

Results on the patient flow of implementing an Acute Medical Unit

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Abstract

Background: There is an increased influx of patients needing admission. Introducing an acute medical unit (AMU) may increase the admission capacity without increasing the total number of beds.

Methods: Data collected during the first four years after implementation of an AMU in an academic tertiary care center in Amsterdam were analyzed.

Results: A 24 bed unit was realized. The total number of admissions increased in the first year with 977 (16%), with an additional 4.1% increase after 2 years with stabilization thereafter. The length of stay decreased, the absolute number of refusals declined, the number of readmissions remained unchanged.

Conclusion: The introduction of an AMU resulted in a higher number of admissions.

Key points

- Introduction of an acute medical unit (AMU) can increase the total number of admissions without increasing the total number of beds.
- By introducing an AMU and optimizing patient flow, the length of stay decreased, the number of refusals declined and the number of readmissions remained unchanged
- To guarantee enough AMU admission capacity an optimal outflow from the AMU to the other hospital wards and other (elderly) care facilities outside the hospital is needed.

Introduction

Acute healthcare chain in the western countries has been increasingly under pressure in the last few decades due to an increasing number of acute admissions.^{1,2} This increase can be explained by the population aging in western countries.^{3,4} Elderly people are more dependent on the health care system and require more health resources.³ In addition, these patients present themselves with a higher severity of illness because they often have multiple comorbidities and polypharmacy. Moreover, older patients tend to have atypical clinical presentations leading to more diagnostics and the number of elderly patients in the emergency department (ED) is increasing.⁵ A relative shortage of hospital beds in combination with a high percentage of beds not being used efficiently have also contributed to ED congestion.⁵ Therefore, the introduction of novel ways to improve the efficiency of the whole acute care chain is needed. Acute Medical Units (AMUs) have been created, mainly in the UK, Ireland and Australia, to accommodate this increasing acute patient flow from the Emergency Department to inpatient hospital wards.⁴

The AMU is as much a philosophy as it is a physical entity.¹ The AMU is a short-term stay department, usually with a maximum length of stay of 72 hours for all acute medical patients.¹ The goals are to provide quick and efficient multi-disciplinary care by specialized teams to ensure rapid diagnosis

and treatment. At the AMU, patients may either be discharged home or transferred to a specialty department, depending on their medical condition.⁶

The objectives of an AMU have been previously defined⁴ and acknowledged.¹ These include rapid and comprehensive multidisciplinary assessment with intensive senior supervision of acutely ill medical patients, standardizing management of acutely ill patients, rapid turnaround in pathology, radiology and other assessments, improved access to geriatric assessments, specialized nurses and other clinical management resources, reduction of waiting times in the ER, elimination of boarding patients in departments of other specialties, optimizing bed management, facilitating research and reduction of staff fatigue.

Implementations of AMUs in the UK and Ireland, led to a reduction of the length of stay and increased discharge rates,^{7,8,9,10,11,12,13} decreased waiting times for patient transfer from emergency departments,^{8,11} without increase of the percentage of unplanned readmissions.¹⁰ Some even reported a decrease of readmissions.^{9,12} An improvement in patient and staff satisfaction has been reported.^{7,14} Furthermore some studies report that the introduction of an Acute Medical Unit was associated with a decrease in all cause hospital mortality.^{9,11,15} However, long-term data on the success of AMUs in European countries such as the Netherlands are lacking.

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This study shows the results of the implementation of an AMU in the VU University Medical Center (VUMC), Amsterdam, the Netherlands. In 2012 the floor was reorganized to introduce a 24 bed AMU with the aim of increasing the number of emergency admissions and decreasing the number of refusals because of lack of admission capacity, while the total number of beds in the hospital remained the same. The number of refusals, the number of admissions, the hospital length of stay, as well as the readmission rate within 3 and 30 days was calculated after introduction of the acute medical unit and compared to the year before the introduction of the AMU. The 4 year follow-up data were analyzed, to evaluate the long-term outcome of the implementation of an AMU.

