU primarily assessed patients directly from the community as an alternative to the ED for a defined range of presentations. Entry sources were not reported in three studies. Regarding the three studies that accepted admissions from the community, one was in

Denmark, one in Ireland and one in the UK. As such international differences in pre-hospital care may also result in variation in these populations.

Evidence of AMU effectiveness

In keeping with accepted recommendations (31), given the heterogeneity of the identified studies with regard to settings and outcome measures a descriptive review was undertaken rather than a formal meta-analysis. The outcomes of the studies are presented in three tables: Table 2 contains hospital length of stay (LOS), mortality and readmission outcomes; Table 3 contains patient and staff satisfaction outcomes; and Table 4 contains all other reported outcomes (these mainly relate to ED performance and patient discharge disposition).

Hospital length of stay

Hospital LOS was examined in 18 analyses across 12 studies totalling 315,000 patients/episodes and was the most commonly reported outcome (Table 2). All reported a reduction in LOS in the AMU group when compared to the non-AMU group. For those which reported mean LOS for the two groups, the magnitude of reduction ranged from 0.3 to 2.62 days. Of the 16 analyses that undertook hypothesis testing, 12 found a statistically significant difference.

Three studies attempted to adjust for confounding. In the study which undertook propensity score matching, the mean reduction was 0.8 days in the matched analysis versus 0.11 days in the unmatched and both results reached significance (30). The study which adjusted for secular trends found LOS was 0.73 less in the AMU group when compared to the non-AMU group (95% confidence interval (CI) -1.5, 0.04; p 0.067) (29). In the study which undertook multiple linear regression, patients being cared for entirely in the AMU were found to have a mean LOS 5.7 days less than patients being cared for entirely on the ward ($p < 0.001$) (27). This was not the case when the ward group was compared with patients being first treated in the AMU and then transferred to the ward, with the latter group having a mean LOS just under a day longer than the ward group ($p = 0.04$).

Mortality rates

Mortality was the outcome of interest in 14 analyses across eight studies totalling 890,000 patients/episodes measured at varying time points (in-hospital, 30 day post admission, 30 day post discharge, one year (Table 2). A reduced mortality rate was found in the AMU group in comparison to the non-AMU group in 12 of the 14 analyses. Five of these 12 analyses reported this decrease as being statistically significant and the remaining reported it as non-significant. Three of the 12 studies that found a decrease attempted to adjust for confounding: there was a non-significant reduction in in-hospital mortality in the AMU cohort compared with non-AMU cohort in the study using propensity score matching (unmatched analysis 3.7% vs. 4.6%; matched analysis 4.2% vs. 4.6%) (30); the study which adjusted for secular trends found no significant difference in mortality following the introduction of the AMU (rate change -0.53, 95% CI -1.72, 0.66; p 0.39) (29); lastly, the study using logistic regression to adjust for confounders including comorbidities, illness severity score and disease category reported a significant reduction in in-hospital mortality in the AMU group compared to the non-AMU group (adjusted odds ratio 0.28, 95% CI 0.23, 0.35) (24).

In the two analyses which found the AMU to be associated with an increase in mortality, both of which related to a single centre Danish study, there were non-significant small increases in 30 day (3.16% to 3.22%) and in-hospital (5.75% to 5.88%) mortality (7). This study did not adjust for confounding.

In summary, the magnitude of the absolute change in mortality between the AMU and non-AMU ranged from +0.1% to -8.8%.

Hospital readmission

Eight studies evaluated the change in the proportion of patients readmitted to hospital in 10 analyses of 168,000 patients/episodes measured at varying time points (7 day, 28 day, 30 day). All three seven day analyses reported a non-significant reduction in the proportion of patients readmitted in the AMU group compared to the non-AMU group (range 0.1% to 0.7%) (29, 30, 32). Three of the six analyses of the proportion of patients readmitted within 28 or 30 days found a decrease in the AMU group compared to the non-AMU group (7, 29, 30) (range 0.7% to 5.2%) with one reaching significance. One study took measures to control for confounding. Using a time series analysis to compare summary changes between non-AMU and AMU groups, the authors found no significant difference in 7 day readmission (summary change -0.02 , 95% CI -0.07, 0.03; p=0.365) or 28 day readmission (-0.04, 95% CI -0.15, 0.07; p=0.49) (29).

Patient/staff satisfaction

Four studies reported on patient satisfaction in the context of the AMU model, two of which did not assess an association between the AMU model and satisfaction (Table 3). Three studies reported survey results of staff satisfaction, two of which did not assess an association between the AMU model and satisfaction (Table 3). In summary, these studies found both positive and negative effects of the AMU model on patient and staff satisfaction.

Comparison of components of the AMU models

The detail given regarding the components of the AMU model varied between studies and in most cases was limited (Table 1). Common to all studies was the establishment of a distinct geographical area for the assessment and/or admission of medical patients. In the majority of studies, the AMU had been reconfigured from an existing bed base. Further similarities included the prioritised provision of supporting services and access to the multidisciplinary team, which were described in five and three AMUs respectively. Dedicated AMU staff was a common theme described in seven of the 12 AMUs. There was variation, however, in the constitution and delivery of these teams. This was most notable in consultant work patterns. A 'consultant of the week' model was described in one AMU and a 'consultant of the day' model in three. Once daily ward rounds were described in three AMUs and twice daily ward rounds in two. The AMUs further differed with regard to their policies on length of stay, which was between was 24 and 48 hours in seven AMUs and five days in the Irish AMU. Admission criteria and entry sources to the AMU also varied (Table 1).

Discussion

Summary of findings

This review comprising 17 studies of 12 AMUs across five countries has found that the AMU model is associated with reduced hospital LOS compared to alternative models of care. The evidence that AMUs are associated with a decrease in mortality is weaker. Findings relating to hospital readmission, patient/staff satisfaction and other reported outcomes are less conclusive. Review of the components of the AMUs in the included studies has shown important differences with regard to admission criteria, entry sources, functions and consultant work patterns. These findings are relevant to interpretation of the current evidence.

