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The Acute Stroke Unit at Middlemore Hospital: an evaluation in its first year of operation

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Abstract

Aim Despite strong evidence of benefit, few stroke units exist in New Zealand. In this paper, we describe the process and outcome for the country's first, comprehensive Acute Stroke Unit (ASU), established at Middlemore Hospital in 2001.

Methods The evaluation comprised: (a) two independent 'before and after' audits of medical records of a random selection of patients (2 x n=100) identified from Diagnostic Related Group (DRG) discharge codes for stroke in 1999 (12 months) and 2001–02 (9 months); (b) a review of all DRG stroke outcome data and internal cost analyses for the study periods; and (c) a 'time-in-motion' study of nursing care requirements.

Results The DRG data showed an increase in separations (538 vs 613); stable re-admissions (8% vs 7%); and declines in average length of stay (6.1 vs 5.4 days), deaths (14.0% vs 8.8%), and referrals for rehabilitation (127 vs 67); while the audit indicated shorter times from admission to brain imaging, and swallow and allied health assessments, for stroke from 1999 to 2001–02. A 1:4 nurse:patient ratio seems to provide an optimum level of care for costs.

Conclusions The introduction of the ASU has been associated with improvements in several key indicators of quality of care for patients with stroke.

Specialised Acute Stroke Units (ASUs) have been shown to improve the use of health care resources and the chances of patients surviving free of dependency and/or institutional care after stroke.[1] Moreover, the benefits appear consistent across major patient subgroups: such as the young and old; those with mild, moderate, or severe grades of disability; and in those admitted either early or late after onset. Several distinct features of ASUs that appear important are better coordination of multidisciplinary team (MDT) rehabilitation, integration of nurses and carers in the rehabilitation process, staff with an interest and special skills in stroke care, and the education and training of staff, patients, and carers.[2] However, despite the strong evidence base, and the recommendations of local experts and organisations,[3,4] most New Zealanders do not have access to well organised stroke care,[5,6] due (in part) to the reluctance of leaders to re-configure services, and a lack of clinical expertise and interest in stroke.

As part of the re-organisation of medical services and the opening of a new building, a 12-bed ASU was established within the Division of Medicine at Middlemore Hospital, Counties Manukau District Health Board (CMDHB), in September 2001. This geographically defined unit, located within a 23-bed general medical ward, includes a dedicated MDT of medical, nursing, and allied health staff, and has a policy of accepting direct admissions (or referrals) from the Emergency Department

and medical or surgical teams during standard working hours. Given its potential to benefit a wide range of patients with stroke, entry into the ASU is based on the availability of beds rather than particular stroke syndromes or patient characteristics. Its aims are to provide both specialist coordinated acute care and early rehabilitation for patients with acute stroke, to implement a structured plan of care within 48 hours, and for discharge or transfer for further inpatient rehabilitation to occur within 1 week of admission.

At the request of the CMDHB, and as a final stage to implementation, we undertook an assessment of the impact of the ASU in its first year of operation.

Methods

The assessment involved: (a) a 'before and after' comparison study of process and outcome data obtained from two independent audits of medical records for a random selection of patients with stroke; (b) analyses of outcomes and costs for stroke using the hospital separations database and other information from systems in the organisation; and (c) a 'time-in-motion' evaluation of nursing care requirements. A medical registrar (MDM), who was independent of the ASU during the study period, extracted data from the case notes of 100 patients who had died or were discharged with a diagnosis of stroke during the experimental 'after' period (9 months; September 2001 to May 2002). These patients had been randomly selected by a clerk in the Medical Records Office who had been provided with a list from the computerised separations database of DRG codes 37 and 38 for stroke and transient ischaemic attack (TIA), only as a primary diagnosis. For an assessment of variation in care, the clerk was also instructed to select approximately equal proportions of patients who had been managed within and outside the ASU. Pre-coded data extraction forms were used to obtain information on several key items of case mix, process of care, and outcome, including the time-dependent variables (admission to assessment, days) of brain imaging, swallow assessment, and allied health assessment. These data were compared with a similar audit of 100 randomly selected case notes pertaining to stroke-related DRGs during a 'before' period (12 months; January to December, 1999), undertaken by another independent medical practitioner, and used in a report recommending establishment of the ASU to CMDHB in December, 2000.