Methods

Patients eligible for admission at the AMU

Patients (at least 18 years of age) that were admitted through the Emergency Department could be admitted at the AMU, with exception of patients that needed admissions at one of the special care departments, including the intensive care, medium care, the coronary care unit, the stroke unit, the maternity ward and psychiatric ward. The total amount of beds in the hospital was not expanded, meaning that the beds as well as the staff needed for the AMU was provided after reorganizing the participating departments.

AMU concept

The AMU concept in the VUMC was created based on the previously defined objectives of an AMU.^{1,4} The specialties general internal medicine, geriatrics, nephrology, hematology, oncology, gastroenterology, general surgery, surgical oncology, vascular surgery, orthopedics, urology and neurology were allowed to admit patients to the AMU. Doctors from each admitting specialty were responsible for the daily medical care of their patients and performed the daily ward rounds and were available on call 24 X 7. To stimulate rapid and multidisciplinary assessment of acutely ill medical patients a daily morning 15 minute standing-session was introduced with participation of the specialists, junior doctors and nurses of all participating departments, physical therapists, geriatric nurses and home-care nurses. All patients are briefly mentioned and the treatment plan is discussed as well as the expected day of discharge during this daily session. If a consultation from another specialist/specialty was needed, this was organized during and performed immediately after the session. Radiology and other required tests after admission were planned and performed as soon as possible with the aim of speeding up the decision making process. In addition,

along with the junior doctors a consultant was always present during the daily ward rounds. To prevent delay in discharge, patients can be discharged 24 hours a day.

Data collection

After introduction of the acute medical unit, the number of admissions, the length of hospital stay as well as the number of refusals due to lack of beds as well as the number of readmissions within 3 and 30 days after discharge were collected.

Data were reported up to 2016, 4 years after opening of the AMU in December of 2012. Of note, in February 2015 (9th of February up to 19th of February) the AMU was closed because of renovation. Extra beds were opened at other hospital departments. In September 2015 all departments of the VUMC were closed for two weeks (September 8th until 23th), due to flooding of the hospital caused by a water leakage. Therefore, data for 2015 were reported with and without extrapolation using a linear model.

For adequate comparison, the median length of stay in the years before opening of the AMU (2011-2012) was calculated for patients with similar patient characteristics as those admitted at the AMU: admission through the ED, patients from 18 years and older, needing admission at a normal care department. For the total length of stay, from year 2013 to 2016, only those patients admitted to the AMU were included.

Readmissions were defined as follows: Unplanned and planned readmissions through ED, to the acute medical unit or other clinical areas, were aged above 18 years, and readmitted to the hospital following a previous hospital admission to any clinical specialty for a minimum of one night in the previous 3 and 30 days.

Statistical analysis

All data are reported as absolute numbers and their percentages. The length of stay is expressed by the median and interquartile range (IQR). For comparison of length of stay, Wilcoxon rank sum test in R was used. A P-value <0.05 was considered statistically significant. The expected number of presentations and admissions (in 2015) was calculated using linear regression.

Results

Number of admissions, length of stay, occupancy rate, the number of refusals and readmissions after introduction of the AMU

The number of admissions

In December 2012, the AMU was opened. It was equipped with 24 beds. In 2013, the total number of admissions from the emergency department increased

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Table 1. Number of ED presentations, number of admissions, length of stay, occupancy rate and the number of refusals per calendar year. The AMU was introduced in December 2012.

	2011	2012	2013	2014	2015 (exp)	2016
Total number of ED presentations	31405	30508	28652	29396	26981(28057)	28959
Number of ED patients needing admission	6548	6635	7437	7787	7737 (8046)	8480
Number of admissions through ED	5900	6151	7128	7381	7119 (7403)	7446
Number of admissions AMU	NA	NA	4072	3812	3315	3106
Number of refusals/transfers	648	484	309	406	618	1034
Median (IQR) length of stay normal care (days)	3.5 (1.4-7.3)	3.8 (1.7-7.7)	2.9 (1.2-7.5)	3.1 (1.3-7.4)	3.5 (1.5-7.5)	3.3 (1.7-6.9)
Median (IQR) length of stay (days) AMU	NA	NA	1.2 (0.8-2.1)	1.3 (0.8-2.1)	1.5 (0.8-2.6)	1.6 (0.8-2.8)
Bed occupancy AMU	NA	NA	78%	76%	80%	74%

