

**DEPARTMENT OF HUMAN SERVICES
ACUTE HEALTH DIVISION**

**POST ACUTE CARE STUDY:
EVALUATION OF OUTCOMES
IN OLDER PATIENTS
APRIL 2001**

Prepared by

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Executive Summary

The Post Acute Care program was introduced in Victoria to improve the transition from hospital to the community. Despite increasing government expenditure on this program, the literature demonstrates that outcome studies examining discharge planning and post acute care interventions have yielded conflicting results. A multicentre randomised controlled study was performed to evaluate the effectiveness of the PAC program. This report focuses on the health, service utilisation and cost outcomes of the PAC program in older patients (65 years and greater) recruited into the study over a 6 month follow-up period.

Data gathering was extracted from case note review as well as various government and community service databases. Three questionnaires, the SF-36, Assessment of Quality of Life and the Carer Strain Index were administered at baseline and one month follow-up.

The main results for patients 65 years and greater are summarised as follows:

- There was no difference in survival between the groups.
- There was an improvement in quality of life scores in the PAC group, as measured by the Assessment of Quality of life (AQoL) instrument, in the independent living and overall AQoL domains.
- There was a decline in the general health domain in the PAC group as measured by the SF-36. All other domains measures by the SF-36 score were however not significantly different between PAC and control groups
- Among patients readmitted to hospital, there was a reduction in hospital lengths of stay in PAC patients compared with controls.
- Using an estimated average bed day cost, there was a significant cost saving in the PAC group as opposed to the control group due to the reduction in hospital bed day utilisation in PAC clients over the 6 month follow-up period.

In conclusion, the PAC program is a viable and cost effective strategy in improving the transition of older patients from hospital to the community.

Chapter 1

Introduction

Since the introduction of casemix or prospective payment systems in Victoria in 1993/94, there has been a significant decline in hospital lengths of stay, from 11 days in 1992/93 to 7 days in 1997/98, among patients greater than 70 years of age. There has also been a shift in governmental policy towards providing increased community care in preference to the traditional model that favoured institutional care. Various hospital and home based interventions aimed at improving the transition from hospital to the community have been performed locally as well as overseas. These strategies have had conflicting results in improving patient outcomes as well as reducing service utilisation and costs (Lim and Gray, 2000).

In keeping with initiatives aimed to promote the process of discharge planning and improve the transition from hospital to the community, the Victorian Post Acute Care program was developed by the Victorian government in 1996. These programs are funded by the Victorian Department of Human Services to provide services to patients in the immediate period (up to six weeks) after discharge from acute hospitals. The Department of Human Services Post Acute Care program newsletter in 1996 defined PAC as *"a time limited short-term intervention designed to assist patients to fully recuperate following an acute hospital admission or to prepare them for appropriate long term support."*

The PAC study was performed in Victoria, Australia over the periods between August 1998 and April 2000 to evaluate the efficacy of the PAC program in meeting its objectives of improving health care and reducing health costs to the community. The design of the study was in the form of a prospective randomised controlled trial. This design is considered to be the gold standard in terms of health services research provided the process of randomisation is performed adequately. Four centres were recruited to participate in the study. Patients were randomised to receive the PAC intervention or in the case of control patients, were referred to the social work department to address post discharge needs.

An extension to the PAC study was submitted to the Department in mid 1999 to look specifically at health outcomes of older patients in the PAC study. The rationale behind this proposal was that older patients were more susceptible to poorer health outcomes, including increased readmission rates to hospital, due to the nature of their illnesses and associated comorbidities. This increase in readmission rates is based both on literature from other developed nations as well as work performed by the *Centre for Applied Gerontology*.

Readmission rates in older patients in Victoria

An analysis was performed looking at the rates of 28-day readmissions in patients over the age of 65 years. This data was obtained through secondary database interrogation and was not corrected for unplanned versus elective readmissions. Other variables that were obtained included the total number of separations / admissions, average length of stay, interhospital transfers and sameday versus multiday admissions. This information is set out in Table 1 below.

Table 1: Readmission rates[#] and Average Length of Stay for older people in Victoria, 1990-91 - 1999-00*

Year	Readmission Rates (%)	Length of Stay (days)
1990-91	NA	10.3
1991-92	13.1	10.6
1992-93	13.8	9.5
1993-94	14.9	7.3
1994-95	15.9	7.0
1995-96	15.8	6.8
1996-97	15.2	6.5
1997-98	15.2	6.1
1998-99	15.2	5.8
1999-00	15.2	5.7

Source: Department of Human Services, Victoria.

28 day readmissions of patients 65+ excluding renal dialysis, chemotherapy and radiotherapy. These are measured as a percentage of total separations

*Average length of stay for all separations, patients aged 65+

Source: Department of human services, Victoria.

The data indicates that, for the period 1991-92 to 1999-00, public hospital readmissions for people 65 years of age and greater have increased by 16 percent, when adjusted for separations. Over this period, the average length of stay for admissions has decreased by 46 percent from 10.6 to 5.7 days. The figure of 15.2% readmission rate is a high one for patients aged 65 years and over and indicates that there is a large scope for improving the health service but reducing hospital utilisation rates.

Aims of the study

In view of the changes in hospital utilisation patterns in older patients in Victoria, a more detailed analysis was performed examining the effects of the PAC program on a subgroup of patients recruited to the PAC study who were aged 65 years and greater. Patients aged 65 years and greater constituted 58% of the overall PAC population in Victoria in 1997/98.

The main aims of this study was to determine if

- 1) The PAC intervention has a beneficial impact on the health status of older patients.
- 2) The PAC intervention improves the quality of life of older patients managed by the Program in the short term.
- 3) The PAC intervention reduces the readmission rate to hospital or the overall hospital utilisation (days in hospital) in the six month period after discharge for patients managed by the Program.
- 4) The PAC program is cost-effective.

Chapter 2

Methodology

The methods used to collect outcome data are outlined in Table 2.

Table 2 Variables measured in the study and instruments/methods used

Variable	Instruments/methods
Demographic characteristics	
age	Supplementary survey derived from Australian Bureau of Statistics
sex	
country of birth	
private insurance status	
main income	
health benefits card	
accommodation	
Characteristics of index admission	
Unplanned/elective admission	Case note review: coding performed using ICD-10
Length of stay	
Diagnostic group (medical/surgical)	
Primary diagnosis	
Complications during admission	
Comorbid conditions	
Medications on admission	
Medications on discharge	
Hospital utilisation data	
Unplanned admissions	Case note review / Victorian inpatient minimum dataset
Emergency room visits	
Community service utilisation data	
	Community services databases
Health outcome measures	
Survival	Case note review/ State office of births, deaths and marriages
Quality of life	
Health status measure	
Carer burden	
Cost data	
Average bed day cost	Victorian Department of Human Services
WIES payments	VAED
Community service costs	Community services database
PAC costs	PAC financial statements 1998/99

Hospital utilisation and medical outcomes data

In order to obtain admission data, an extensive case note review was performed by the same researcher (the author). The rationale behind performing the case note review was that:

- extensive data could be obtained on patient diagnosis and medication use
- a single reviewer could provide consistency to the coding of patient diagnoses
- the characteristics of each admission could be examined thoroughly
- unplanned readmissions to hospital could be identified more accurately
- additional information, for example emergency admissions to hospital could be obtained

The case note review was performed after the 6 month follow-up period had been completed on all patients 65 years and greater in the study. All patients had their admission characteristics documented on a proforma by the case note reviewer who was blinded to the patient's study group allocation. Characteristics of the index admission were initially collected. This included the index admission length of stay, whether the admission was planned or unplanned or whether the admission was a medical or surgical admission. An unplanned admission was defined as an emergency admission where the patient required immediate admission to hospital due to a decline in their health status. Most of these admissions occurred through the emergency department. A planned or elective admission was defined as an admission that had been organised or booked previously for the patient to have a procedure or investigation.

Diagnoses of patients were documented by case note review using the ICD-10 criteria. As all patients' notes were assessed by the same reviewer, all files were coded using the same criteria. The coding framework for the diagnoses was divided into three main areas, that included primary diagnosis, complications and associated diagnosis. The primary diagnosis was the primary reason the patient presented to hospital. Associated diagnosis was defined as other medical conditions that required chronic management or impacted on the patient's primary diagnosis. Complications were unforeseen medical or surgical events that occurred during the admission. Coding was performed for all index admissions and unplanned admissions in the 12 months prior to and 6 months after trial recruitment. All emergency department visits to the participating hospitals was also documented for the same periods.

Economic analysis

This section outlines the methods in which costs were calculated to measure the effectiveness of the intervention. Cost minimisation analysis was not an appropriate form of analysis for this study as the outcomes between the two groups were different. For the purposes of this evaluation a cost benefit analysis was used as it provides monetary values that is useful for the provider of the health service, in this case, both the Department of Human Services and the individual hospitals who have a stake in

the PAC program. The outcome assessed was hospital and community service utilisation costs following the intervention over a 6 month follow-up period.

Hospital utilisation was examined from two perspectives. Firstly the cost of reimbursement for patient admissions was analysed using weighted inlier equivalent separations (WIES) data derived from the Victorian Admissions Episodes database (VAED). WIES is a form of remuneration based on casemix or prospective payment systems used by the Department of Health to reimburse hospitals for episodes of patient care. This method funds hospitals primarily on the diagnosis of patients admitted, with discounted payments provided in the event that the patient overstays (high outliers) or understays (low outliers) the predicted length of stay. By using WIES data to evaluate the cost benefits of the intervention, the Department is able to review its expenditure in relation to supporting the PAC program and to assess the impact of the program on expenditure related to inpatient admission episodes, over the 6 month follow-up period.

Secondly, hospital bed day costs were calculated using an average bed day cost derived from the National Hospitals Costing Study for Victorian hospitals (NHDC, 1999). The rationale behind calculating hospital utilisation costs using this method lies in the fact that WIES payments have a greater bias towards payments for specific diagnoses rather than accounting for true resource utilisation in the form of hospital length of stay. Therefore, it is conceivable that reductions in length of stay, without an increase in patient readmissions to hospital, will not be reflected in costings performed using the WIES payment method. The average bed day cost for Victorian public hospitals was calculated as A\$650.