In addition, the outcomes of total number of admissions, total average length of stay (ALOS), re-admissions (within one month), and deaths for all cases of stroke/TIA (only as a primary diagnosis) were obtained from the hospital DRG database for the defined 'before' and 'after' study periods. The average unit cost related to an ALOS for stroke/TIA were then calculated by dividing the total costs by the number of cases in each of the study periods. Direct and indirect costs for stroke/TIA, included both fixed and unfixed costs, and covered expenses such as investigations, therapists, nutritional services, medical services, pharmacy, and bed costs, as well as overhead charges for depreciation, administration, and support services. These data were analysed using the software and systems of the Decision Support Unit of Middlemore Hospital.[7] Finally, the optimal nurse:patient ratio was tested in a 'time and motion' study. This involved an independent registered nurse being assigned to the ASU to directly assess the type and amount of nursing care undertaken by five nurses, at varying levels in their clinical career pathway, over four morning and one afternoon duty rosters during a 'typical' week in June 2002. The costs for nursing were then identified by the Decision Support Unit.

Statistical evaluations were conducted with 'Software Package for the Social Services' (SPSS) for Windows software.[8] Descriptive statistics including mean, median, minimum, and maximum values are presented in tables, with the Mann-Whitney U test used to compare groups with continuous variables and skewed distribution, and the chi-square ($?^2$) test statistic used to compare groups with categorical variables. All tests were two-tailed and the level of significance was $p < 0.05$.

Results

Process and outcome audit Table 1 presents the characteristics of the 100 patients in the control 'before' group and 100 patients in the intervention 'after' group, with the

latter group further subdivided into 51 patients admitted to the ASU and 49 patients who received all their care in other medical wards.

Table 1. Demographic and clinical characteristics, by group

Characteristic	1999 group	2001–02 group, overall		2001–2002, by unit		
	(n = 100)	(n = 100)	p value	Other medical unit (n = 49)	Acute Stroke Unit (n = 51)	p value
Demography						
Mean age, yrs (range)	70 (31–89)	70 (33–96)		71 (41–96) 24	(33–89) 29	
Female	51	53	n/s	35	49	0.001
Definite stroke*	90	84	n/s	27	25	
Married	64	52	n/s			
Ethnicity						
Caucasian	62	49	n/s	22	27	n/s
Maori/Pacific Islander	22	27		16	11	
Other	16	24		11	13	
Pre-morbid dependency	21	11	n/s	7	4	n/s
Co-morbidity (³2 risk factors)†	37	54	n/s	27	27	n/s
Mode of referral						
GP	47	41	0.003	19	22	n/s
Self	39	56		29	27	
Other	13	1		-	1	
Unknown	1	2		1	1	

*Excludes transient ischaemic attack (TIA) and other cerebral pathologies such as subdural haematoma

†Includes two or more of diabetes, cardiac disease, renal failure, hypertension, cigarette smoking

The profile of patients was broadly similar in the ‘before’ and ‘after’ groups, although there were slightly fewer patients with a diagnosis of stroke in the ‘after’ group due to the inclusion of several patients with TIA and subdural haematoma who had been retrieved by the DRG codes. This was pertinent to the ‘medical ward’ subgroup, as patients with TIA were not routinely admitted to the ASU. Furthermore, patients in the ‘after’ group had less pre-morbid dependency but more co-morbidity (eg, hypertension, diabetes) than the ‘before’ group.

Table 2 shows data on the process of care. The proportion of patients who underwent brain imaging was high (approximately 95%) in both the ‘before’ and ‘after’ groups, and there was a trend for a greater proportion of patients being imaged on the ASU compared to other medical units. Compared to the ‘before’ group, swallow assessments were undertaken in a higher proportion of patients closer to the time of admission in the ‘after’ group, and were performed more often in patients on the ASU than in other medical units. Although the proportion of patients who received allied health assessments was high in both groups, overall, the trends were for reductions in the time from admission to this assessment, and for more patients in the ASU to receive the assessment compared to those in other medical units. Although the proportion of patients who had a formal functional assessment performed on them

was low (about one fifth in the 'before' and 'after' groups), there was an increase in the proportion of patients with completed discharge summaries.

Table 2. Process of care, by group

Variable	1999 group	2001–02 group, overall		2001–02 group, by unit		
	(n = 100)	(n = 100)	p value	Other medical unit (n = 49)	Acute Stroke Unit (n = 51)	p value
CT use (includes MRI)	95	93		43	50	0.02
Admission to test (days)						
- Mean	1.6	0.9	n/s			
- Median (range)	1.0 (0–23)	1.0 (0–4)	n/s			
Swallow assessment	35	41	0.001	10	31	<0.001
Admission to assessment (days)						
- Mean	4.7	3.1	n/s			
- Median (range)	3.0 (0–19)	3.0 (1–11)	n/s			
Allied health assessment	86	84	n/s	36	48	0.01
Admission to assessment (days)						
- Mean	2.0	1.7				
- Median (range)	1.0 (1–17)	1.0 (0–9)	n/s			
Functional assessment recorded	26	14	n/s	2	12	0.01
Discharge letter completed*	68	98	<0.001	49	49	