ED=emergency department. NA= not applicable, exp =expected

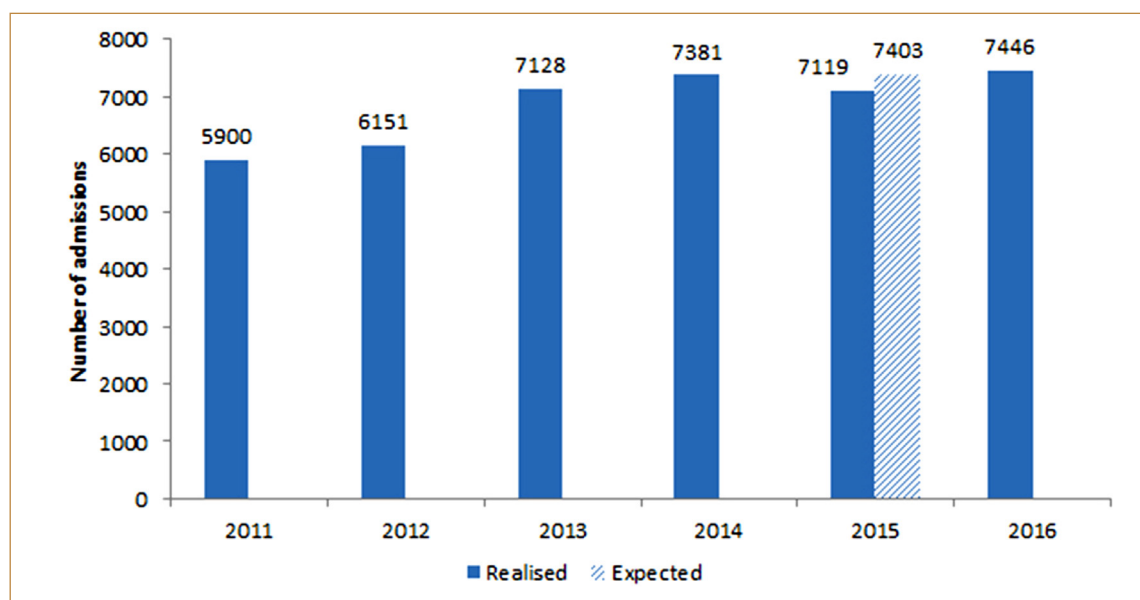


Figure 1. Number of admissions from the emergency department, year 2011-2016.

(from 6151 to 7128) with 977 (16%) (table 1, figure 1). The second year, the number increased (from 7128 to 7381) with 253 (3.5%). The third year following introduction the number of admissions stabilized to 7119. Extrapolating the data by a linear model would indicate the number of admissions in 2015 would have increased (from 7381 to 7403) with 22 (0.3%). While the absolute number of ED presentations needing admission, increased over the years (table 1, figure 2), the absolute number of admissions at the AMU decreased over the years (table 1).

The length of stay

The median length of hospital stay of patients on normal care departments in 2012 was 3.8 days. After introducing AMU, the length of stay decreased from 3.8 (IQR 1.7-7.7) to 2.9 (IQR 1.2-7.5) days ($p < 0.001$), and remained stable between 2013 and 2016.

On the contrary, the length of stay at the AMU increased gradually over the years, with an increase of 0.2 days between 2014 and 2015 ($p < 0.001$) (table 1, figure 3).

The occupancy rate

The average occupancy of the beds in the first year after opening of the AMU (2013) was 78%, 76% in 2014, 80% in 2015, and 74% in 2016. The occupancy rate decreased in most departments in the hospital (data not shown).

The number of refusals

After opening of the AMU, the absolute number of refusals dropped from 484 to 309 the following year. The following years the absolute number of refusals increased again due to increase in number of ED presentations needing admission (table 1).

