Outcomes of establishing an acute assessment unit in the general medical service of a tertiary teaching hospital

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ABSTRACT

Objective: To evaluate the impact of an acute assessment unit (AAU) on length of hospital stay (LOS), emergency department (ED) waiting times, direct discharge rate, unplanned readmission rate and all-cause hospital mortality of general medical patients.

Design and setting: Retrospective comparison of data for general medical patients admitted to a tertiary teaching hospital in Adelaide, South Australia, before and after the establishment of an AAU (reference years, 2003 [before] and 2006 [after]).

Main outcome measures: Mean LOS, ED waiting times and all-cause hospital mortality during calendar years 2003 (pre-establishment) and 2006 (post-establishment).

Results: Following the establishment of an AAU, the mean LOS shortened (from 6.8 days in 2003 to 5.7 days in 2006; $P < 0.001$) despite a 50.5% increase in the number of admissions (from 2652 to 3992). The number of admitted patients waiting in the ED more than 8 hours for a hospital bed decreased (from 28.7% to 17.9%; $P < 0.001$), as did the number waiting more than 12 hours (from 20.2% to 10.4%; $P < 0.001$). The rates of unplanned readmission within 7 and 28 days did not change. The all-cause hospital mortality for general medical admissions was 4.6% in 2003 v 3.7% in 2006 ($P = 0.056$).

Conclusion: The establishment of an AAU within the general medical service coincided with decreases in both LOS and ED waiting times, despite a 50% increase in admissions. This structural reform in the process of acute medical care may have contributed to the improvement in these key health care performance indices without compromising the quality of patient care.

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The increasing number of acute medical admissions to major teaching hospitals over the past few years demands significant process redesign. The ageing population, improved survival rate of patients with multiple chronic medical conditions and increased patient and general practitioner expectations may all contribute to the burgeoning number of complex medical admissions.[1,2] This increase in the number of admissions has coincided with a restriction in the number of hospital inpatient beds.[3] Clinicians are increasingly expected to accelerate throughput and reduce length of hospital stay (LOS).

A possible solution to these problems is the interposition of an acute assessment unit (AAU) between the emergency department (ED) and the treatment settings in which ongoing care is provided. The AAU provides early review of patients by both a consultant physician (usually a general physician) and an appropriately skilled multidisciplinary treatment team of nurses and allied health staff. The purpose of such a unit is to facilitate admission and discharge processes, as well as improve quality of care.[4,5] The multidisciplinary team plans and initiates inpatient care and facilitates discharge planning from early in the inpatient stay. In such a unit, acutely ill patients can be stabilised and discharged by the AAU team or transferred to inpatient units for further management.

There are few data on the impact of establishing an AAU within existing services. In 2004, Flinders Medical Centre (FMC) in Adelaide, South Australia, established a 16-bed AAU. We retrospectively compared data on hospital presentations and admissions from periods before and after the establishment of this AAU to assess its potential impact in this high patient-volume general medical and subspecialty medical service.

METHODS

Serving the population (330 000) of the southern region of Adelaide, FMC is a 500-bed tertiary referral, university teaching hospital. All acutely ill patients presenting as an emergency are assessed by ED doctors and referred by them to appropriate services; many medical patients are referred to a general medical service staffed by trainees and consultant physicians in general internal medicine.

In 2003, an adult, non-surgical patient considered by ED doctors to need admission could either be referred to a subspecialty service (admission criteria of each unit determined whether or not a patient was accepted) or to an "on-take" general medical team of the day. Patients in the latter group were processed by the on-take team registrar, then admitted to any available hospital bed in any ward (but preferentially to the on-take unit's "home" ward), allocated by a central bed manager, under the care of an "on-call" consultant physician working in one of four general medical teams. This system possibly contributed to congestion in the ED, potentially provoking a higher level of risk to patient care and prolonging hospital stay.[6]

In 2004, the AAU was established and, from the beginning of 2006, it was fully staffed and functioning. The unit was located close to the ED, Intensive Care Unit and the diagnostic imaging department. Its remit was to receive adult patients whose clinical profile made them inappropriate for a subspecialty medical unit, or for a surgical service. Twice a day within the AAU, the consultant physician on duty reviews all new admissions. Patients requiring a stay longer than 48 hours are transferred from the AAU to a general medical unit or an appropriate specialty unit.