Strengths and limitations

This review has a number of strengths and limitations. The scoping exercise to explore how AMUs were described in the literature increased the likelihood of identifying relevant publications. Running search strategies in six databases in addition to the grey literature reduced publication bias and increased the likelihood of including all potentially relevant sources. The weaknesses of electronic searching alone were mitigated by undertaking hand searching. A further strength was a broad, inclusive search strategy primarily based on the population and intervention without restriction on outcome and study design. As such, this work provides a comprehensive review of the available evidence. Our review was limited by data extraction being performed by one author and checked by a second; independent extraction by each author would have been preferable. However, data were still objectively analysed and screening and quality assessment were undertaken by two reviewers independently.

All 17 included studies utilised an observational non-longitudinal design. All bar one were single-centred. Only five studies attempted to correct for potential confounders. Outcomes in the other 12 studies, therefore, should be interpreted with caution. Similarly, 16 studies in this review compared the AMU group to a historical group. Such an approach is susceptible to selection bias, given the potential effects of temporal trends and other changes to the context of the intervention between the two periods. Furthermore, given the observational design, it is still possible that observed differences are due to residual confounding even after adjustment for known confounders. It is only possible to definitively establish causality using a randomised design. To our knowledge there have been no such studies of AMUs to date.

A strength of the majority of the studies was their sample size, which may have been sufficient to detect any differences that existed between the groups and to negate chance as the explanation for the association. However, the majority of the studies focused upon hypothesis testing as a means of reporting the effectiveness of AMUs and confidence intervals were infrequently reported (Table 2). There has been much discussion relating to the disadvantages of hypothesis testing in isolation in statistical analysis (33). The lack of reporting of confidence intervals means that an assessment of the precision of the point estimates is not possible, which is important to note when generalising results to the target population.

Taken together, this appraisal of the included studies suggest that the overall quality of the evidence relating to AMUs is limited. There were, however, the more methodologically robust studies that support the trend for a reduction in LOS that was found in all analyses, the majority of which were reported as significant. These higher quality studies also support the finding that AMUs are associated with a reduction in mortality rates, but the fact that less than half of the total number of analyses performed in these sizeable studies reported a statistically significant reduction in mortality rates indicates that the evidence for this outcome is weaker. Our findings are in keeping with those of the previous review based upon AMUs in the UK and Ireland and in addition suggest this is consistent elsewhere in Europe and Australasia.

The evidence surrounding the association of AMUs with a reduction in hospital readmissions is less convincing: it is largely based upon unadjusted data. Only one study reported significance and there is evidence that AMUs might be associated with an increase in readmissions (26, 27). We have found that AMU patient and staff satisfaction has not been adequately studied to date. There is some limited evidence to suggest that the AMU model may improve ED LOS, ED waiting time, time to medical review in the ED, direct discharge and 24/48 hour discharge rate.

Given that no restriction was placed on the included outcomes, this review provides a comprehensive picture of the metrics that have been used to evaluate AMUs to date. The relevance of these outcomes can be considered against national policy to provide patient-centred, safe, effective, efficient, equitable and timely health care (34) and it can be argued that the scope of the outcome measures used to evaluate AMUs to date has been limited.

The variation in AMU components

The heterogeneity of the AMU model should be acknowledged when considering this evidence. This can be conceptualised in the context of the AMU as a complex intervention. Complex interventions are defined as interventions that comprise a number of interacting components (35, 36). The Medical Research Council states that there are two key questions to consider when evaluating complex interventions: i) are they effective in everyday practice, and ii) what are the active ingredients and how are they exerting their effect (35).

This review aimed to address this first question. However, evaluation of the effectiveness of complex interventions through the process of systematic review is challenging, not least because the lack of standardisation of the intervention between studies can limit useful comparisons (37). The inclusion criteria used in this review were based upon the RCP definition of the AMU as a dedicated facility for medical emergencies. Arguably this is a relatively simple definition of a complex intervention. While a degree of flexibility is required, it remains necessary to assess the quality of the intervention and judge how similar a given intervention is to the intervention of interest (36, 38). There is currently little to guide how much flexibility in which components of the AMU model is permissible. Although published recommendations provide a starting point (3, 11, 12), it should be acknowledged that they do not have an empirical evidence base and do not take into account the necessity for contextual adaption of the AMU model that is claimed to be essential for such a complex intervention to work (37). This review highlights important differences in published AMU models. Adoption of so broad a definition and the heterogeneity of described interventions may impact both the strength of the synthesised evidence and the generalisability of this review's findings.

With regard to the second key question in evaluating complex interventions, it is unclear from the current evidence base what the "active ingredients" – or the effective components - of AMUs are, nor how they exert their effect. This is not helped by the lack of detail provided in the AMU models appraised in this review. From this work we can conclude that a key feature of the AMU model that contributes to the generation of the reported benefits is a distinct geographical location and the prioritised provision of multidisciplinary input and diagnostic services are likely to be important. The discussion sections in the majority of the reviewed articles offer views as to the structural, process and contextual factors of AMU care that are responsible for the positive reported effects. However, these were not objectively measured and further granularity as to the effective components of an AMU is not possible from the studies included in this review.

Implications and conclusions

In summary, this review has shown that the evidence relating to the effectiveness of AMUs is limited. This relates to both the quality of the current evidence and its use in directing future developments. There have been just 17 studies of moderate quality since the inception of acute medicine. The majority have been driven by service evaluation rather than an evidence based assessment of a clinical intervention and the scope of the metrics of evaluation thus far has been narrow. Nonetheless we have drawn conclusions in keeping with previous work in the field relating to the beneficial effects of the AMU model with regard to LOS and mortality, although potentially limited by residual confounding, and present the novel finding that these effects are consistent across European and Australasian settings.

The variation in the components of the AMU model demonstrated here may influence interpretation and application of the evidence. The evaluation of complex interventions is challenging. This is especially true in the case of AMUs given both the heterogeneity in the model and that there is minimal evidence to inform on what the effective components are. Further work should attempt to delineate these components. This should involve a review of the literature and primary mixed methods research informed by other studies that have defined organisational components of complex interventions (39-43). This is essential to inform clinical practice, optimise resources and design more effective AMUs to ensure safety and quality within an agreed model of care across different settings. This is of particular importance given the current pressures on acute medical services and the role AMUs play in the admission pathway of the vast majority of acute medical patients.

ACKNOWLEDGEMENTS

The authors would like to thank Mr Aaron Crookshanks, medical student at The University of Edinburgh, for his assistance with the abstract screening; Mrs Sheila Fisken, academic librarian at The University of Edinburgh, for her advice relating to the search strategy; and Ms Estela Dukan, librarian at The Royal College of Physicians of Edinburgh, for her assistance with retrieving and collating articles.