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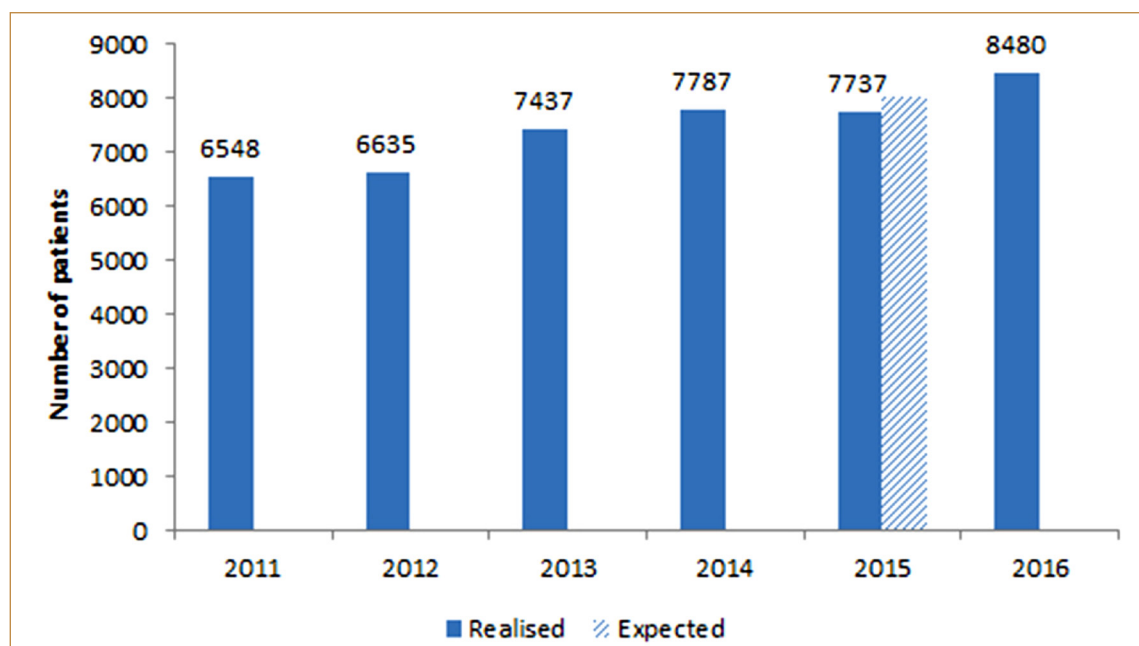


Figure 2. Number of patients, presenting at the emergency department, requiring admission, year 2011-2016.

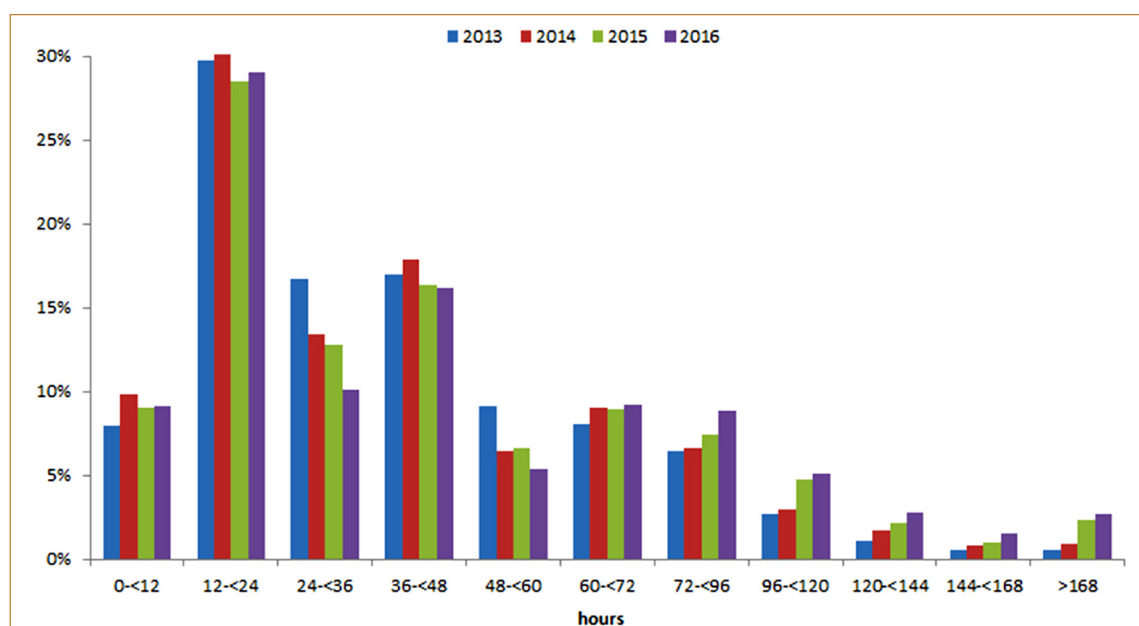


Figure 3. Length of stay at the acute medical department.