Data collection

A patient database was created by linking the hospital morbidity dataset collected at discharge to an inpatient tracking database and an ED database. This enabled the creation of a dataset that included sex, date of birth, dates of admission and discharge, unplanned readmission at 7 and 28 days after discharge with the same medical conditions, time spent in the ED after admission and before transfer to the AAU or another inpatient service, and all-cause hospital mortality.

Statistical methods

Descriptive statistics were calculated for background demographic data, including means (SD) or percentages. The Charlson

Characteristics and outcomes of acute general medical and subspecialty medical patients admitted either before (2003) or after (2006) establishment of an AAU at Flinders Medical Centre

	2003		2006		
	General medicine	Subspecialty	General medicine	PS matched*	Subspecialty
Number of patients	2652	4195	3992	2652	5541
Mean Charlson score (SD)	1.4 (1.8)	1.5 (1.9)	1.2 (1.7)†	1.4 (1.8)	1.4 (1.9)‡
Mean age, years (SD)	68.3 (19.1)	62.1 (17.4)	71.0 (19.2)‡	72.0 (18.7)‡	62.5 (17.9)
Sex, male	43%	43%	44%	44%	45%†
LOS, days (SD)	6.8 (10.0)	6.8 (9.7)	5.7 (8.8)‡	6.0 (8.5)‡	7.4 (11.6)†
Mortality	122 (4.6%)	142 (3.4%)	146 (3.7%)	111 (4.2%)	144 (2.6%)†
EDWT > 8 h	761 (28.7%)	1501 (35.8%)	714 (17.9%)‡	456 (17.2%)‡	1972 (35.6%)
EDWT > 12 h	535 (20.2%)	822 (19.6%)	415 (10.4%)‡	278 (10.5%)‡	1041 (18.8%)

EDWT = emergency department waiting time. LOS = length of hospital stay. PS = propensity score.
* A cohort of general medical patients admitted in 2006 but propensity score (PS) matched to the cohort of general medical patients admitted in 2003. † $P < 0.05$ compared to relevant 2003 population.
‡ $P < 0.001$ compared to relevant 2003 population. ◆

comorbidity method[7] as modified by Quan and colleagues[8] was used to compute a weighted index for each patient. A higher weighting score (based on 19 diagnostic categories) indicates more comorbid disease. Comparisons for LOS, ED waiting times, direct discharge rate, unplanned readmission rate and all-cause hospital mortality were made between reference years 2003 and 2006. Chi-square tests were used to compare categorical variables, and *t* tests for continuous variables of unmatched data. Analyses were performed using Stata 10.0 statistical software (StataCorp, College Station, Texas, USA).

The Charlson score for the general medical patients admitted in 2006 was lower than that for those admitted in 2003. To reduce this bias, propensity score matching was used to compare key outcomes of the two populations. Sex, intensive care unit admission (or not), clinical characteristics defined by principal diagnoses, and comorbidities defined by secondary diagnoses were the matching variables in the propensity scoring procedure. McNemar tests were used to compare categorical variables, and matched *t* tests for continuous variables generated by propensity matching. The propensity score matching was performed using the psmatch2 program found within the Stata 10.0 statistical software.[9]

RESULTS

Patient characteristics

In 2003, there were 2652 admission episodes to the general medical service. The mean age of the admitted population was 68.3 years (SD, 19.1) and 43% were male (Box). The proportion of patients with any comorbidity was 58.6% (Charlson comorbidity score > 0).