Community service costs were obtained from community service utilisation data extracted from the study population. The cost of care coordination was generated from the difference between the PAC budget in 1998/99 (\$6.9 million) and the cost of services (\$3.98 million). The cost per patient was calculated by dividing this value over the number of clients who had services commenced in 1998/99 (PAC program, 1998/99). This formula is summarised below:

Mean cost of PAC coordination per client = [PAC budget (98/99) - cost of services] / number of clients who had services commenced.

The cost of care coordination for PAC patients was \$292.40 per patient.

Total cost for the PAC group was the sum of community costs, hospital costs in the follow-up period and the cost of PAC coordination. The total cost for the control group was the sum of hospital and community costs. Differences in cost data between the groups were analysed using the Student's t-test to compare arithmetic means. Although resource use or cost data are highly positively skewed, the mean was presented for descriptive purposes. Provision of information about median resource use and costs are of little value to service planners who require estimates of total costs associated with any health service intervention. As a result of the skewed data, standard deviations must be interpreted with caution.

Sensitivity analysis

The inclusion of an average per day cost in the evaluation of hospital care may overstate the actual hospital costs. This is because the marginal or end-of-stay costs may be lower than the average bed day cost. To approximate these marginal bed day costs, a sensitivity analysis was performed assuming that the costs were 90%, 75% and 50% of the average bed day expenditure. This allowed a further estimate of hospital utilisation costs and total costs.

Chapter 3

Results

Introduction

The main study findings are presented in this chapter. In the first section, data related to the sample selection and the study population's demographic characteristics and medical characteristics are described. The study results or outcomes are then divided into three main areas.

Firstly, the study examines patient specific outcomes. This includes measures of survival, quality of life as measured by the Assessment of Quality of Life questionnaire (AQoL), functional status as measured by the SF-36 and the carer strain index. Secondly, service utilisation outcomes are presented. This relates to hospital readmission rates and bed day utilisation as well as community service utilisation by patients in the study in the 6 month follow-up period. Thirdly an economic analysis is performed looking at the impact of PAC and the cost effectiveness of the program in relation to service utilisation data extracted. A summary of the results is presented in the final section.

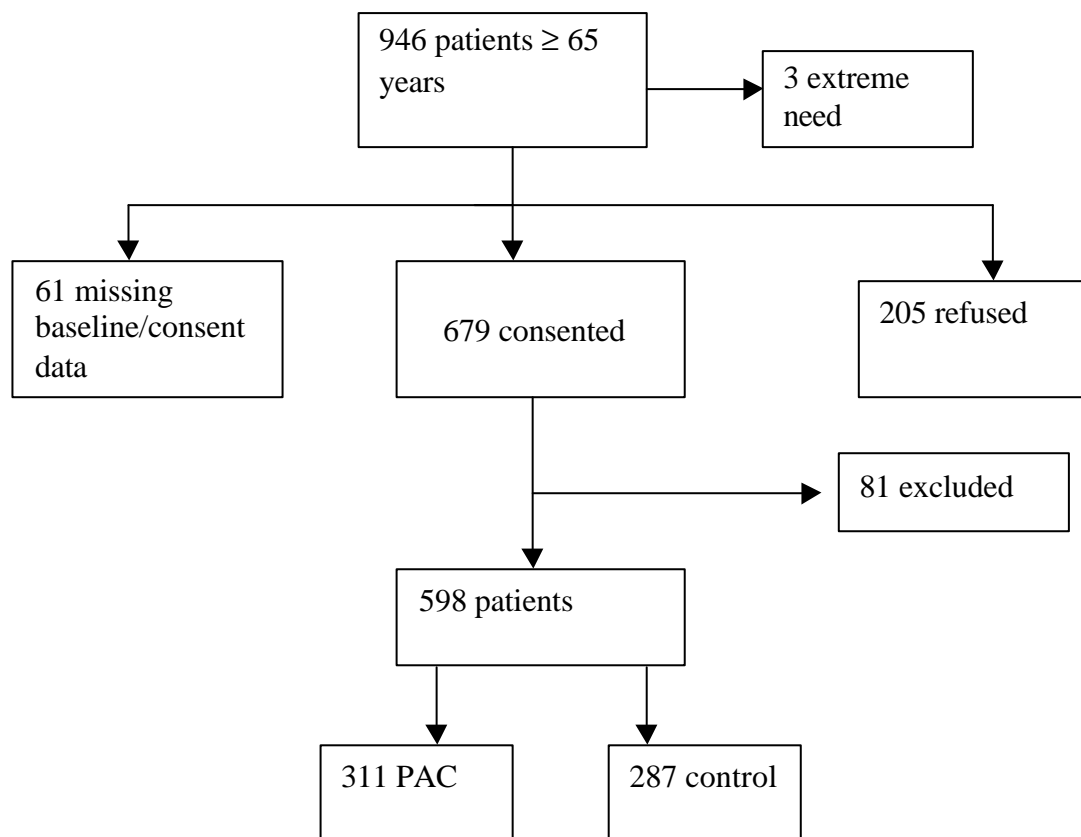
Sample selection

There were 1553 patients who were considered to be PAC eligible during the study recruitment phase. Of these, 946 patients (61%) were aged 65 years and greater (refer Figure 1). Out of the 946 PAC eligible subjects, 136 patients (14.4%) refused consent, 61 (6.4 %) had extensive missing baseline data, 56 (6%) refused the PAC intervention, 13 (1.4%) refused to be interviewed and 3 (0.4%) were considered to be of extreme need and requiring the PAC intervention. Of the remainder 679 patients who consented to be in the study, 48 patients were excluded as they died during the index admission (20.8%), were not discharged directly home (70.9%) or were unavailable for follow-up due to being discharged interstate (4.2%). Reasons for patient exclusion after recruitment to the study are illustrated in Table 3. There was extensive missing data in 33 patients or 5.5% of the cohort. For the purposes of the analysis therefore, there were 598 patients, which constitutes 63.3% of the original population greater than 65 years of age, screened to be eligible for the study.

Table 3 Reasons for patients being excluded from the study

Reason for exclusion	No of patients (Percentage %) n = 81
Missing data	33 (40.8%)
Discharged to rehabilitation hospital	27 (33.4%)
Died during index admission	10 (12.4%)
Discharge to acute hospital	6 (7.4%)
Discharge to nursing home	1 (1.3%)
Extreme need	1 (1.3%)
Discharged interstate	2 (2.5%)

Figure 1 Flow chart of eligible patients for the study



Demographic characteristics of the sample

The 598 patients included 287 (48.1%) control patients and 311 (51.9%) intervention patients. Their baseline demographic characteristics are outlined in Table 4. The patients in the PAC group were well matched with the controls. There were no significant differences in terms of age, gender mix, income and education as well as other government benefits like the pension and the presence of a health care card.

The median age of patients was 76.4 years in the intervention group and 76.3 years in controls. A large proportion of patients were born overseas, 56% in the PAC group and 44% in the control group respectively. About a quarter of patients had a tertiary education. The majority of patients also relied on the pension as the main source of income. There was a low uptake of private health insurance, 16% of all patients which was also not statistically different when comparing the two groups.

Table 4 Demographic characteristics of patients

Variables	PAC group (n=311)	Control group (n=287)	Significance (p value)
Age (Median +IQR)	76.4 (71.1-81.2)	76.3 (71.1-81.2)	0.42 (NPT)
Gender			
M (%)	40	43	0.358 (Chi ²)
F (%)	60	57	
Born overseas (%)	56	44	0.485 (Chi ²)
Private insurance (%)	16	16	0.783 (Chi ²)
Main income (%)			
Government Pension	69	66	0.727 (Chi ²)
Private income	31	37	
Health Benefits Card (%)	9	11	0.422 (Chi ²)
Education (%)			
Primary school	1	0	0.804 (Chi ²)
Secondary school	4	5	
Diploma/certificate	70	67	
University	23	26	
Other	3	2	

Medical Characteristics of Patients

The medical characteristics of patients were coded using their presenting or index admission. This was done by case note review and focused on:

- identifying their index admission as planned or unplanned
- distinguishing admission type as medical or surgical
- coding their primary admission using ICD10 criteria
- developing subgroups for each admission type
- identifying the number of medical comorbidities each patient had
- coding whether the admission was complicated by unforeseen events

Results of medical characteristics of the primary/index admission

The characteristics of the admission diagnosis are outlined in Table 5. Figures 2 and 3 illustrate the primary diagnostic group of the intervention and control groups. None of the diagnostic admission characteristics were significantly different between the groups. Over 65% of patients had an unplanned index admission. Approximately half of patients in both groups had medical admissions. The rate of unforeseen

complications occurred in slightly over 30% of admissions. Both groups had a median number of two comorbidities. Comorbidities were defined as conditions requiring active medical management but which were not the primary reason for the patient's admission to hospital. The median number of medications at admission was 4 and at discharge, a median number of 6 medications were prescribed.

Table 5: Medical characteristics of the index admission

	PAC	Control	Significance
Unplanned index (%)	67.0	69.2	p = 0.558, Chi ²
Diagnostic group			
Medical (%)	49.7	53.8	p = 0.362, Chi ²
Surgical (%)	50.3	46.2	
Complications (%)	31.7	33.2	p = 0.716, Chi ²
Comorbidities	2 (1-3)	2 (1-3)	p = 0.821, Mann Whitney
Median (IQR)			
Medications on admissions	4 (2-7)	4 (2-7)	p = 0.37, Mann Whitney
Median (IQR)			
Medications on discharge	6 (4-8)	6 (4-9)	p = 0.71, Mann Whitney
Median (IQR)			

Analysis was performed comparing the primary diagnosis of both groups at the time of recruitment. There was a non-significant difference in terms of diagnostic spread of the 2 groups (p = 0.609, Chi²). Figures 2 and 3 illustrate the diagnostic categories of the patients. The most common diagnosis was a cardiac cause which occurred in 21.1% of the PAC group and 23.1% of the controls. Musculoskeletal causes mainly in the form of fractures and respiratory causes were the next most common reasons for admission to hospital.