FUNDING

This work was supported by the Royal College of Physicians of Edinburgh and the Health and Social Care Directorates at the Scottish Government. CJW was supported in this work by NHS Lothian via the Edinburgh Health Services Research Unit.

REFERENCES

1. Beckett DJ, Raby E, Pal S, Jamdar R, Selby C. Improvement in time to treatment following establishment of a dedicated medical admissions unit. Emergency Medicine Journal. 2009;26(12):878-80.

2. McNeill GBS, Brahmbhatt DH, Prevost AT, Trepte NJB. What is the effect of a consultant presence in an acute medical unit? Clinical Medicine. 2009;9(3):214-8.

3. Acute Medicine Task Force. Acute Medical care. The right person in the right setting - first time. Royal College of Physicians, 2007.

4. Watts M, Powys L, Hora CO, Kinsella S, Saunders J, Reid L, et al. Acute medical assessment units: an efficient alternative to in-hospital acute medical care. Irish Medical Journal. 2011;104(2):47-9.

5. Providence C, Gommans J, Burns A. Managing acute medical admissions: a survey of acute medical services and medical assessment and planning units in New Zealand. Intern Med J. 2012;42(1):51-6.

6. McNeill GBS, Brand C, Clark K, Jenkins G, Scott I, Thompson C, et al. Optimizing care for acute medical patients: the Australasian Medical Assessment Unit Survey. Internal Medicine Journal. 2011;41(1A):19-26.

7. Vork JC, Brabrand M, Folkestad L, Thomsen KK, Knudsen T, Christiansen C. A medical admission unit reduces duration of hospital stay and number of readmissions. Danish Medical Bulletin. 2011;58(8):A4298.

8. Diepeveen BA, Jansen-Vullers M, Dellaert N. Performance analysis and improvement at the Acute Admissions Unit of Máxima Medical Centre: Technische Universiteit Eindhoven; 2009.

9. Realdi G, Giannini S, Fioretto P, Fabris F, Vettore G, Tosato F. Diagnostic pathways of the complex patients: rapid intensive observation in an Acute Medical Unit. Internal & Emergency Medicine. 2011;6 Suppl 1:85-92.

10. Scott I, Vaughan L, Bell D. Effectiveness of acute medical units in hospitals: a systematic review. International Journal for Quality in Health Care. 2009;21(6):397-407.

11. West Midlands Urgent Care Pathway Group. Quality Standards for Acute Medical Units. West Midlands Quality Review Service and the Society for Acute Medicine, 2012.

12. National Institute for Health and Clinical Excellence. NICE Clinical guideline 50 - Acutely ill patients in hospital. Recognition of and response to acute illness in adults in hospital. 2007.

13. Ward D. Acute medical care. The right person, in the right setting first time: how does practice match the report recommendations? Clinical Medicine. 2009;9(6).

14. Jayawarna C, Atkinson D, Ahmed SV, Leong K. Acute medicine units: the current state of affairs in the North-West of England. Journal of the Royal College of Physicians of Edinburgh. 2010;40(3):201-4.

15. Ilyas M, Zahid M, Roseveare C. Acute medical care. Clinical Medicine. 2010;10(3):304-.

16. Le Jeune I, Masterton-Smith C, Subbe CP, Ward D. "State of the Nation"--the Society for Acute Medicine's Benchmarking Audit 2013 (SAMBA '13). Acute Medicine. 2013;12(4):214-9.

17. Wood I. Medical assessment units in the West Midlands region: a nursing perspective. Accident & Emergency Nursing. 2000;8(4):196-200.

18. Liberati A, Altman DG, Tetzlaff J, Mulrow C, Gøtzsche PC, Ioannidis JP, et al. The PRISMA statement for reporting systematic reviews and meta-analyses of studies that evaluate healthcare interventions: explanation and elaboration. BMJ. 2009;339:b2700.

19. von Elm E, Altman DG, Egger M, Pocock SJ, Gøtzsche PC, Vandenbroucke JP, et al. Strengthening the Reporting of Observational Studies in Epidemiology (STROBE) statement: guidelines for reporting observational studies. BMJ. 2007;335(7624):806-8.

20. Moloney ED, Smith D, Bennett K, O'Riordan D, Silke B. Impact of an acute medical admission unit on length of hospital stay, and emergency department 'wait times'. Qjm. 2005;98(4):283-9.

21. Moloney ED, Bennett K, O'Riordan D, Silke B. Emergency department census of patients awaiting admission following reorganisation of an admissions process. Emerg Med J. 2006;23(5):363-7.

22. Moloney ED, Bennett K, Silke B. Effect of an acute medical admission unit on key quality indicators assessed by funnel plots. Postgraduate Medical Journal. 2007;83(984):659-63.

23. Conway R, O'Riordan D, Silke B. Long-term outcome of an AMAU-a decade's experience. Qjm-an International Journal of Medicine. 2014;107(1):43-9.

24. Rooney T, Moloney ED, Bennett K, O'Riordan D, Silke B. Impact of an acute medical admission unit on hospital mortality: a 5-year prospective study. Qjm. 2008;101(6):457-65.

25. Sullivan P, Harris ML, Bell D. The quality of patient experience of short-stay acute medical admissions: findings of the Adult Inpatient Survey in England. Clinical Medicine. 2013;13(6):553-6.

26. Brand CA, Kennedy MP, King-Kallimanis BL, Williams G, Bain CA, Russell DM. Evaluation of the impact of implementation of a Medical Assessment and Planning Unit on length of stay. Australian Health Review. 2010;34(3):334-9.

27. Suthers B, Pickles R, Boyle M, Nair K, Cook J, Attia J. The effect of context on performance of an acute medical unit: experience from an Australian tertiary hospital. Australian Health Review. 2012;36(3):320-4.

28. Li JY, Yong TY, Bennett DM, O'Brien LT, Roberts S, Hakendorf P, et al. Outcomes of establishing an acute assessment unit in the general medical service of a tertiary teaching hospital. Medical Journal of Australia. 2010;192(7):384-7.

29. Moore S, Gemmell I, Almond S, Buchan I, Osman I, Glover A, et al. Impact of specialist care on clinical outcomes for medical emergencies. Clinical Medicine. 2006;6(3):286-93.