In 2006, when the AAU was fully functioning, there were 3992 admission episodes from the ED to the general medical service, an overall increase from those in 2003 of 50.5%. Because the AAU was staffed as part of the general medical service, all AAU patients were considered as general medical patients for coding and analytical purposes. The mean age of the admitted general medical patients was 71.0 years (SD, 19.2) in 2006 ($P < 0.001$ compared with 2003). The percentage of patients with a Charlson comorbidity index greater than zero decreased between 2003 and 2006 (58.6% to 50.1%; $P < 0.001$). However, the absolute number of patients with a Charlson index greater than zero was 1554 in 2003 and 2000 in 2006. Therefore, as well as the total number of admitted patients increasing, the absolute number of patients with multiple comorbidities also increased.

Between 2003 and 2006, a 32% increase in admissions to medical subspecialty units (Box) was observed. The age of patients in these subspecialty units was similar to the cohort in general medicine. However, as in the general medicine cohort, the Charlson score of the subspecialty cohort in 2006 was lower than that observed in 2003.

Length of hospital stay

In 2006, the patient population admitted to the general medical service had a mean LOS of 5.7 days (SD, 8.8) compared with 6.8 days (SD, 10.0) in the 2003 population ($P < 0.001$). To reduce bias caused by the disparity in Charlson scores, 2652 of the general medical patients admitted in 2006 who went through the AAU were propensity score matched with the 2652 general medical patients in 2003. Matched patients in 2006 had a mean LOS of 6.0 days (SD, 8.5; $P < 0.001$ compared with 2003).

Direct discharge rate

The direct discharge rate from the AAU to home or to a setting outside the FMC within 24 hours of admission increased from 13.2% in 2003 to 17.7% in 2006 ($P = 0.002$).

ED waiting time

In 2003, 28.7% and 20.2% of admitted patients spent more than 8 and 12 hours, respectively, in the ED while awaiting a ward bed. There were significant improvements by 2006. In that year, 17.9% and 10.4% of general medical admitted patients were waiting for more than 8 and 12 hours, respectively ($P < 0.001$). These significant reductions in the 8- and 12-hour ED waiting times were preserved in the matched cohorts (Box).

Unplanned readmission rate

In 2006, the rates of unplanned readmission of general medical patients after discharge within 7 and 28 days were 3.7% and 8.0%, respectively, compared with 3.8% and 8.7%, respectively, in 2003 ($P = 0.80$).

Mortality

There were 122 deaths within the general medical service in 2003 and 146 in 2006. These comprised all deaths occurring within the general medical service at any time during the relevant hospital admission episodes, whether the patient was under the care of the AAU or a general medical unit. The all-cause hospital mortality rate in general medical patients was 4.6% in 2003 and

3.7% in 2006 ($P = 0.06$) — a reduction of 20% despite the 50.5% increase in admission episodes and increased age of the patients. Mortality was unaltered in the 2006 cohort that had been matched with the 2003 cohort.

DISCUSSION

We describe several outcomes that followed the establishment of an AAU within a general medical service in a busy teaching hospital in Australia. Despite considerable increases in the number of admitted patients to both subspecialties and general medicine, and despite the increase in the age of the patients, several key performance outcomes significantly improved. Hospital LOS decreased by an average of 1.1 days, increasing bed capacity by about 4391 bed-days per year. The direct discharge rate within 24 hours increased from 13.2% to 17.7%, and all-cause hospital mortality and unplanned readmission rates within 7 and 28 days were unchanged for general medical patients. This suggests that senior and prompt input from consultants and an appropriately skilled multidisciplinary treatment team into each patient's care facilitated the timely discharge of appropriate patients.

The percentage of admitted patients waiting in the ED for more than 8 and 12 hours for a hospital bed also decreased significantly. This suggests that access block parameters may have been improved by the introduction of an AAU. The LOS and ED waiting times for patients admitted to other medical subspecialties did not improve over the same period.