Figure 2 Diagnosis (PAC)

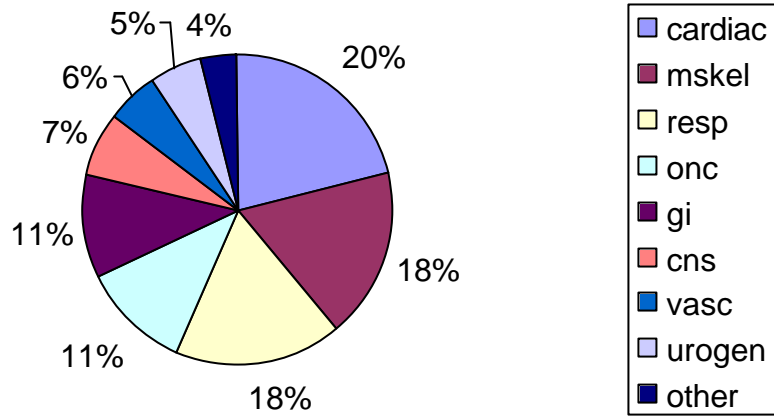
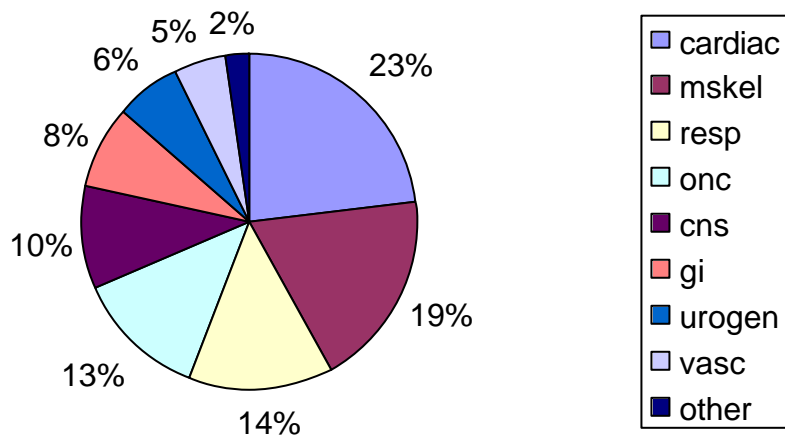


Figure 3 Diagnosis (Control group)



Patient Outcomes

Primary outcome: Survival

In terms of patient outcomes, survival was the primary outcome measure. The proportion of patients who died in the study was not statistically different between PAC and control groups ($p = 0.924$, Chi^2). 19 patients in the intervention group (6%) of patients died during the six month study follow-up period compared with 17 patients (6%) in the control group. This is illustrated in Table 6.

Table 6 Patient mortality during the 6 month follow-up period

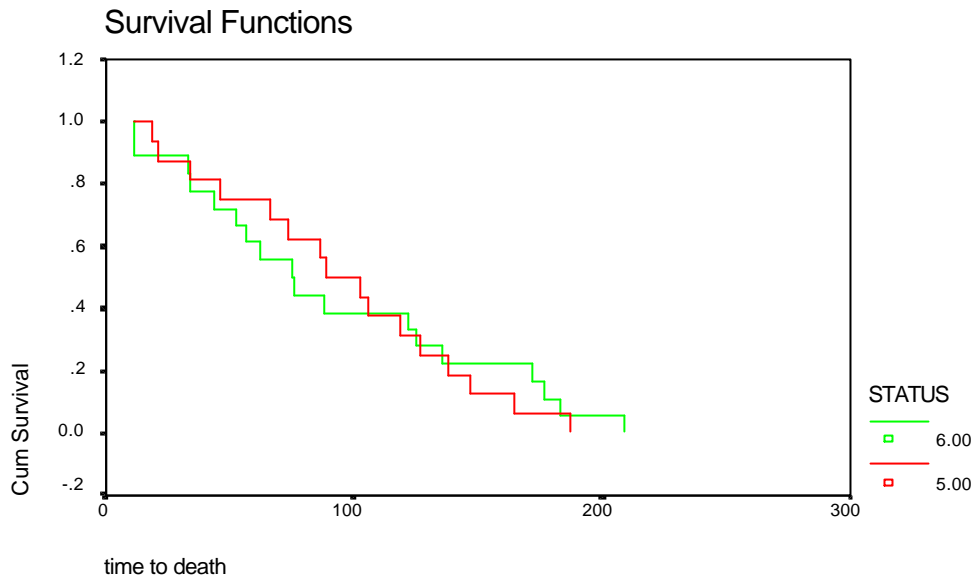
Status	Deceased	Not deceased	Total (100%)
Control no (%)	17 (6%)	270 (94%)	287
PAC no (%)	19 (6%)	292 (94%)	311
Total no (%)	36 (6%)	562 (94%)	598

Further analysis was performed to examine the impact of the intervention in terms of time from patient recruitment to death, using log rank tests for analysis of mortality data. A limited Kaplan Meier curve was also constructed looking specifically at the subjects who died during the follow-up period. The median number of days to death, in patients who died was 75 days in the intervention group and 89 days in the control group. This difference was not statistically significant (refer Table 7, $p = 0.84$ by log rank analysis). Figure 4 illustrates the survival data comparison between the two groups looking specifically at patients who died.

Table 7 Time to death: Kaplan Meier survival analysis

	Intervention	Control	Significance (Log rank)
No events	19	17	NA
Median (days)	75.00	89.00	$p = 0.8426$
95% CI	(95% CI, 45.90-104.10)	(95% CI, 57.64-120.36)	

Figure 4 Survival data during study follow-up (Kaplan Meier survival curve for patients who died)



5 = control and 6 = PAC

Secondary outcomes

Secondary patient outcomes measured included quality of life assessed by the AQoL instrument and the SF-36. Carer outcome measures included the measurement of the Carer Strain Index (CSI). The SF-36 and AQoL questionnaires were administered at baseline and at one month follow-up. The Carer Strain Index (CSI) was administered to carers at one month follow-up.

Assessment of Quality of Life instrument (AQoL)

At baseline, there were 679 subjects, 327 in the control group and 352 PAC patients who completed the questionnaire. At one month follow-up, there were 540 patients who completed the AQoL questionnaire (282 PAC and 258 controls). There was a 20% drop out rate between the first and second interviews. The difference in proportion of subjects who were in intervention and control groups (Table 8) was not significant between baseline and one month follow-up (Chi^2 , $p = 0.87$).

Table 8 AQoL baseline and 1 month follow-up (Difference $p = 0.87$, Chi^2)

	Baseline	Round 2	Percentage (%)
Intervention	351	282	80.4%
Control	327	258	78.9%
Total	678	540	79.7%

Table 9 lists the baseline, second round and change in AQoL scores of the two groups. Using non-parametric tests, there was no difference between the two groups at baseline except for one dimension of the AQoL. This was in the independent living score where the control group had a higher baseline score than the PAC/intervention group ($p = 0.028$).

For patients who completed the 1 month follow-up or round 2 questionnaire, there was no difference in scores between the two groups when comparing the two groups at round 2 or one month from randomisation (Table 9).

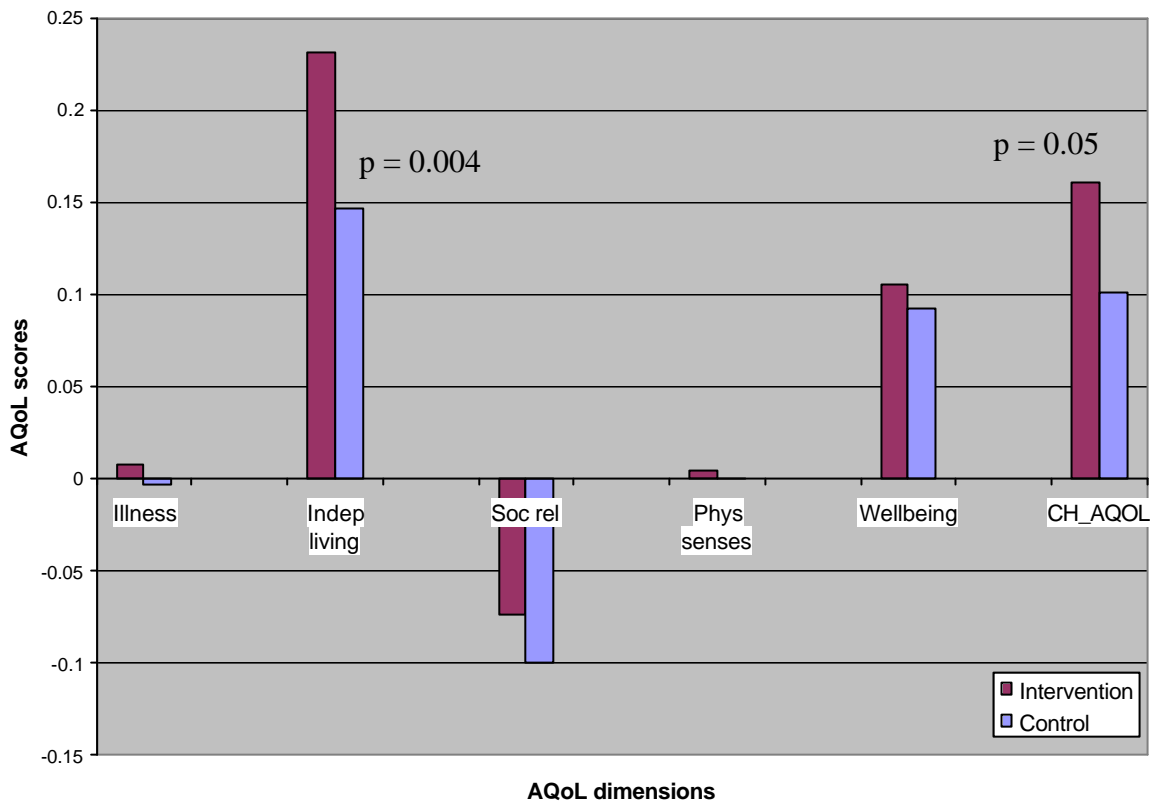
There were, however, significant differences between the two groups when looking at the change in AQoL scores (refer also Figure 5). In the PAC group, there was significant improvement compared to controls in the independent living scores ($p = 0.028$). There was also an overall improvement in AQoL scores compared to controls ($p=0.05$). There were no differences in the other domains measured.