The number of readmissions

The number of readmissions after admissions at the AMU was 1% within 3 days after discharge and between 10-13% within 30 days after discharge (table 2).

The total number of hospital readmissions within 3 days after discharge was 2% for normal care patients before introduction of the AMU and remained around 2% after the introduction of the AMU, the following 4 years. The total number of readmissions in the hospital for normal care patients within 30 days was 16% before

introduction of the AMU and remained between 16-17% the years after introduction of the AMU.

The year following introduction of the AMU (2013), the number of patients discharged, after 48 and 72 hours was: 71% and 89% respectively. Three years after introduction of the AMU (2015) the number of patient discharged within 48 hours was 67% and 72 hours 82%. In the third year after introduction of the AMU 18% of admissions exceeded the recommended length of stay of 72 hours at the AMU, 2% stayed more than one week.

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Table 2. Readmissions, after 3 days and after 30 days

	2011	2012	2013	2014	2015	2016
Number of patients discharged directly from the AMU			1960	1825	1628	1537
Number of readmissions within 3 days after discharge from AMU	NA	NA	21 (1%)	21 (1%)	19 (1%)	13 (1%)
Number of readmissions AMU after discharge AMU within 30 days	NA	NA	251 (13%)	208 (11 %)	170 (10%)	204 (13%)
Discharged total (including elective admissions)	14084	14065	14468	14882	14027	13617
Number of total readmissions, within 3 days	230 (2%)	223 (2%)	310(2%)	307 (2%)	241(2%)	259 (2%)
Number of total readmissions, within 30 days	2267 (16%)	2213 (16%)	2371 (16%)	2506 (17%)	2180 (16%)	2166 (16%)

Discussion

We demonstrate that reorganising the floor and introducing an AMU without increasing the total number of beds in the hospital led to a 16% increase in total admissions from the emergency department, without an increase in the number of readmissions within 3 and 30 days, during the following 4 years.

Increasing the number of admissions, without expanding the number of beds, can be accomplished by shortening the length of stay and increasing the bed occupancy rate. Increasing the efficiency of the use of existing beds with involvement of the experienced supervisors in the daily care leading to speeding up of the decision making process, diagnostics, treatment and discharge of the admitted patients has in our opinion led to this persistent increase in acute admissions. In addition, introducing a daily meeting with all specialists taking care of the patients in the AMU improves the care for patients who require a multi-disciplinary approach not only in the AMU but also in the other wards. In addition, other disciplines, such as physiotherapists, dieticians and specialized nurses organizing care at home are involved earlier during a patient's admission. Elderly patients, especially those with multiple co-morbidities, who contribute to a large extent to the increase of the number of acute admissions,¹⁶ and may benefit from this approach.

However, while the number of patients that were admitted through the emergency department increased over the years (table 1), the number of admitted patients at the AMU slowly decreased (table 1). While the total length of the hospital stay for patients passing the AMU remained stable, the time patients spent at the AMU gradually increased. This was mainly due to lack of beds in the other units increasing the time spent at the AMU, sometimes exceeding the recommended time of 72 hours. This could be explained by several factors. Every unit had to contribute 1–3 of their beds to the AMU leading to less available beds in these units. Another factor of stagnation in these units can be attributed to the fact that, some of these departments still worked in a traditional way. At the same time most patients who were transferred to other units were sicker

and needed intensive and sometimes long-term care leading to more stagnation in the unit. Therefore, the bed occupancy of some departments such as neurology decreased. In addition, increase in patients with multi-resistant bacteria needing isolation at admission also led to a reduction in the use of the existing capacity.