The FMC AAU provides focused systems of acute medical care for a large daily volume of patients. It seems probable that the improvement in key performance indices observed between 2003 and 2006 for patients admitted to the general medicine service occurred because of the systematic structural reforms that were introduced. This outcome supports the concept that increased attention to, and standardisation of, high-volume work produces better health care outcomes. This concept has been applied and validated in numerous other clinical settings.[10]

The AAU abandons the tradition of on-take admission and, instead, focuses on rapid and accurate multidisciplinary assessment of acutely ill patients by competent senior clinical decision makers. This helps generate appropriate treatment at the point of initial assessment, and transfer for ongoing care to the most appropriate specialty unit (or early discharge).

Our analysis shows that the number of admissions to medical inpatient units increased between 2003 and 2006 — by over 50% to general medicine and by over 30% to other medical subspecialty units. The increase in workload was accompanied by a reduction in complexity of illness as determined by the Charlson score. Therefore, matching a subset of the 2006 general medicine cohort to the 2003 group allowed a more valid comparison of clinically relevant outcomes. We observed a reduction in LOS by 0.8 days in propensity score-matched patients. The comparison of LOS between 2003 and 2006 using propensity score-matched patients reduces any potential bias that might have led to this observation. The propensity score is a statistical technique that, by matching patients in different groups, reduces bias resulting from the non-random nature of the treatment assignment seen in observational studies.[11-14] In a propensity score-matched cohort, all variables used to derive the propensity score are balanced, which reduces the potential confounding effects caused by unbalanced covariates.[11,12,14]

The early unplanned readmission of a patient is a major concern.[15] It is thus reassuring that the observed improvements in direct discharge rate and mean LOS were not associated with an increase in the rate of unplanned readmissions, whether examined at 7 or 28 days after discharge. Following AAU establishment elsewhere, 28-day unplanned readmission rate was also unchanged despite a significant drop in LOS.[16]

We observed a total mortality in 2006 about 20% lower after the establishment of the AAU. This bordered on statistical significance, but the matched comparison showed no significant reduction. The establishment of a similar unit in a teaching hospital in Ireland reduced all-cause mortality by 45% over a 4-year period.[17] The all-cause mortality before establishment of an AAU in that hospital was relatively high at 12.6%. Because the all-cause mortality among the FMC's general medical patients was relatively low before the establishment of the AAU (4.6%), we hypothesise that, at best, only a small further reduction in mortality could be achieved.

The inpatient LOS and all-cause hospital mortality are influenced by a number of factors, including the delay in initial review by a senior consultant, the challenges associated with obtaining diagnostic investigations promptly, prolonged waiting in ED for a hospital bed,[18-20] the workload of clinical staff and medical complications arising during the admission. The initial presentation, assessment and treatment of patients with acute medical conditions are crucial but vulnerable to influence by several factors, namely, experience of the assessing medical staff, reluctance of subspecialty units to accept patients with multiple problems and prolonged waits for tests and results.[21] Most delays in discharge are attributable to organisational problems.[22]

An AAU overcomes some of these problems by providing prompt review by competent senior decision makers. An AAU provides a more suitable environment for reviewing patients and their initial test results without overcrowding the ED. The FMC AAU physicians are able to do their work in one location, with coordinated, multidisciplinary input from the unit's nursing and allied health staff. Through restructuring the system of care in acute medicine, LOS for medical patients, even for those with complex conditions, can be shortened and direct discharge rates can be improved.[23] We face a steady increase in the number of acute medical admissions — any reduction in the LOS of general medical inpatients contributes significantly to the efficiency of care provision and availability of beds.

Data of the outcomes of this structural reform are observational and uncontrolled and, therefore, may be affected by unknown bias and other confounders, such as an overall change in the socioeconomic status of admitted patients. It will be extremely difficult, if not impossible, to conduct a randomised trial of the introduction of AAU processes within teaching hospitals. The design of the present study was deliberately hypothesis-generating and not intended to be definitive proof-of-concept. However, our data suggest that continuous reform in the mode of care delivery in acute medicine may have an impact on patients' outcomes.

COMPETING INTERESTS

None identified.

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