Table 9 Comparison of AQoL scores

Variables	Intervention median (IQR)	Control median (IQR)	Significance (Mann Whitney U)
AQoL baseline	0.21 (0.08-0.40)	0.24 (0.10-0.43)	p = 0.066
AQoL round 2	0.39 (0.20-0.65)	0.42 (0.16-0.59)	p = 0.415
AQoL change	0.15 (-0.05-0.37)	0.08 (-0.08-0.30)	p = 0.05
<i>Baseline:</i>			
Illness	0.19 (0.08-0.38)	0.17 (0.08-0.38)	p = 0.859
Independent living	0.35 (0.18-0.61)	0.43 (0.24-0.64)	p = 0.028
Social relationships	0.90 (0.80-1.00)	0.90 (0.78-1.00)	p = 0.408
Physical senses	1.00 (0.88-1.00)	1.00 (0.88-1.00)	p = 0.975
Psychological well-being	0.71 (0.57-0.87)	0.73 (0.57-0.89)	p = 0.300
<i>Round 2:</i>			
Illness	0.17 (0.13-0.26)	0.15 (0.13-0.26)	p = 0.214
Independent living	0.61 (0.45-0.83)	0.61 (0.42-0.83)	p = 0.177
Social relationships	0.86 (0.58-1.00)	0.88 (0.35-1.00)	p = 0.843
Physical senses	1.00 (0.91-1.00)	1.00 (0.88-1.00)	p = 0.358
Psychological well-being	0.85 (0.71-0.95)	0.85 (0.72-0.91)	p = 0.415
<i>Change in AQoL:</i>			
Illness	0.00 (-0.13-0.13)	0.00 (-0.15-0.11)	p = 0.899
Independent living	0.20 (0.00-0.48)	0.11 (0.00-0.34)	p = 0.004
Social relationships	0.00 (-0.20-0.06)	0.00 (-0.20-0.06)	p = 0.411
Physical senses	0.00 (0.00-0.05)	0.00 (0.02-0.06)	p = 0.767
Psychological well-being	0.07 (-0.00-0.26)	0.05 (-0.04-0.22)	p = 0.250

Bold = significance level ≤ 0.05

Figure 5 Change in AQoL median scores



Soc rel = Social relationships
 Indep living = Independent living
 Phys senses = Physical senses
 CH_AQOL = Change in overall AQoL score

Correlation between the AQoL and hospital utilisation

In order to examine if any of the dimensions of the AQoL were related to patient readmissions and hospital utilisation in the 6 month follow-up period, correlation analysis was performed (Table 10). At baseline, none of the dimensions of the AQoL were significantly correlated with either unplanned readmissions or hospital bed day utilisation in the 6 months after trial recruitment.

When looking at the change in AQoL scores however, two variables were identified as being correlated with hospital utilisation and unplanned readmissions. These were change in independent living scores and change in overall AQoL scores, where an improvement in scores was negatively correlated with hospital use in the 6 month trial follow-up period (Pearson's correlation = -0.136, p = 0.003).

Table 10 Correlation between AQoL scores and hospital utilisation

	Hospital days (Pearson correlation/Sig)	Unplanned readmissions (Pearson correlation/Sig)
AQoL baseline		
Illness	$r^2 = -0.049 ; p = 0.235$	$r^2 = -0.067 ; p = 0.103$
Independent living	$r^2 = 0.008 ; p = 0.842$	$r^2 = 0.052 ; p = 0.208$
Social relationships	$r^2 = -0.068 ; p = 0.100$	$r^2 = -0.052 ; p = 0.209$
Physical senses	$r^2 = -0.072 ; p = 0.083$	$r^2 = -0.066 ; p = 0.112$
Wellbeing	$r^2 = -0.034 ; p = 0.410$	$r^2 = -0.051 ; p = 0.588$
Overall AQoL	$r^2 = -0.031 ; p = 0.457$	$r^2 = -0.024 ; p = 0.558$
AQoL change		
Illness	$r^2 = -0.074 ; p = 0.107$	$r^2 = -0.084 ; p = 0.065$
Independent living	$r^2 = -0.136 ; p = 0.003$	$r^2 = -0.163 ; p = 0.000$
Social relationships	$r^2 = -0.059 ; p = 0.198$	$r^2 = -0.074 ; p = 0.107$
Physical senses	$r^2 = -0.032 ; p = 0.485$	$r^2 = -0.022 ; p = 0.634$
Wellbeing	$r^2 = -0.048 ; p = 0.292$	$r^2 = -0.019 ; p = 0.676$
Overall AQoL	$r^2 = -0.136 ; p = 0.003$	$r^2 = -0.150 ; p = 0.001$

The Short Form-36 questionnaire

The SF-36 was administered at baseline and at one month follow-up. The proportion of responders is illustrated in Table 11. There was no difference in proportion of responders between the PAC and control group at baseline and at one month follow-up ($p = 0.972$, Chi^2).

Table 11 No of responders SF-36 baseline and 1 month follow-up (Difference $p = 0.972$, Chi^2)

	Baseline	Round 2	Percentage (%)
Intervention	352	280	79.6%
Control	327	259	79.2%
Total	679	539	79.4%

The SF-36 scores at baseline, round 2 and the change in scores are shown in Table 12. The only domain that shows a statistically significant difference is the General Health

variable. The PAC group has a higher baseline score (median 62.0) compared to the control group (median 50.0). All other parameters were not significantly different.

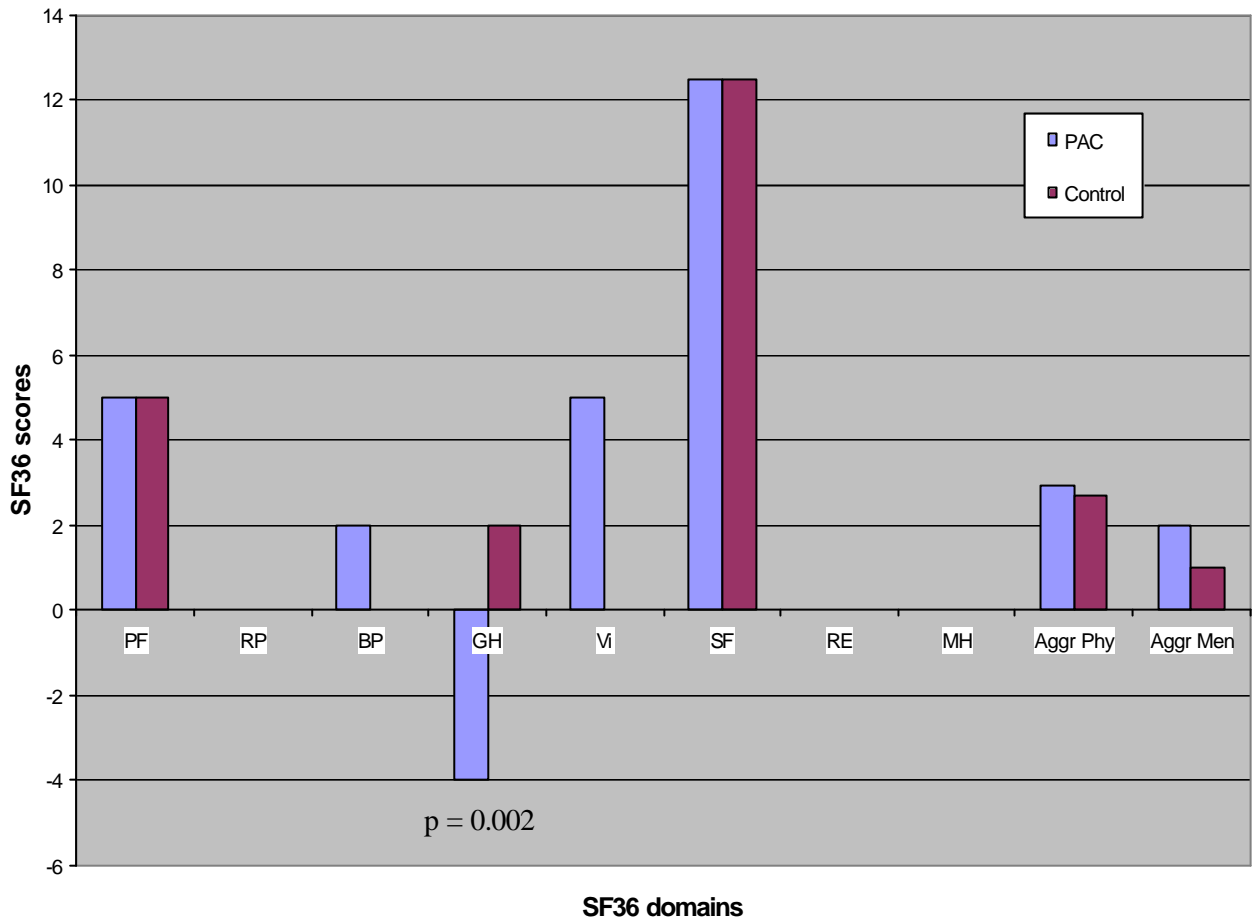
At Round 2, the only difference between the 2 groups was in the Role Emotional domain. The change in SF-36 scores (also refer Figure 6) showed no differences between groups apart from the General Health domain. In this instance the scores for the intervention group decreased from a median of 62 to a median of 57. This corresponded with an increase in control group scores from a median of 50 to a median of 57. These changes were statistically significant ($p < 0.05$).