*Includes transfer summary

Table 3 shows measures of patient outcomes. Overall, there was a decline in the number of admissions associated with complications in the 'after' study period, with the ASU having more patients with complicated hospital stays and higher mortality than other medical units, yet a greater proportion of patients discharged home. In addition, from 'before' to 'after', there were declines in the proportion of patients referred to the Assessment, Treatment and Rehabilitation (AT&R) Unit (17% vs 35%) and to Home Health Care Services (13% vs 49%), although the number of referrals to outpatient medical clinics for follow-up increased.

Table 3. Outcome measures

Variable	1999 group	2001–02 group		2001–02 group, by unit		
	(n = 100)	(n = 100)	p value	Other medical unit (n = 49)	Acute Stroke Unit (n = 51)	p value
Hospital stay with complications*	43	32	n/s	11	21	
Discharge disposition from Medicine						
Death	5	9	0.02	3	6	0.01
Home	44	58		38	20	
AT&R†	35	16		2	14	
Private hospital or other	16	17		6	11	
Follow-up						
Follow-up plan identified	35	41	n/s			
Medical outpatient clinic	31	52	<0.001	19	33	0.01
Home health care referral	49	13	<0.001	6	7	
NASC referral‡	N/A	14	-	5	9	
Stroke Foundation referral†	N/A	11	-	2	9	0.03
Evidence of delay in discharge§	28	9	<0.001	1	8	0.06
Mean (range) time waiting		6.4 (2–12)	-			

*Includes any of the following: falls, pressure sores, infections, confusion, venous thrombosis, embolism, myocardial infarction, and seizure

†AT&R = Assessment, Treatment and Rehabilitation Unit for older people

‡NASC = Needs Assessment and Service Coordination service for older people; data only included in the 2001–02 audit

§In most cases, delay in discharge was related to an unexpected illness (e.g. pneumonia) in the patient or the wait of an available bed in a private hospital, but it also included investigations such as gastrostomy and videofluroscopy procedures.

Review of DRGs for stroke/TIA The DRG data showed that the number of separations for stroke/TIA had increased from 538 in 1999 to 613 in 2001–02, with 33% of all cases in the later period being managed within the ASU. The ALOS for stroke had decreased from 6.1 days to 5.4 days, and the ALOS in ASU ranged from 5.8 to 9.1 days (mean 7.1 days) compared to 3.0 to 6.1 days (mean 4.2 days) in the rest of general medicine. For the two time periods, transfers to AT&R had decreased (127 to 67) and re-admissions to hospital had declined (8% to 7%), with the ASU cases having a lower re-admission (4.2%) compared to cases from the rest of the hospital (5.5%). Overall, deaths had decreased between the two study periods, but were higher (11.4%) for the ASU compared to other units (9%) during 2001–02.

Cost analyses The average cost per stroke/TIA (relative to ALOS) had increased from $3560 in 1999 to $4464 in 2001–02. The total cost of care in the ASU was $759 473 during the ‘after’ period, which was approximately $70 000 higher than that for

other medical wards—the result of an actual 1:3 nurse-to-patient ratio of care together with the use of special, watch and bureau nurses. An annualised figure of $84 000 for the ASU was derived by deducting the average cost of the 12 beds from the total cost for all beds on the ward. Based on the 'time and motion' study, which showed that a 1:4 nurse-to-patient ratio was adequate for patient care and the safety of staff, the cost of the ASU was estimated at $718 179 (without special and watch nurses)—a difference of $41 000 above that of other medical wards.

Discussion

We undertook an evaluation of the effectiveness of the ASU, by comparing various measures of the new model of care against an historical standard. In general, the data show that the introduction of the ASU has been associated with improvement in the quality of care outcomes for patients with acute stroke admitted to Middlemore Hospital. These effects occurred against a background of rising patient numbers, as well as higher costs of care for patients with stroke.

Increasing demand and economic pressures on the health care system have intensified the need for evidence-based approaches, cost-effective analyses, and better strategies to improve patient and consumer outcomes. Quality of care is increasingly being judged on process and outcome data, although this is a complex task, with the deficiencies in valid and reliable measures being widely acknowledged.[9] In our audit of medical records, we chose several measures that captured aspects of the chain of care for patients with stroke; that of diagnosis, functional (disability) assessment, acute and rehabilitation management, discharge, and follow-up. The data show a consistently high level of brain imaging being undertaken to confirm the diagnosis of stroke in both study periods, but the trend was for earlier imaging to be undertaken in 2001–02 compared to 1999. Arguably more important, though, was the finding of an increase in swallow assessments, and a trend for them to be done closer to admission following introduction of the ASU.