30. Li JYZ, Yong TY, Bennett DM, O'Brien LT, Roberts S, Hakendorf P, et al. Outcomes of establishing an acute assessment unit in the general medical service of a tertiary teaching hospital. Medical Journal of Australia. 2010;192(7):384-7.

31. Higgins J, Green S. Cochrane Handbook for Systematic Reviews of Interventions Version 5.1.0. The Cochrane Collaboration; 2011.

32. St Noble VJ, Davies G, Bell D. Improving continuity of care in an acute medical unit: initial outcomes. Qjm. 2008;101(7):529-33.

33. Gardner MJ, Altman DG. Confidence intervals rather than P values: estimation rather than hypothesis testing. Br Med J (Clin Res Ed). 1986;292(6522):746-50.

34. The Scottish Government. The Healthcare Quality Strategy for NHS Scotland. 2010.

35. Craig P, Dieppe P, Macintyre S, Michie S, Nazareth I, Petticrew M. Developing and evaluating complex interventions: the new Medical Research Council guidance2008 2008-09-29 10:52:26.

36. Shepperd S, Lewin S, Straus S, Clarke M, Eccles MP, Fitzpatrick R, et al. Can we systematically review studies that evaluate complex interventions? PLoS Med. 2009;6(8):e1000086.

37. Hawe P, Shiell A, Riley T. Complex interventions: how "out of control" can a randomised controlled trial be? BMJ. 2004;328(7455):1561-3.

38. Herbert RD, Bø K. Analysis of quality of interventions in systematic reviews. BMJ. 2005;331(7515):507-9.

39. Stephenson M, McArthur A, Giles K, Lockwood C, Aromataris E, Pearson A. Prevention of falls in acute hospital settings: a multi-site audit and best practice implementation project. Int J Qual Health Care. 2015.

40. Sunol R, Wagner C, Arah OA, Shaw CD, Kristensen S, Thompson CA, et al. Evidence-based organization and patient safety strategies in European hospitals. Int J Qual Health Care. 2014;26 Suppl 1:47-55.

41. Secanell M, Groene O, Arah OA, Lopez MA, Kutryba B, Pfaff H, et al. Deepening our understanding of quality improvement in Europe (DUQuE): overview of a study of hospital quality management in seven countries. Int J Qual Health Care. 2014;26 Suppl 1:5-15.

42. Dubois CA, D'amour D, Tchouaket E, Clarke S, Rivard M, Blais R. Associations of patient safety outcomes with models of nursing care organization at unit level in hospitals. Int J Qual Health Care. 2013;25(2):110-7.

43. Anderson JE, Kodate N, Walters R, Dodds A. Can incident reporting improve safety? Healthcare practitioners' views of the effectiveness of incident reporting. Int J Qual Health Care. 2013;25(2):141-50.

44. Hanlon P. Coping with the inexorable rise in medical admissions: evaluating a radical reorganisation of acute medical care in a Scottish district general hospital. Health Bulletin. 1997;55(3).

45. McLaren EH. Re-organising emergency medical admitting : the Stobhill experience, 1992-1997. Health Bulletin. 1999;57(2):108-17.

46. Munday T, Forbes M, Little J, Warren G, Bowe P, Lind J. THE PATIENT FLOW EFFECTS OF A NEW MEDICAL ASSESSMENT UNIT WITHIN A LARGE URBAN HEALTH SERVICE. Internal Medicine Journal. 2012;42:9-10.

TABLES

Table 1: Charactesristics of study AMUs

First author, Year, Reference	Description of comparison	Description of intervention	Components of AMU				
			Entry sources	Admission criteria	Staffing	Operational policies	Length of stay
Hanlon, 1997, (44)	Pre-AMU group admitted to one of 6 general medical wards under the care of a consultant on call for a day at a time.	Reconfiguration of bed base to form a 38 bedded AMU and 4 specialty wards.	ED.	All medical patients with the exception of those admitted to CCU.	• Consultant of the week model with no other duties.	• Twice daily ward rounds. • Enhanced support services comprising phlebotomy, ECG and rapid radiology.	24 – 48 hours.
McLaren, 1999, (45)	Pre-AMU group admitted to one of 3 medical wards, each receiving admissions every third day.	Reconfiguration into a 26 bedded AMU with reorganisation of specialty wards.	Not reported.	All medical emergencies with the exception of those admitted to CCU.	• Consultant physician on call for 24 hour periods. • Discharge planning coordinator appointed.	• Daily post receiving ward rounds. • Medicine of the elderly consultant attends daily; Community psychiatric nurse attends 6 days a week.	48 hours.
Moloney, 2005, (20)[1]; Moloney, 2006, (21)[1]; Moloney, 2007, (22)[1]; Rooney,	Pre-AMU group admitted to a variety of medical wards under a named consultant physician.	Reconfiguration of two modern centrally located wards to create a 59 bedded AMU in close proximity to the ED and diagnostic imaging department	ED.	All medical patients with the exception of those admitted to CCU/ITU.	• Consultant physician on call for 24 hour periods. • On call AMU team consisting of a registrar and 2 senior house officers.	• Post call ward round each morning (during which consutlant has not other fixed duties). • Radiology, endoscopy, laboratory services, physiotherapy, occupational therapy and social services prioritised.	5 days.

2008, (24)[1]; Conway, 2014, (23)[1]					• Nursing staff recruited based upon prior experience on acute medical units. • Discharge manager was appointed.	• Identification of patients suitable for fast-track discharge with discharge facilitated by discharge coordinator. • Detailed operational plan devised prior to inception.	
Moore, 2006, (29)	Pre-AMU group admitted to the first available medical bed under the care of the on call team and remained under this team's care for the entirety of their stay.	Expansion of a 20 bedded admissions unit into a purpose built 47 bed AMU; medical specialities allocated own clearly defined bed base with a ward-based system of responsibility.	ED and community.	All medical admissions with the exception of Geriatric patients and patients presenting with a stroke patients (triaged to an acute stroke unit subject to bed availability).	• Sequential appointments of 5 consultants in acute medicine. • 12 hour cover of an admitting team comprising of consultant, specialist registrars, senior and junior house officers who are free from conflicting duties. • A team of bed managers operational throughout the week.	• Morning handover meeting. • Specialty allocation decided by senior member of the AMU nursing staff with discussion with acute medicine consultant as required. • Acute admissions to the Care of the Elderly Directorate admitted by a consultant-led team consisting of a house physician, SHO and specialist registrar.	15 -21 hours.
St Noble, 2008, (32)	Pre-AMU group cared for by a consultant of the day 7 days a week.	Reconfiguration of an existing medical ward into a 24 bedded AMU including a 6 bed 'level 1' bay.	Not reported.	Emergency medical admissions.	• 'Consultant of the day' for weekday and 'Consultant of the weekend' from Friday to Monday. • Staggered 24 hour SHO rota.	Not reported.	Not stated.