Table 12 SF-36 scores

Variables	Intervention median (IQR)	Control median (IQR)	Significance (Mann Whitney)
<i>Baseline:</i>			
Physical Functioning	10.0 (5.0-28.80)	15.0 (5.0-30.0)	p = 0.219
Role Physical	0.0 (0.0-0.0)	0.0 (0.0-0.0)	p = 0.968
Bodily Pain	42.0 (22.0-74.0)	42.0 (22.0-84.0)	p = 0.912
General Health	62.0 (45.5-77.0)	50.0 (30.0-77.0)	p = 0.000
Vitality	35.0 (15.0-55.0)	35.0 (20.0-55.0)	p = 0.428
Social Functioning	37.5 (12.5-75.0)	37.5 (12.5-75.0)	p = 0.507
Role Emotional	66.7 (0.0-100.0)	100.0 (0.0-100.0)	p = 0.066
Mental Health	76.0 (56.0-84.0)	72.0 (56.0-88.0)	p = 0.269
Aggregate Physical	26.3 (21.1-32.6)	25.0 (19.6-31.4)	p = 0.048
Aggregate Mental	47.0 (37.5-56.2)	49.2 (38.8-58.4)	p = 0.111
<i>Round 2:</i>			
Physical Functioning	20.0 (10.0-50.0)	20.0 (10.0-45.0)	p = 0.547
Role Physical	0.0 (0.0-25.0)	0.0 (0.0-50.0)	p = 0.753
Bodily Pain	61.0 (31.0-100.0)	52.0 (31.0-84.0)	p = 0.217
General Health	57.0 (45.0-72.0)	57.0 (42.0-72.0)	p = 0.719
Vitality	40.0 (20.0-55.0)	35.0 (20.0-55.0)	p = 0.676
Social Functioning	62.5 (25.0-100.0)	62.5 (37.5-100.0)	p = 0.930
Role Emotional	100 (33.3-100.0)	100 (100.0-100.0)	p = 0.037
Mental Health	74.0 (56.0-88.0)	76.0 (60.0-88.0)	p = 0.304
Aggregate Physical	30.3 (23.7-37.2)	29.0 (23.1-35.4)	p = 0.243
Aggregate Mental	51.4 (41.1-59.6)	52.6 (43.7-58.8)	p = 0.406
<i>Change in SF-36:</i>			
Physical Functioning	5.0 (-5.0-20.0)	5.0 (-5.0-25.0)	p = 0.882
Role Physical	0.0 (0.0-25.0)	0.0 (0.0-25.0)	p = 0.743
Bodily Pain	2.0 (-12.0-30.0)	0.0 (-16.0-29.0)	p = 0.289
General Health	-4.0 (-15.0-7.0)	2.0 (-12.0-15.0)	p = 0.002
Vitality	5.0 (-15.0-15.0)	0.0 (-15.0-15.0)	p = 0.165
Social Functioning	12.5 (-12.5-50.0)	12.5 (-12.5-37.5)	p = 0.575
Role Emotional	0.0 (0.0-66.7)	0.0 (0.0-67.0)	p = 0.522
Mental Health	0.0 (-12.0-12.0)	0.0 (-12.0-12.0)	p = 0.707
Aggregate Physical	2.9 (-4.5-10.1)	2.7 (-2.2-9.2)	p = 0.607
Aggregate Mental	2.0 (-4.9-10.8)	1.0 (-5.5-8.2)	p = 0.270

Bold = significance level \leq 5%

Figure 6: Change in SF-36 scores



Correlation between SF-36 and hospital utilisation

Analysis was performed examining the correlation between hospital utilisation and SF-36 scores. Each dimension of the SF-36 was analysed separately looking at baseline scores and changes over a one month period to see if there was a statistical correlation with hospital utilisation patterns of patients in the study. Table 13 examines the baseline SF-36 scores and the changes in the SF-36 scores. Pearson's correlation coefficient was computed in each instance.

At baseline, having higher scores in the general health domain was significantly negatively correlated with both unplanned readmissions (Pearson's correlation = -0.188, p = 0.000) and hospital utilisation (Pearson's correlation = -0.135, p = 0.001). in the follow-up period. None of the other domains were significantly correlated. After completion of second round interviews, two domains were significantly correlated with both unplanned readmissions and bed day utilisation. These variables

were change in physical function and vitality. Improvements in scores were correlated with a reduction in readmissions and bed day utilisation. Positive changes in the mental health scores was negatively correlated with hospital bed day utilisation but was not significantly associated with unplanned readmissions.

Table 13 Correlations between SF-36 scores and hospital utilisation

	Hospital days (Pearson correlation/Sig)	Unplanned readmissions (Pearson correlation/Sig)
SF-36 baseline		
Physical function	$r^2 = 0.014$; $p = 0.583$	$r^2 = -0.011$; $p = 0.786$
Role physical	$r^2 = -0.016$; $p = 0.703$	$r^2 = -0.042$; $p = 0.316$
Bodily pain	$r^2 = 0.001$; $p = 0.984$	$r^2 = -0.002$; $p = 0.957$
General health	$r^2 = -0.135$; $p = 0.001$	$r^2 = -0.188$; $p = 0.000$
Vitality	$r^2 = -0.015$; $p = 0.722$	$r^2 = -0.055$; $p = 0.184$
Social functioning	$r^2 = -0.038$; $p = 0.357$	$r^2 = -0.048$; $p = 0.245$
Role emotional	$r^2 = -0.029$; $p = 0.479$	$r^2 = 0.004$; $p = 0.923$
Mental health	$r^2 = -0.042$; $p = 0.310$	$r^2 = -0.069$; $p = 0.096$
Aggr physical	$r^2 = -0.012$; $p = 0.763$	$r^2 = -0.044$; $p = 0.290$
Aggr mental	$r^2 = -0.054$; $p = 0.189$	$r^2 = -0.065$; $p = 0.116$
SF-36 change		
Physical function	$r^2 = -0.174$; $p = 0.000$	$r^2 = -0.165$; $p = 0.000$
Role physical	$r^2 = -0.049$; $p = 0.291$	$r^2 = -0.041$; $p = 0.372$
Bodily pain	$r^2 = -0.072$; $p = 0.118$	$r^2 = -0.072$; $p = 0.115$
General health	$r^2 = -0.009$; $p = 0.841$	$r^2 = 0.003$; $p = 0.941$
Vitality	$r^2 = -0.130$; $p = 0.005$	$r^2 = -0.091$; $p = 0.049$
Social functioning	$r^2 = -0.028$; $p = 0.545$	$r^2 = -0.006$; $p = 0.898$
Role emotional	$r^2 = -0.018$; $p = 0.704$	$r^2 = -0.038$; $p = 0.412$
Mental health	$r^2 = -0.100$; $p = 0.030$	$r^2 = -0.042$; $p = 0.360$
Aggr physical	$r^2 = -0.034$; $p = 0.464$	$r^2 = -0.011$; $p = 0.818$
Aggr mental	$r^2 = -0.058$; $p = 0.205$	$r^2 = -0.022$; $p = 0.630$

Carer Strain Index

The Carer Strain Index (CSI) was administered one month after discharge from hospital to ascertain the effects of the intervention on carer burden. The range of

scores was from 1 to 13. The total number of responses was 140 or 39.4% of the original intervention group consented and in the PAC group and 123 or 37.4% of the control group. Non parametric tests (Mann Whitney) were used to compare ranked scores between the two groups. Both groups had a median score of 3. There was no significant difference in terms of carer burden as measured by the CSI at the follow-up period among responders to the questionnaire (Table 14).

Table 14 Carer Strain Index scores

Intervention	Control	Significance (Mann
Median (IQR)	Median (IQR)	Whitney) p value
3 (0.25 to 6.0)	3 (1.0 to 6.0)	0.661

Hospital utilisation

Hospital utilisation focused on two main outcome measures. These outcomes were hospital readmission rates, looking specifically at unplanned readmissions to hospital and hospital bed day utilisation. This underpins the hypothesis as to whether PAC reduces hospital utilisation rates in the 6 month follow-up period.

Baseline data

As illustrated in Table 15, at baseline, there was no difference in terms index admission length of stay and hospital utilisation in the 12 months prior to this admission. Hospital utilisation prior to trial recruitment was measured by unplanned readmissions and emergency department visits to the same hospital in the preceding 12 months. The proportion of patients who had unplanned admissions in the 12 months prior to the index admission was 26% in the control group and 26% in the intervention group. The proportion of patients that presented to the emergency department that did not result in a hospital admission, in the 12 months prior to trial recruitment, was 6.2% in the intervention group and 3.8% of controls ($p = 0.149$, Chi^2).

Table 15 Baseline data: hospital utilisation

	PAC	Control	Significance
LOS	8.0 (4.5-13.0)	8.0 (5.0-14.0)	0.48 (Mann Whitney)
Median (IQR)			
Pre unplanned admissions	0.0 (0.0-1.0)	0.0 (0.0-1.0)	0.87 (Mann Whitney)
Median (IQR)			
Pre emergency visits	0.0 (0.0-0.0)	0.0 (0.0-0.0)	0.37 (Mann Whitney)
Median (IQR)			
Pre A&E (%)	6.2	3.8	p = 0.179, Chi ²
Pre UNP (%)	25.9	25.9	p = 0.393, Chi ²

LOS = Length of stay in index admission

Pre unplanned admissions = Median number of unplanned admissions in the previous 12 months prior to the index admission

Pre emergency visits = Median number of Emergency department visits in the 12 months prior to the index admission (this excludes A&E visits that resulted in a hospital admission)

Pre A&E = Proportion of patients who visited the emergency department in the 12 months prior to trial recruitment

Pre UNP = Proportion of patients who had unplanned readmissions to the same hospital in the 12 months prior to trial recruitment

Hospital utilisation in the study follow-up period

Hospital utilisation in the 6 month follow-up period looked at 3 specific variables:

- Unplanned readmissions
- Number of hospital bed days used
- Emergency department visits

In the 6 month follow-up period, 25% of the PAC group and 25% of controls had unplanned readmissions to their index hospital (Table 4.14). Similarly the differences in emergency department presentations was also not significantly different (7% in the PAC group and 6% in controls).

Looking at the differences in hospital usage using non-parametric tests (Table 16), there were also no significant differences between the 2 groups in terms of unplanned readmissions, emergency department visits and hospital bed day utilisation in the 6 month follow-up period. The median values of 0 indicate that the majority of patients were not readmitted to hospital.