Moreover, compared to other medical wards, this assessment was more likely to be done on patients admitted to the ASU, possibly due to the training of Dysphagia Link Nurses to improve clinical management and reduce the time that patients are kept 'nil by mouth'. Allied health assessments, including those by occupational health, physiotherapy, speech-language therapy, and social workers, was high in both study groups, but the trend was for earlier assessments to be undertaken in 2001–02.

Overall, the number of hospital admissions complicated by medical illness, such as falls and infections, was lower in 2001–02. However, the greater proportion of complicated cases on the ASU, as compared to other medical wards, can largely be attributed to case selection—whereby patients with TIA were excluded (and the more severe or complicated cases included) in the ASU. Use of functional assessment measures, such as the Barthel Index,[10] were low in both study periods, in part because none of the staff on the ASU were instructed in their use; a situation that has now been corrected. There was a large increase in the proportion of completed patient discharge letters, but this probably reflects the introduction of electronic discharge summaries after 1999.

While the audit of medical records showed a trend towards an increase in the number of deaths after stroke, this was not supported by the DRG data for all patients with

stroke/TIA during the two study periods. Deaths from stroke had declined by over one-third since 1999, but the higher number of deaths on the ASU compared to other medical units during 2001–02 may again be attributable to the admission of more severe cases on that ward. This explanation is further supported by the higher number of patients referred to AT&R and private hospitals from the ASU—as compared to other medical units, where a greater proportion were discharged home. Overall, the number of patients discharged home after stroke had increased since 1999.

The overall decline in referrals to AT&R in 2001–02 is striking. One explanation is that the ASU is providing early rehabilitation, including effective discharge planning, that was not possible on other medical wards, resulting in an earlier and direct discharge to home for some patients who would otherwise have received further inpatient rehabilitation. As the overall ALOS for patients with stroke had declined from 1999 to 2001–02, the ASU does not appear to be retaining patients longer than was necessary, and (in line with other studies) shows that patients were usually discharged within 7 days of admission.[1] A decline in ALOS was also seen after the introduction of a dedicated stroke rehabilitation ward for older people at the Princess Margaret Hospital, Christchurch, in 2001.[11] Moreover, the higher number of patients discharged home, the increased referral for follow-up in a medical outpatient clinic, and the low re-admission, provide further support that the ASU offers an improved and effective discharge process. While the low referral to Needs Assessment Service Coordination (NASC) and to Home Health Care services may be due to patients being more independent and having less need of home help, it could also represent changes in documentation of referrals, and so requires further investigation.

The relative and absolute costs of stroke are high, and increasing, as evident by the DRG data. However, this trend should be viewed within the context of an overall increase in the costs of medical care as well as inflation, rather than being necessarily due to the use of MDTs on the ASU and other medical units. The ‘time in motion’ study showed that a 1:4 (as opposed to the 1:3) nurse:patient ratio, initially employed on the ASU (with a health care assistant employed for tasks such as tidying rooms, making beds and emptying indwelling catheters), is adequate for care and safety, and provides an appropriate budget for nursing care.

There are several limitations to this study that must be mentioned. Firstly, the quality of the data is highly dependent on the accuracy and completeness of information included in the DRG codes and medical records, cross-sectionally and over time. However, we used only primary stroke/TIA DRG codes that have been shown to be valid,[12] and any bias is likely to have been balanced across the two study periods. Secondly, the small number of charts included in the audits raises the possibility of error due to chance or random variation, particularly due to differences in periods of observation (12 months in 1999 versus 9 months in 2001–02). Finally, it is not only difficult to draw conclusions regarding ‘cause-and-effect’ relationships (that is, effects of the ASU), but it is also important to consider the data in the context of ongoing changes in the health care environment, both within the hospital and the community as a whole. Public health strategies and new community initiatives, especially chronic disease management projects, could have had an impact on stroke outcomes independent of the ASU.

Despite its limitations, though, we believe our study has shown that the introduction of the ASU has been associated with a better process of care, as evidenced by an

increase in swallow assessments and speed of input from allied health, as well as better discharge planning and medical follow-up. As with any new service, there were set-up problems, some of which could have been avoided with better planning. However, the findings from the audits complement the DRG data in indicating favourable trends in stroke outcome, possibly due to the benefits of the MDT model of care and rehabilitation, as indicated by the randomised evidence.[2] However, the declines in referrals for inpatient rehabilitation and to community services, requires further investigation to ensure that patients' re-settlement back home after stroke is effective.

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