					• Weekend junior doctor cover aligned with consultant cover.		
Diepeveen, 2009, (8)	Split-site hospital. One ED was closed when the AMU was established.	32 bedded unit designed as an intermediate ward between the ED and the regular wards.	ED.	Medical and surgical patients with the exception of Cardiology and Gynaecology patients, and those requiring ITU/CCU/MCU/Stroke unit care.	Not reported.	• Ward rounds twice a day. • Faster access to diagnostic tests.	48 hours.
Brand, 2010, (26)	Pre-AMU group (historical comparison) admitted directly to general medical ward. Non-AMU group (concurrent comparison) admitted directly to a conventional ward.	Re-configuration of the short stay observation to create a 10 bedded AMU.	ED.	All general medical patients with the exclusion of impending death and severe behaviour disturbance. In the concurrent comparison, if a bed was available in the AMU the patient was admitted there; if no bed available the patient was admitted to a general ward setting.	Multidisciplinary team including medical staff (general and/or geriatric medicine physicians), care coordinators, physiotherpaists and occupational therapists.	• Prioritised access to investigations. • Rapid access to MDT planning.	48 hours.
Li, 2010, (30)	Pre-AMU group admitted under the "on-take" general medical team to any available hospital bed in any ward (but preferentially the on call team's 'home' ward).	Establishment of an AMU located close to ED/ITU/diagnostic imaging department.	ED.	Medical patients whose clinical profile made them inappropriate for a subspecialty medical unit.	• Consultant physician reviews all admissions.	• Twice daily consultant reviews of all new admissions.	48 hours.

Vork, 2011, (7)	Pre-AMU group admitted into 2 separate units.	Reconfiguration involving the unification of previously physically and administratively separate units.	ED and community.	All subspecialties of internal medicine apart from Geriatrics.	• Staffed by a specialist in Internal Medicine, senior and junior house officer.	Not reported.	48 hours.
Watt, 2011, (4)	Non-AMU concurrent group assessed in the ED.	Establishment of a 9 bedded AMU, operating from 0800 – 2030 on weekdays.	ED and community.	Medical patients with defined presentations including headache, syncope, DVT, palpitations, COPD/CCF/Asthma, persistent chest infection, seizure, TIA, unexplained fall, and abnormal shadow on chest x-ray. Patients likely to require resuscitation facilities and those with acute chest pain of probable cardiac origin were excluded.	• Dedicated staff including one Consultant physician, one specialist registrar, one registrar; 6 nursing staff; 3 administrative staff.	• Clinical pathways are used for specified conditions. • Regular outpatient clinics (3 per week).	
Munday, 2012, (46)	Not reported.	Not reported.	Not reported.	Not reported.	Not reported.	Not reported.	Not reported.
Suthers, 2012, (27)	Pre-AMU group (historical analysis) and 'Ward' group (concurrent analysis) admitted directly from the ED to a ward.	15 bedded unit located near the ED and an emergency short stay unit opened.	ED.	Acute general medicine patients who were haemodynamically stable and who may benefit from rapid intervention from medical and AHPs.	• Staffed with medical registrars, a resident medical officer, nursing staff, physiotherapist, occupational therapist, pharmacist,	• Priority access to imaging and Community Acute/Post-acute Care Services. • Patients referred to the AMU registrars by the medical staff in the ED.	48 hours.

					dietician, social worker and a case manager. • Junior medical staff rostered from 0800 – 1800 7 days a week.		

CCU – Coronary care unit; ITU – Intensive Care unit; ED – Emergency department; MCU – Medium care unit; AHP – allied health professional; MDT – Multidisciplinary team; DVT – deep vein thrombosis; COPD – chronic obstructive airways disease; CCF – congestive heart failure; TIA – transient ischaemic attack; SHO – senior house officer

[1]There were no changes to the Irish AMU across the 5 articles and as such the components of the intervention in these 5 articles is considered as one.

Table 2: Hospital length of stay, mortality rates and proportions of patients readmitted outcomes

First author, Year, Reference Sample size	Hospital length of stay (days) (mean unless stated)				Mortality rate (Time point of measurement)				Proportion of patients readmitted (Time point of measurement)			
	Non-AMU cohort	AMU cohort	Difference in means/medians (95% CI, where given)	Test of association	Non-AMU cohort	AMU cohort	Difference in proportion/risk difference/risk ratio (95% CI, where given)	Test of association	Non-AMU cohort	AMU cohort	Difference in proportion/risk difference/risk ratio (95% CI, where given)	Test of association
McLaren, 1999, (45) n = 30,088	7.1	4.5	Not stated	Not tested								
Moloney, 2005,(20) n = 10,566	6.0 (median)	5.0 (median)	Not stated	P < 0.0001								
Moloney, 2006,(21) n = 17211	7.0	5.0	Not stated	P < 0.001								
Moore, 2006, (29) 1. Unadjusted n = 133,509	9.3	8.8	Not stated	Not tested	6.4% (In-hospital)	5.9% (In-hospital)	Not stated	"not significant"	4.0% (7 day) 10.2% (28 day)	3.3% (7 day) 8.3% (28 day)	Not stated	Not tested
2. Adjusted for downward trend n = 133,509	Not stated	Not stated	Summary change -0.73 (95% CI -1.5, 0.04) (monthly time series analysis)	p = 0.067			Summary change -0.53 (95% CI -1.72, 0.66) (monthly time series analysis)	p = 0.385			Summary change -0.02 (95% CI -0.07, 0.03) (7 day); -0.04 (95% CI -0.15, 0.07) (28 days) (monthly time series analysis)	p = 0.365 p = 0.493
Moloney, 2007, (22) 1. All patients n = 17,211 episodes/11928 patients					12.6% (Annual)	10.8% (Annual)	Not stated	p = 0.07				
2. Patients staying 30 days or less n = 15,726	7.0	5.0	Not stated	p < 0.0001								
3. Patients staying longer than 30 days, n = 1,485	51.0	48.0	Not stated	p = 0.431								
Rooney, 2008, (24) n = 33,367	-	-	-	-	12.6% (In-hospital)	7% (In-hospital)	Risk ratio 0.56 (In-hospital)	p < 0.0001 (In-hospital)				