Table 16 Hospital utilisation: A comparison between PAC and controls

	PAC	Control	Significance
Prop A&E (%)	6.4	6.3	p= 0.989, Chi ²
Prop UNP (%)	24.6	27.6	p = 0.251, Chi ²
Post UNP			
Mean (SD)	0.38 (0.84)	0.48 (0.93)	
Median (IQR)	0 (0-0)	0 (0-1)	p = 0.26 (Mann Whitney)
Post A&E			
Mean (SD)	0.07 (0.28)	0.07 (0.28)	
Median (IQR)	0 (0-0)	0 (0-0)	p = 0.92 (Mann Whitney)
Hos days			
Mean (SD)	5.19 (12.20)	2.98 (7.88)	
Median (IQR)	0 (0-0)	0 (0-1.25)	p = 0.18 (Mann Whitney)

Prop A&E = Proportion of patients who visited the emergency department in the 6 month follow-up period

Prop UNP = Proportion of patients who had unplanned readmissions to the same hospital in the 6 month follow-up period

Post UNP = Unplanned readmissions to the same hospital in the 6 month follow-up period

Post A&E = Emergency department visits in the 6 month follow-up period

Hos days = Number of hospital days utilised at the same hospital in the 6 month follow-up period

Analysis of readmissions

Comparison between readmitted and non-readmitted patients

Out of the study sample, 24.6% of PAC and 27.6% of control patients were readmitted during the study follow-up period. A comparison was performed between patients readmitted and those not readmitted (see Table 17). Valid data was obtained in 153 patients readmitted as compared to 440 patients who were not readmitted.

There were no differences in terms of age or trial status of the patient. There were however significant findings in other variables tested. Subjects who were readmitted were more likely to have had unplanned admissions to hospital in the previous 12 months. The index admission was also more likely to be an unplanned admission and readmitted patients tended to have a longer initial length of stay (a median of 9 days compared to 8 days in non-readmitted patients, p = 0.03, Mann Whitney). Other characteristics of readmitted patients included being a medical as opposed to a surgical patient, having more comorbidities and being on more medications. Patients who were readmitted also had a higher mortality rate.

Table 17 Comparison in characteristics between patients readmitted and non-readmitted

	Readmitted n = 153	Not readmitted n = 440	Tests of Significance (p value)
Age	74.9 (71.2-81.6)	76.6 (71.0-81.5)	0.342 (Mann Whitney)
Status			
PAC	48.7%	52.9%	0.363 (Chi ²)
Control	51.3%	47.1%	
LOS	9.0 (6.0-14.0)	8.0 (4.0-12.0)	0.026 (Mann Whitney)
Pre UNP	0.0 (0.0-1.0)	0.0 (0.0-0.0)	0.000 (Mann Whitney)
Index UNP	77.3%	64.8%	0.004 (Chi²)
Diag group			
Medical	66.7%	46.4%	0.000 (Chi²)
Surgical	33.3%	53.6%	
Pre A&E	0.0 (0.0-0.0)	0.0 (0.0-0.0)	0.332 (Mann Whitney)
Meds Admit	6.0 (3.0-8.3)	5.0 (3.0-8.0)	0.000 (Mann Whitney)
Meds Disch	7.0 (5.0-10.0)	5.0 (3.0-8.0)	0.000 (Mann Whitney)
No comorbid	2.0 (1.0-4.0)	2.0 (1.0-3.0)	0.002 (Mann Whitney)
Deceased	19.5%	1.4%	0.000 (Chi²)

LOS = Length of stay in the index admission

Index UNP = Percentage of patients who had an unplanned admission as their index admission

Pre UNP = Unplanned readmissions to the same hospital in the 12 months prior to trial recruitment

Post UNP = Unplanned readmissions to the same hospital in the 6 month follow-up period

Post A&E = Emergency department visits in the 6 month follow-up period

Hos days = Number of hospital days utilised at the same hospital in the 6 month follow-up period

Meds Admit = No of medications on admission

Meds Disch = No of medications at discharge

No Comorbid = Number of comorbidities

Bold = Significance < 0.05

Comparison between PAC and controls in readmitted patients

The baseline characteristics of patients readmitted in PAC and control groups are illustrated in Table 18 and Table 19. The two groups were not significantly different in the domains of age, primary diagnosis and other admission characteristics including ratio of medical to surgical admissions, number of patients who developed complications in the index admission as well as the number of comorbidities. There were also no significant differences in the number of medications prescribed on admission and at discharge.

Table 18 illustrates the frequencies of the primary diagnosis of both groups. The majority of patients readmitted had a cardiac or a respiratory diagnosis. As previous studies have shown, there was a high degree of medical admissions in the patients who were readmitted, 69.0% in the intervention group and 64.6% in the control group. A large proportion of the index admissions was also unplanned, constituting in excess of 75% of admissions in both groups. During the follow-up period, there was no significant difference in patient survival between the groups ($p = 0.572$).

In terms of hospital utilisation, the PAC group had a higher number of emergency department visits in the 12 months before recruitment compared with the control group ($p = 0.04$). Hospital utilisation in terms of number of unplanned admissions in the 12 months prior to recruitment and index admission length of stay was however not statistically different in both groups.

During the 6 month follow-up period however, there was a statistically significant difference in terms of median number of bed days used among patients readmitted between the study and the control group. The PAC group used significantly less bed days, median 8.5 days compared to the control group which had a median bed day use of 12 days ($p = 0.024$, Mann Whitney). The full cost benefit of this apparent reduction in bed day usage will be further analysed in the final section of this chapter which will assess the economic impact of the PAC program.

Table 18 Primary Diagnosis of readmitted patients

	PAC	Control	Significance p value (Chi²)
Cardiac %	24.0	22.8	0.822
Respiratory %	25.3	22.8	0.676
Oncology %	12.0	15.2	0.587
GIT %	10.7	12.7	0.723
Vasc %	9.3	3.8	0.157
Muskuloskel %	6.7	11.4	0.320
CNS %	4.0	8.9	0.229
Urogenital %	2.7	2.5	0.947
Other %	4.0	0.0	0.071

Table 19 Baseline medical characteristics and hospital utilisation in readmitted patients

	PAC n = 75	Control n = 79	Tests of significance p value
Age	74.9 (71.1-81.6)	74.8 (71.4-82.0)	0.818 (Mann Whitney)
Diag group %			
Medical	69.0	64.6	0.567 (Ch ²)
Surgical	31.0	35.4	
Unplanned index admission %	78.7	76	0.688 (Ch ²)
Comorbid	2.0 (1.0-4.0)	3.0 (1.0-4.0)	0.369 (Mann Whitney)
Complications during index %	29.8	36.7	0.367 (Ch ²)
Deceased %	21.4	17.8	0.572 (Ch ²)
Meds Admit	6.0 (3.0-9.0)	6.0 (3.0-8.0)	0.863 (Mann Whitney)
Meds discharge	7.0 (5.0-10.0)	8.0 (5.0-10.0)	0.867 (Mann Whitney)
LOS	9.0 (6.0-14.0)	9.0 (6.0-16.0)	0.768 (Mann Whitney)
Pre A&E (mean)	0.13	0.03	
Median (IQR)	0.0 (0.0-0.0)	0.0 (0.0-0.0)	0.040 (Mann Whitney)
Pre UNP	0.0 (0.0-2.0)	0.0 (0.0-1.0)	0.256 (Mann Whitney)
Post A&E	0.0 (0.0-0.0)	0.0 (0.0-0.0)	0.714 (Mann Whitney)
Post UNP	1.0 (1.0-2.0)	1.0 (1.0-20.)	0.139 (Mann Whitney)
Hos Days	8.5 (5.0-15.0)	12.0 (7.0-29.0)	0.024 (Mann Whitney)

Numeric values reflect the median unless otherwise specified. Values in brackets are the interquartile range.

Bold denotes significance < 0.05

Predictors of hospital readmission

An analysis was performed to determine the factors that predict readmission to hospital. This was performed using stepwise logistic regression with 'having an unplanned readmission' as a binary dependent variable. The variables used in the regression model included

- Baseline characteristics of the index admission. This included the age, trial status of the patient, the primary diagnosis of the admission, the presence or absence of complications in the index admission, the number of comorbid conditions present, whether the index admission was a planned or unplanned admission and the number of medications prescribed.

- Hospital utilisation data including index admission length of stay, previous emergency department visits and number of unplanned admissions in the previous 12 months. These variables were examined as continuous variables.
- The specific hospital in which the patient was admitted.

In order to assess the impact of individual primary diagnoses that may have been predictive of unplanned readmissions, dummy variables were created and coded as 1 for presence of disease and 0 for absence.

A summary of the results is presented in Table 20. Predictors of readmission included being admitted to hospitals A ($p = 0.0034$, OR, 2.10; 95% CI, 1.28-3.44) and B ($p = 0.0262$, OR, 1.70; 95% CI 1.06-2.71). Other risk factors for readmission were having unplanned admissions in the previous 12 months ($p = 0.0004$, OR, 1.48; 95% CI, 1.19-1.84) and increasing length of stay during the index admission ($p = 0.0197$, OR, 1.03; 95% CI 1.00-1.05). Patients who were discharged on more medications were also at increased risk for readmission ($p = 0.0037$, OR, 1.09; 95% CI 1.03-1.16). Surprisingly, the primary diagnosis and number of comorbidities did not contribute to an increased risk of readmissions ($p < 0.05$). Trial status was also not a predictor of readmission.