Furthermore the quality of care at the AMU should be evaluated continuously. An initiative to maintain high quality care in the AMUs was introduced a few years ago: the Society for Acute Medicine's benchmarking audit. Previous audits already signalled compliance with the clinical quality indicators could be improved in some AMUs.^{17,18,19} To improve the care at an AMU it is also important to take the patient's experience in consideration.²⁰ Analysis of unplanned readmissions at our AMU revealed coordination of care is the weakest link.²¹

Overall, 4 years after introduction a consistent picture is appearing and the number of admissions to the AMU has stabilised to around 3200 yearly admissions. During the first year more admissions were realised to the AMU. However, in the last few years there has been marked increase in the elderly patients presenting to the ED's in Amsterdam region and beyond. This not only affected the VUMC but other Dutch hospitals in the region as well. Recently an alarming report was sent to the minister, members of the parliament, published in a national newspaper (NRC)²² reporting that the ED in the Amsterdam region had to close down temporarily about 2000 times in 2015 due to lack of capacity. This is mainly due to increase in the number of elderly patients. It is known that elderly patients spend longer at the ED because of the atypical presentations of their disease conditions and their comorbidity which may make even a simple problem complex to treat.^{23,24,25}

In addition, these patients need admission to the hospital more often than younger patients. At the same time due to governmental policy changes such as of closure to nursing homes, patients tend to stay longer at home with their diseases resulting in increase in the severity and complexity of the problems leading to more admissions and longer hospital length of stay.

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More nursing homes for instance, can help decrease the length of hospital stay for elderly patients, who now stay in the hospital after they recovered from their acute illness but still need additional care.

In spite of these developments we still managed to admit more patients from the ED to the hospital and the median length of stay was reduced to 5.6 days in 2016. Besides introducing an AMU and introducing 15 minutes standing session at the AMU we also introduced another standing session for the nurse-managers to stimulate optimal use of beds in the whole hospital. In addition, some other departments also integrated the principles of the AMU in their own care processes. Alongside the AMU this may have also contributed to this increase in admissions.

This study has limitations. Whether the increase in number of admission can solely be attributed to the introduction of the AMU could be questioned. As mentioned earlier, during the introduction of the AMU the health care workers in other units were educated about the advantages of key concepts of the AMU. This indeed led to integration of these

concepts in some other units which probably led to more efficiency and more admissions. In addition, we also introduced a short (15 minute) daily standing session at the beginning of the evening shift at the ED in which all the junior and senior doctors on duty took part which probably also led to an improvement in the patient flow.

In conclusion, an introduction of AMUs could be beneficial in improving the current strain on the acute healthcare system.²⁶ In addition, introducing concepts of an AMU in other departments and introducing unique and new concepts such as standing sessions with the aim of stimulating multidisciplinary teamwork may also improve patient flow. However to guarantee enough AMU admission capacity an optimal outflow from the AMU to the other hospital wards and other (elderly) care facilities outside the hospital are needed.

Conflict of Interest

The authors declare they have no conflict of interest. Ethical approval was not required as only anonymous epidemiological data were used.