					8.8% (30 day post admission)	5.6% (30 day post admission)	Not stated	p < 0.0001 (30 day)				
St Noble 2008, (32) n = 3,263	9.3	7.7	Not stated	p = 0.028					4.5% (7 day)	4.0% (7 day)	Not stated	"not significant"
Diepeveen, 2009, (8) n = 3,043	6.4	5.8	Not stated	0.001 (difference in medians)								
Brand, 2010, (26) 1. Concurrent analysis, n = 1,623	3.6	2.0	Not stated	"not significant"	7.6% (In-hospital)	3.2% (In-hospital)	Not stated	p < 0.001	16.2% (28 days)	17.7% (28 days)	Not stated	"not significant"
2. Historical analysis, n = 3,154	4.2	3.9	Not stated	"not significant"	6% (In-hospital)	5.4% (In-hospital)	Not stated	"not significant"	24.4% (28 days)	28.4% (28 days)	Not stated	p < 0.01
Li, 2010, (30) 1. Unmatched analysis, n = 6,644	6.8 (SD 10)	5.7 (SD 8.8)	Not stated	p < 0.001	4.6% (In-hospital)	3.7% (In-hospital)	Not stated	P = 0.06	3.8% (7 days)	3.7% (7 days)	Not stated	p = 0.8
									8.7% (28 days)	8.0% (28 days)	Not stated	p = 0.8
2. Matched analysis, n = 6,644	6 .8 (SD 10)	6.0 (SD 8.5)	Not stated	p < 0.001	4.6% (In-hospital)	4.2% (In-hospital)	Not stated	Not stated				
Vork, 2011, (7) n = 25,004	4.1 (median)	3.8 (median)	Not stated	< 0.01	3.16% (In-hospital)	3.22% (In-hospital)	Not stated	p < 0.70	19.8% (30 day)	14.6% (30 day)	Not stated	< 0.01
					5.75% (30 day post discharge)	5.88% (30 day post discharge)	Not stated	p < 0.81				
Suthers, 2012, (27) 1. Concurrent analysis, n = 1,180	4.9 (median)	1.9 (median)	Not stated	P < 0.001	6.6% (Not stated)	5.2% (Not stated)	Not stated	p = 0.67	17.7% (28 days)	19.5% (28 days)	Not stated	P = 0.58
2. Historical analysis, n = 3,930	6.8 (median)	5.2 (median)	Not stated	P < 0.001								
Conway, 2014, (23) 1. All patients n = 670,971 (episodes) n = 37,828 (patients)					7.0% (episodes) (In-hospital)	4.6% (episodes) (In-hospital)	Risk ratio 0.65	p = 0.001				
					14.5% (patients) (In-hospital)	5.7% (patients) (In-hospital)	Risk ratio 0.4	p = 0.001				
2. Patients staying < 30 days n = 60,496 (episodes) n = 31,107 (patients)	7.1 (median) (episodes)	6.9 (median)	Not stated	p = 0.0003								

	7.1 (median) (patients)	episodes) 6.6 (median) (patients)	Not stated	$p < 0.001$									

CI – confidence intervals; SD – standard deviation

Table 3 - Patient and staff satisfaction outcomes

First author, Year, Reference	Patient satisfaction: Findings Sample size	Staff satisfaction: Findings Sample size
Hanlon, 1997, (44)	• Patients reporting that staff had time to explain their treatment: 79% in non-AMU group vs. 89% AMU group ($p < 0.05$) • Patients feeling ready for discharge: 84% in AMU group vs. 93% in AMU group ($p < 0.05$) • Based upon an average response of 57% from 4 surveys of 100 people.	• Non-consultant staff less concerned about losing track of patients and boarding in AMU group AMU ($p < 0.01$) and more concerned about 'blocked beds' ($p < 0.05$) • Nurses reported more time for health promotion in AMU group ($p < 0.01$) • Rise in mean score for questions about stress and job satisfaction in AMU group ($p < 0.05$) • Based upon 3 surveys of 26 non-consultant medical staff (average response rate 66%) and 96 qualified nursing staff (average response rate 64%)
McLaren, 1999, (45)	• 52% of patients report the AMU model to be better • n = 22	• 93% of medical staff and 91% of nurses report the AMU model to be better • n = 11 and n = 26 respectively
Watts, 2011, (4)	• 77% of patients extremely satisfied with AMU care • n = 30 (response rate 83%)	• 75% of GP preferred AMU route to the ED • n = 115 (response rate 72%)
Sullivan, 2013, (25)	• AMU group scored significantly less well than short stay elective admissions for all questions; and significantly less well than the unscheduled admissions to other specialties for all items apart from confidence in nursing staff; opportunity for family updates from medical staff and consistency of information from team members (odd ratios 0.339 – 0.909) • n = 3,325 (short stay unscheduled medical admissions); n = 3,420 (short stay unscheduled non-medical admissions); n = 10,437 (short stay scheduled admissions)	