Table 20 Predictors of unplanned readmission by binary logistic regression

Variable	R	Significance	OR (95% CI)
LOS	0.0712	0.0197	1.03 (1.00-1.05)
Hosp A	0.0984	0.0034	2.10 (1.28-3.44)
Hosp B	0.0659	0.0262	1.70 (1.06-2.71)
Pre UNP	0.1255	0.0004	1.48 (1.19-1.84)
Meds disc	0.0974	0.0037	1.09 (1.03-1.16)

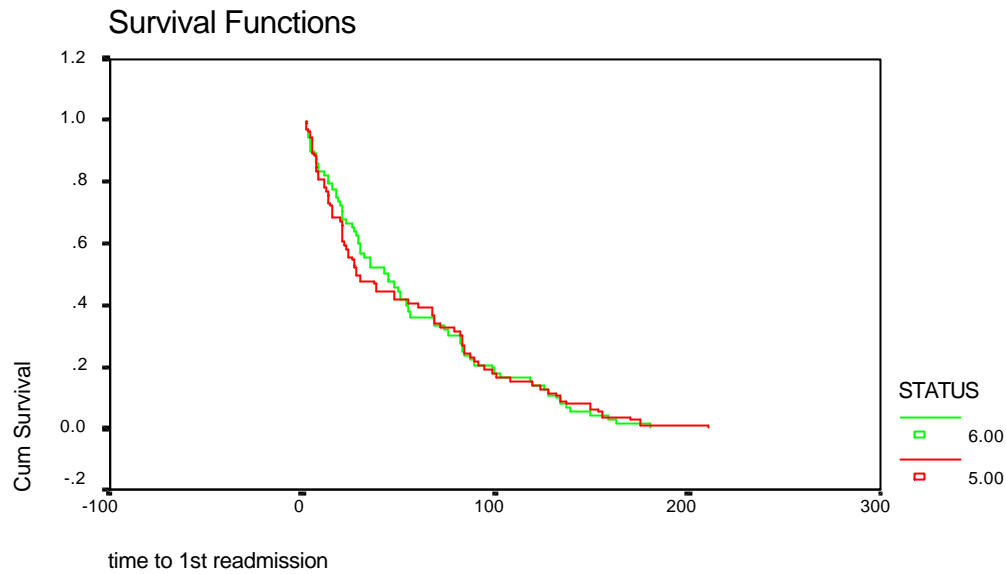
Time to first readmission

Further analysis was performed looking at whether PAC reduced the time to first readmission in patients who had unplanned readmissions in the follow-up period. A Kaplan- Meier survival curve was constructed and log rank analysis was performed to test the hypothesis that PAC may have had an impact on early readmission to hospital. As shown in Table 21 and Figure 7, there was no difference in time to first readmission between groups.

Table 21: Time to first admission in readmitted patients

	Intervention	Control	Significance (Log rank)
No readmissions	72	79	NA
Mean (days)	55.83	54.48	$p = 0.9799$
95% CI	(95% CI, 44.9 - 6.8)	(95% CI, 43.2-65.7)	

Figure 7 Survival analysis: Time to first readmission. Kaplan Meier curve



5.00 = control and 6.00 = PAC

Predictors of hospital bed day utilisation in the follow-up period

Although Post Acute Care did not directly lead to a reduction in readmissions in the study group compared with controls, the PAC group did use significantly less hospital bed days when readmitted. In order to elucidate the role of PAC on hospital utilisation patterns, a general linear regression model was constructed. The aim of this regression model was to examine the effects of various variables on hospital bed day utilisation, an important outcome in determining the cost effectiveness of the program.

The variables examined were similar to those used in predicting risk of readmission and significant results are summarised in Table 22. The strongest predictor of hospital use in the follow-up period was unplanned admissions in the 12 months prior to recruitment. Post Acute Care was also negatively correlated with hospital utilisation in the 6 month follow-up period and this reduction in hospital utilisation in PAC patients was statistically significant ($p = 0.009$; 95% CI, -3.713 to -0.533). Other variables that predicted hospital bed day utilisation were length of stay at the index admission as well as being admitted to hospitals A and B.

Table 22 Predictors of hospital utilisation using a general linear regression model (stepwise)

	Beta	t	Significance	95% CI
Constant		1.736	0.083	-0.206 to 3.341
Pre UNP	0.200	4.968	0.000	1.286 to 2.968
PAC	-0.104	-2.623	0.009	-3.713 to -0.533
LOS	0.107	2.671	0.008	0.031 to 0.205
Hosp A	0.123	2.798	0.005	0.881 to 5.035
Hosp B	0.1049	2.390	0.017	0.408 to 4.094

LOS = Length of stay during the index admission

Pre UNP = Unplanned readmissions to the same hospital in the 12 months prior to trial recruitment

Excluded variables include: index admission unplanned, primary diagnosis (cardiac medical, cardiac, respiratory, CNS, GIT, oncology, vascular, musculoskeletal and urogenital as dummy variables), comorbidities, complications at the index admission, hospital admitted all having significance < 0.05.

Comparison of characteristics across hospitals

Patients admitted to hospital A and hospital B were found to have an increased risk of being readmitted to hospital. This implies a difference in the populations recruited for the study. This section analyses the interhospital differences in terms of admission characteristics and medical characteristics of subjects recruited to the study (refer Table 23).

There were no significant differences in the proportions of patients admitted as intervention and controls. A larger proportion patients admitted to hospitals A and B had unplanned index admissions and had a medical admission ($p < 0.05$, Chi^2). The number of comorbidities was not significantly different between groups. The primary diagnosis was significantly different between hospitals, with hospital A and hospital B having cardiac and respiratory patients as the largest 2 groups that were recruited as opposed to hospital C (musculoskeletal and oncology patients) and hospital D (cardiac and gastrointestinal patients). The populations also differed in terms of mean number of medications on admission and discharge with hospital A having the largest number of prescribed medications per patient.

Hospital utilisation data in the preceding 12 months was statistically different between the 4 hospitals. Hospitals A and D had the longest mean lengths of stay in the index admission, 12.4 and 12.7 days respectively ($p < 0.05$, ANOVA). Hospitals A and B which were responsible for the bulk of unplanned admissions during the follow-up phase, had the most number of unplanned admissions in the 12 months leading to study recruitment ($p < 0.05$, Kruskal-Wallis one-way analysis of variance).

Table 23 Interhospital characteristics of patients

	Hos A	Hos B	Hos C	Hos D	Significance
Trial status					
no (%)					
PAC	73 (51.4%)	97 (49%)	86 (55.9%)	53 (52.5%)	0.646 (Ch ²)
Controls	69 (48.6%)	101 (51%)	68 (44.2%)	48 (47.6%)	
Total	142 (100%)	198 (100%)	154 (100%)	101 (100%)	
Index %					
Planned	19.1%	23.3%	47.4%	43.6%	0.000 (Ch ²)
Unplanned	80.9%	76.7%	52.6%	56.4%	
Adm type %					
Medical	78.1%	60.6%	26.0%	36.7%	0.000 (Ch ²)
Surgical	21.9%	39.4%	74%	63.3%	
LOS	12.4 (13.7)	8.2 (6.6)	9.1 (6.4)	12.7 (8.6)	0.000
Mean (SD)					(ANOVA)
Pre UNP	0 (0-1)	0(0-1)	0 (0-0)	0 (0-0)	0.004
Median (IQR)					(KW)
Meds Admit	5.6 (3.5)	4.7 (3.1)	3.9 (2.9)	5.1 (3.4)	0.000
Mean (SD)					(ANOVA)
Meds Disch	7.8 (3.7)	5.9 (3.3)	5.1 (3.1)	6.5 (3.2)	0.000
Mean (SD)					(ANOVA)
Diag group %					
Cardiac	19.0%	26.8%	5.8%	41.6%	0.000 (Ch ²)
Respiratory	25.4%	19.2%	9.1%	5.9%	
CNS	20.4%	4.5%	3.2%	5.9%	
Vascular	2.1%	5.6%	5.2%	9.9%	
GIT	4.2%	11.1%	11.0%	10.9%	
Mskel	13.4%	12.1%	38.3%	6.9%	
Oncology	9.2%	12.1%	16.2%	8.9%	
Urogenital	2.1%	4.5%	10.4%	5.9%	
Other	3.5%	4.0%	0.6%	4.0%	
Comorbidities					
Median (IQR)	2 (1-4)	2 (1-3)	2 (1-3)	2 (1-4)	0.120 (Ch ²)

KS = Kruskal Wallis one-way analysis of variance (non-normally distributed variables)

ANOVA = Analysis of variance (normally distributed variables)

Community service utilisation

Community service utilisation was sourced from 30 service providers. These were the main service providers in each geographical location. There were 28 service types that were obtained from various providers. Community data was obtained 12 months prior to and 6 months after trial recruitment.

There were 187 (31.3% of sample) number of subjects identified in the 12 months before recruitment of which 104 (55.7%) were in the intervention group and 83 (44.3%) were in the control group. In the 6 month follow-up phase, service utilisation data was obtained in 244 subjects and this constituted 40.8% of the total sample. There was a bias towards obtaining data for intervention patients with 59% of patients being in the intervention group and 41% being controls.

Types of community services used

The main community services used in the sample before and after trial recruitment are illustrated in Figures 8, 9 and Table 24. The service percentages were derived as a proportion of the total number of services provided in the control or PAC groups, 12 months prior or 6 months following trial recruitment. The main services used 12 months prior to trial recruitment were meals on wheels, nursing, home care and personal care. Following trial recruitment, the most frequent service used was nursing services with more than 50% of services use obtained from registered nursing services. The majority of nursing services was obtained from the Royal District Nursing Service.