References

- Byrne D, Silke B. Acute medical units: review of evidence, *European journal of internal medicine* 2011; **22**(4) 344–347
- Walters Haydn E, Dawson, DJ. Whole-of-hospital response to admission access block: the need for a clinical revolution. *The Medical journal of Australia* 2009; **191**(10) 561–563
- Kendrick S, Conway M. Increasing Emergency Hospital Admissions among Older People in Scotland: A Whole System Account. Edinburgh: Information and Statistics Division, 2003.
- Scott I, Vaughan L, Bell D. Effectiveness of acute medical units in hospitals: a systematic review, *International journal for quality in health care*, 2009; **Volume 21, number 6**:pp. 397–407
- Samaras N, Chevalley T, Samaras D, *et al.* Older patients in the emergency department: a review. *Ann Emerg Med.* 2010 Sep;**56**(3):261–9
- Hindmarsh D, Lees L. Improving the safety of patient transfer from AMU using a written checklist. *Acute Med.* 2012;**11**(1):13–7
- McLaren EH, Summerhill LE, Miller WJ *et al.* Re-organising emergency medical admitting: the Stobhill experience, 1992–1997. *Health Bull (Edinb)* 1999;**57**:108–17.
- Moloney ED, Smith D, Bennett K *et al.* Impact of an acute medical admission unit on length of hospital stay and emergency department 'wait times.'. *Q J Med* 2005;**98**:283–9.
- Moore S, Gemmell I, Almond S *et al.* Impact of specialist care on clinical outcomes for medical emergencies. *Clin Med* 2006;**6**:286–93.
- St Noble VJ, Davies G, Bell D. Improving continuity of care in an acute medical unit: initial outcomes. *Q J Med* 2008;**101**:529–33.
- Rooney T, Moloney ED, Bennett K *et al.* Impact of an acute medical admission unit on hospital mortality: a 5-year prospective study. *Q J Med* 2008;**101**:457–65.
- Wanklyn P, Hosker H, Pearson S *et al.* Slowing the rate of acute medical admissions. *J R Coll Physicians Lond* 1997;**31**: 173–6.
- Armitage M, Raza T. A consultant physician in acute medicine: the Bournemouth model for managing increasing numbers of medical emergency admissions. *Clin Med* 2002;**2**: 331–3.
- Hanlon P, Beck S, Robertson G *et al.* Coping with the inexorable rise in medical admissions: evaluating a radical reorganisation of acute medical care in a Scottish district general hospital. *Health Bull (Edinb)* 1997;**55**:176–84.
- Coary R, Byrne D, O'Riordan D, *et al.* Does admission via an acute medical unit influence hospital mortality? 12 years' experience in a large Dublin hospital. *Acute Med.* 2014;**13**(4):152–8.
- Schrijver EJ, Toppinga Q, de Vries OJ, *et al.* An observational cohort study on geriatric patient profile in an emergency department in the Netherlands. *Neth J Med.* 2013 Jul-Aug;**71**(6):324–30
- Subbe CP, Ward D, Latip L *et al.* A day in the life of the AMU—the Society for Acute Medicine's benchmarking audit 2012 (SAMBA '12), *Acute Med.* 2013;**12**(2):69–73.
- Le Jeune I, Masterton-Smith C, Subbe CP *et al.* "State of the Nation"—the Society for Acute Medicine's Benchmarking Audit 2013 (SAMBA '13). *Acute Med.* 2013;**12**(4):214–9.
- Subbe CP, Le Jeune I, Burford C, *et al.* The Team at Work—The Society for Acute Medicine's Benchmarking Audit 2014 (SAMBA '14)., *Acute Med.* 2015;**14**(3):99–103.
- Pradhan S, Ratnasingham D, Subbe CP, *et al.* Society for Acute Medicine Benchmarking Audit 2015: The Patient Perspective. *Acute Med.* 2015;**14**(4):147–50.
- Fluitman KS, van Galen LS, Merten H, *et al.* Exploring the preventable causes of unplanned readmissions using root cause analysis: Coordination of care is the weakest link. *Eur J Intern Med.* 2016 May;**30**:18–24
- <https://www.nrc.nl/nieuws/2016/05/23/spoedeisende-hulp-weigert-vaker-patienten-1621922-a79962>
- Vegting IL, Alam N, Ghanes K, *et al.* What are we waiting for? Factors influencing completion times in an academic and peripheral emergency department. *Neth J Med.* 2015 Aug;**73**(7):331–40.
- Nickel CH, Ruedinger JM, Messmer AS, *et al.* Drug - related emergency department visits by elderly patients presenting with non-specific complaints. *Scand J Trauma Resusc Emerg Med.* 2013 Mar **5**:21:15
- Karakoumis J, Nickel CH, Kirsch M, *et al.* Emergency Presentations With Nonspecific Complaints—the Burden of Morbidity and the Spectrum of Underlying Disease: Nonspecific Complaints and Underlying Disease. *Medicine* (Baltimore). 2015 Jul;**94**(26):e840.
- van Galen LS, Lammers EM, Schoonmade LJ *et al.* Acute medical units: The way to go? A literature review., *Eur J Intern Med.* 2016 Nov 11.