Table 4 - Other reported outcomes

First author, Year, Reference	Findings – Emergency department performance	Findings – Patient discharge disposition	Findings – Other
Hanlon, 1997, (44)		• 24 hour discharge rate 30.0% (no further detail given). • CCU patients transferred out into the care of a Cardiologist: 39.0% in the non-AMU group vs. 83.0% in the AMU group (p < 0.001) • Patients with a Cardiology diagnosis under the care of a Cardiologist: 34.0% in the non-AMU group vs. 58.0% in the AMU group (p < 0.001) • Patients with a Respiratory diagnosis under the care of a respiratory physician: 53.0% in the non-AMU group vs. 67.0% in the AMU group (p < 0.001) • Asthmatic patients cared for in non-respiratory wards: 56.0% in the non-AMU group vs. 7.0% in the AMU group (P < 0.001)	• No change in outpatient wait times (no further detail given). • Overall bed occupancy in the medical directorate rose from 84.0% to 88.0%. • Number of patients boarded in non-AMU group 272 vs. 0 in AMU group (data described as 'best guess').
Moloney, 2005, (20)	• Number of patients waiting in ED for a hospital bed: reduced by 30.0% between non-AMU and AMU data periods (OR 0.7, 95% CI 0.67 – 0.74) • Number of months with > 10 patients on average waiting for a bed at 0700: 9 in non-AMU group vs. 4 in AMU group (p < 0.05)		• Median cost per patient: 1,816 EURO for non-AMU group vs. 2,122 EURO for AMU group (p < 0.0001)
Moloney, 2006, (21)	• Median number of patients in ED waiting a bed: 14 in non-AMU group vs. 8 in AMU group (p < 0.0001)		
Moore, 2006, (29)		• 27.2% of patients cared for by appropriate specialty in non-AMU group vs. 55.9% in AMU group	
Munday, 2012, (46)	• ED LOS 9.7 hours in non-AMU group versus 2.9 hours in AMU group		
St Noble 2008, (32)		• 24 hour direct discharge rate 21.3% in non-AMU group (2005) vs. 28.5% in AMU group (p < 0.005)	

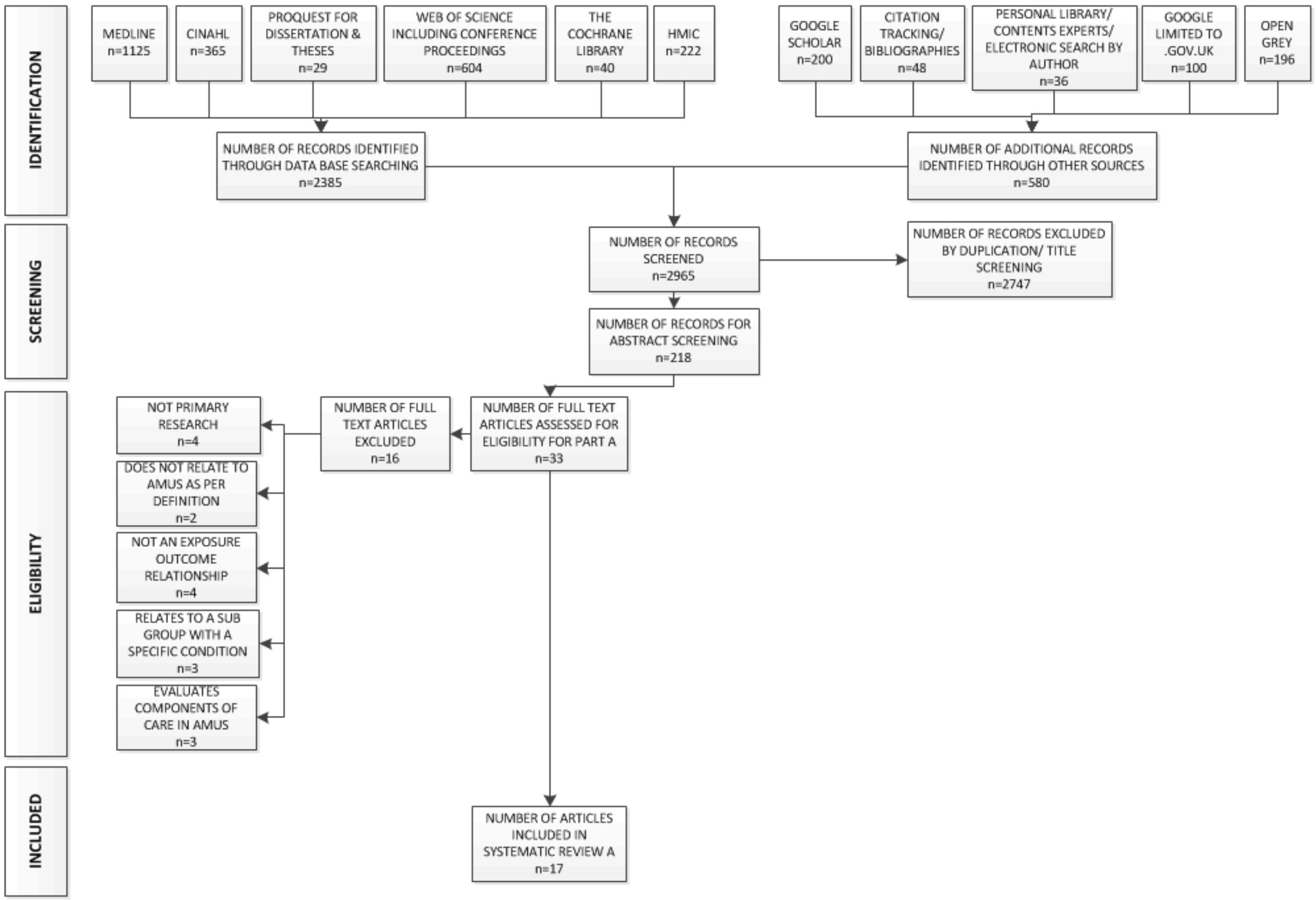
		• 48 hour direct discharge rate 31.2% in non-AMU group (2005) vs. 39.5% in AMU group (p = 0.038) • Percentage of patients discharged by 48 hours increased for 11 of 12 subgroups determined by consultant post-AMU (p < 0.006) • There was a trend towards a smoother daily discharge rate over the 7 days but not statistically significant	
Brand, 2010, (26)	• ED LOS 13.2 hours in non-AMU group versus 10.4 hours in AMU group	• 73.7% discharged home in the non-AMU groups vs. 71.4% in the AMU group (p value not reported but "not significant") (historical analysis) • 65.8% of patients discharged home in the non-AMU group versus 39.4% in the AMU group (p < 0.001) (concurrent analysis) • 29.4% not discharged within 48 hours in the non-AMU groups vs. 30.8% in the AMU group (p > 0.05) • 38.4% of patient were not discharged at 48 hours in the non-AMU group versus 32.0% in the AMU group (p > 0.05)	
Li, 2010, (30)	• Percentage of patient waiting in ED for more than 8 hours: 28.7% in non-AMU group vs. 17.2% in AMU group • Percentage of patient waiting in ED for more than 12 hours: 20.2% non-AMU versus 10.4% in the AMU group	• 24 hour direct discharge rate: 13.2% in non-AMU group vs. 17.7% in AMU group (p = 0.002)	
Suthers, 2012, (27)	• ED LOS 9.4 hours in non-AMU group versus 6.4 hours in AMU group (p < 0.0001) (concurrent analysis) • ED LOS 8.7 hours in non-AMU group versus 8.0 hours in AMU group (p = 0.004) (historical analysis)		
Watts, 2011, (4)		• 43.3% of non-AMU (ED) group hospitalised vs. 12.5% in AMU group; • 49.5% of non-AMU (ED) patients discharged to GP vs. 13.2% of AMU group	

		• 1.2% non-AMU (ED) group referred to an outpatient pathway vs. 78.4% of AMU cohort • 2.2% of non-AMU (ED) group referred to a specialist OPD vs. 1.7% of AMU cohort.	
Conway, 2014, (23)	• Number of patients waiting in the ED between 0700 and 0800 11.1 during period of AMU institution vs. 6.3 post AMU ($p < 0.001$) • Time from presentation in ED to medical review 7 hours during period of AMU institution vs. 6.3 hours post AMU ($p < 0.001$)		

FIGURE LEGEND

Figure 1 - A Preferred Reporting of Items for Systematic Reviews and Meta-Analyses (PRISMA) (18) diagram detailing the identification, screening and assessment for eligibility of articles. CINAHL - Cumulative Index to Nursing and Allied Health Literature

FIGURE 1 – PRISMA diagram



Supplementary Table 1: Criteria used for Quality Assessment

	Component	Stratification
Methods	Study design	2 = Presents key elements of study design early in the paper 1 = Does so partially 0 = Does not
	Setting	2 = Describes the setting, location, dates, exposure, follow up and data collection 1 = Does so partially 0 = Does not
	Participants	2 = Gives the eligibility criteria, the sources and methods of selection of participants 1 = Does so partially 0 = Does not
	Variables	2 = Clearly defines all outcomes, exposures, predictors, potential confounders, and effect modifiers 1 = Does so partially 0 = Does not
	Data sources/ measurement	2 = For each variable of interest, gives sources of data and details methods of assessment (measurement). Describe comparability of assessment methods if there is more than one group. 1 = Does so partially 0 = Does not
	Bias	2 = Describes any efforts to address potential sources of bias 1 = Does so partially 0 = Does not
	Study size	2 = Explains how the study size was arrived at 1 = Does so partially 0 = Does not
	Statistical methods	2 = Describes all statistical methods including those used to control for confounding; describes methods used to examine for subgroups and interactions; explains how missing data were was addressed; describes any sensitivity analyses 1 = Does so partially 0 = Does not
Results	Participants	2 = Reports numbers of individuals at each stage of study and gives reasons for non-participation at each stage 1 = Does so partially 0 = Does not
	Descriptive data	2 = Give characteristics of study participants and information on exposures and potential confounders and indicates number of participants with missing data for each variable of interest. 1 = Does so partially 0 = Does not
	Outcome data	2 = Report number of outcome events or summary measures 1 = Does so partially 0 = Does not
	Main results	2 = Gives unadjusted estimates and, if applicable, confounder-adjusted estimates and their precision, making clear which confounders are adjusted for why they were included; report category boundaries when continuous variables have been categorized; if relevant consider translating estimates of relative risk into absolute risk for a meaningful time period

		1 = Does so partially 0 = Does not
Discussion	Limitations	2 = Discusses limitations to the study, taking into account sources of potential bias or imprecision 1 = Does so partially 0 = Does not

Supplementary Table 2: Study characteristics

First author, Year, Reference	Setting – Country, Time period, Description of hospital stated in paper	Study population	Comparators Reported group comparisons	Total episodes/patients	Data source (s)	Quality assessment score (max.26)
Hanlon, 1997, (39)	UK, 1993 – 1995, district general hospital.	All medical patients in one hospital after initial assessment in the ED with the exception of those admitted to CCU.	One non-AMU group (prior to the establishment of the AMU) compared with 1 AMU group (data from 1 year following the establishment of the AMU). Increased patient episodes reported between the 2 groups.	Not stated for data from the patient administration system; 122 staff surveyed with a 65% response rate; 400 patients surveyed with a 57% response rate.	Patient administration system; staff and patient survey.	15
McLaren, 1999, (40)	UK, 1992 – 1997, acute hospital.	All medical emergencies in one hospital with the exception of those admitted to CCU.	One non-AMU group (prior to the establishment of the AMU) compared with 1 AMU group (data from 4 years following the establishment of the AMU). Cohort comparisons not reported.	30,088 episodes; 22 patients and 37 staff surveyed (data on response rate not given)	Prospective data collected by discharge coordinator; retrospective data from Information and statistics division; staff and patient survey.	16
Moloney, 2005, (20)	Ireland, 2002 – 2004, acute tertiary referral hospital.	All acute medicine emergencies in one hospital.	One non-AMU group (prior to the establishment of the AMU) compared with 1 AMU group (data from 1 year following the establishment of the AMU). Increased episodes reported between the 2 groups. Charlson case-mix and age index did not differ between groups.	10,566 episodes and 7,857 patients	Linkage of the patient administration system (PAS) to the Hospital inpatient enquiry scheme (HIPE), a national database of coded discharge summaries.	23
Moloney, 2006, (21)	Ireland, 2002 – 2004, acute tertiary referral hospital.	All acute medicine emergencies in one hospital.	One non-AMU group (prior to the establishment of the AMU) compared with 2 AMU groups (data from 1 year following the establishment of the AMU). Episodes and Charlson case-mix increased significantly in AMU groups ($p < 0.0001$) with no change to age.	17,211 episodes and 11,928 patients	As Moloney 2005.	24
Moore, 2006, (29)	UK, 1995 – 2003, university hospital.	All medical admissions in one hospital, both from the ED and directly from primary care, except Geriatric medicine and patients presenting with a stroke (triaged to an acute stroke unit subject to bed availability).	Two non-AMU groups (prior to the establishment of the AMU) compared with 1 AMU group (data from 3 year following the establishment of the AMU).	133,509 episodes	Hospital information system.	17

			Cohort comparisons not reported.			