Figure 8 Services used prior to recruitment

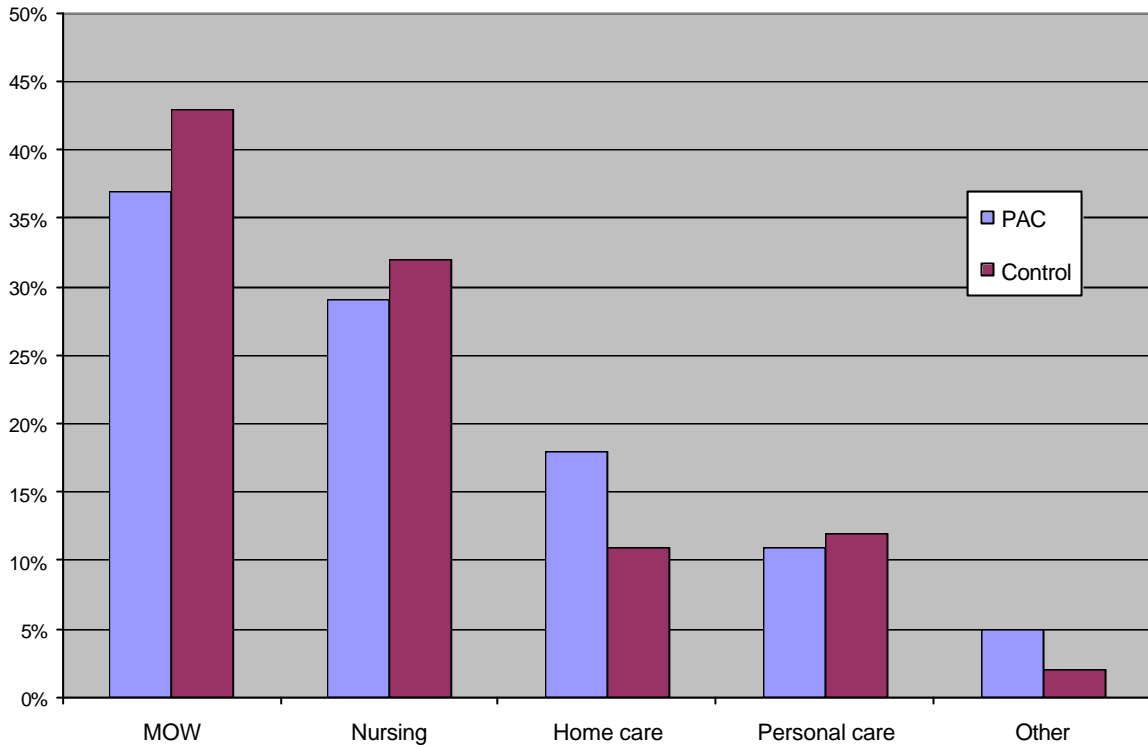
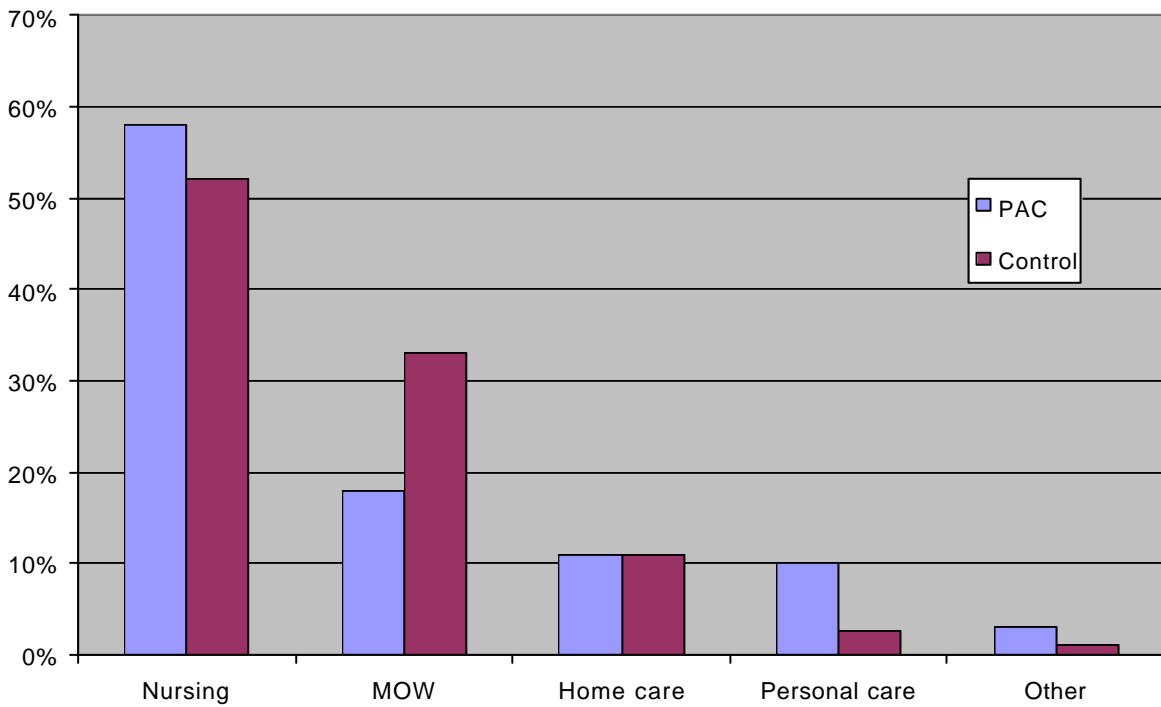


Figure 9 Services used after recruitment



Community service utilisation patterns by PAC and control groups

The main services used by PAC and controls are displayed in Table 24. In the 12 month period prior to trial recruitment, the control group used significantly more meals on wheels and nursing services ($p < 0.05$, Chi^2). The PAC group however used more home care services with 18% of service provision obtained as home care episodes as opposed to controls, where home care constituted 11% of total service utilisation. There were no significant differences in terms of personal care use between the groups.

Following trial recruitment, nursing was the predominant form of community service used, comprising greater than 50% of service utilisation in the 6 month-follow-up period. PAC subjects used significantly more nursing and personal care services compared with controls. Control subjects, on the other hand used significantly more meals on wheels services, 33% of services used as compared to PAC subjects where meals on wheels constituted 18% of services used. Home care was used similarly by both groups.

Table 24 Community service utilisation patterns

Variable	PAC	Control	Tests of Significance
Pre-intervention	n = 104	n= 83	
Meals on wheels	37%	43%	0.000 (Chi²)
Nursing	29%	32%	0.001 (Chi²)
Home care	18%	11%	0.000 (Chi²)
Personal care	11%	12%	0.840(Chi ²)
Other	5%	2%	
Post-intervention	n = 144	n = 100	
Nursing	58%	52%	0.000 (Chi²)
Meals on wheels	18%	33%	0.000 (Chi²)
Home Care	11%	11%	0.730 (Chi ²)
Personal care	10%	3%	0.000 (Chi²)
Other	3%	1%	

Pre-intervention = number and percentage of patients who used a particular service in the 12 months prior to recruitment

Post-intervention = number and percentage of patients who used a particular service in the 6 months after recruitment

Bold results indicates significance < 0.05

Cost analysis

Community service utilisation costs were obtained from various service providers. As cost data was not available for the whole sample, an average or mean cost per patient was derived 12 months before and 6 months after trial recruitment in order to perform comparative analysis between the two groups.

In terms of hospital service utilisation, reimbursements (WIES payments) for each admission was examined. This allowed for an estimation of costs from the health funder's or Department of Health's perspective. The average Victorian bed day cost was also used (average reimbursement for each DRG or episode of care divided by the State's average length of stay). The hospital utilisation costs was the sum of all bed days used in the index admission and all subsequent unplanned admissions to the same hospital over the 6 month follow-up period

Results of cost analysis

The cost of reimbursement for admissions to hospital (WIES6 payments for each episode of care) was analysed (Table 25). This data, derived from the Department of Health's admitted episodes database, was limited in its capacity to provide a true reflection of costs due to the large amount of missing data. There were 179 episodes of admissions in the 12 month period prior to trial recruitment and 391 episodes in the 6 month follow-up period. There were no significant differences noted in mean costs for each patient episode or admission before and after trial recruitment.

Table 25: WIES reimbursements for each episode of care

Trial recruitment	PAC mean (SD) Cost/episode A\$	Control mean (SD) Cost/episode A\$	Significance p (95% CI)
12 months prior n = 179	3169.38 (4016.03)	2949.77 (3381.92)	0.692 (-1312.08 to 872.86)
6 month follow-up n = 391	5081.22 (3957.75)	5971.44 (6592.26)	0.111 (-207.22 to 1987.65)

The data for the cost analysis is presented in Table 26. In terms of costs associated with community service utilisation, the mean cost per patient in the intervention group 12 months prior to trial recruitment was A\$696.54. In the control group, the mean cost was A\$1189.25. The differences in costs between the 2 groups using parametric (students t) tests however were not significantly different ($p = 0.130$). During the 6 month follow-up period the average cost per patient for community service utilisation was A\$459.30 and A\$525.93 for controls. Once again the differences between groups was not significant ($p = 0.516$).

There was a significant difference in costs incurred due to hospital utilisation when using average bed day costs (Table 4.24). The mean cost per patient in the PAC group was A\$8390.59, which was significantly lower than the average cost in the control group of A\$10160.97 ($p = 0.024$, mean difference of \$1770.39; 95% CI, \$236.76 to 3304.01).

There was also a significant cost difference when looking at total costs per patient, which included the cost per client of the PAC program excluding costs of purchasing services (A\$292.40 per PAC client). The average total cost of each PAC patient was A\$9142.28. This compared favourably with the costs incurred by the control group which was significantly higher at A\$10686.90 ($p = 0.048$). The mean difference between the two groups was A\$1544.63 (95% CI, \$11.00 to \$3078.25).

Table 26: Average costs per patient during the trial

	PAC n = 311 A\$	Control n = 287 A\$	Significance p value 95% CI
Comm service utilisation			
Pre-Costs mean (SD)	696.54 (1165.31)	1189.25 (2554.86)	$p = 0.130$ -147.53 to 1132.94
Post-Costs mean (SD)	459.29 (678.53)	525.93 (1014.63)	$p = 0.516$ -135.35 to 268.61
Hospital utilisation mean (SD)	8390.59 (8936.44)	10160.97 (9998.57)	$p = 0.024$ mean diff = 1770.39 236.76 to 3304.01
Total cost mean (SD)	9142.28 (8936.44)	10686.90 (9998.57)	$p = 0.048$ mean diff = 1544.63 11.00 to 3078.25

Pre-costs = mean cost per patient for all services used 12 months prior to recruitment

Post-costs = mean cost per patient for all services used 6 months after recruitment

Total cost for PAC patients = hospital bed days used (index and 6 month follow-up) + care coordination + community service utilisation 6 months after recruitment

Total cost for Control patients = hospital bed days used (index and 6 month follow-up) + community service utilisation 6 months after recruitment

Sensitivity analysis was performed to discount the marginal costs of additional bed day use by the control group (Table 27). As discussed in the Methods section, this analysis was performed as the end-of-stay costs in a particular episode of hospitalisation may be lower than the average bed day costs of an episode of care. Discounting the marginal beds used by 10%, the statistical difference in total costs was not significant ($p = 0.066$, 95% CI, -\$93.89 to \$2953.51). However the difference in hospital utilisation costs was still significant between control and intervention groups (mean difference \$1655.57, 95% CI, \$131.87 to \$3179.27). At a 25% marginal bed use discount rate, the difference in hospital utilisation costs was not significant.

Table 27: Sensitivity analysis: comparing costs of hospital care and total costs discounting marginal bed days by 10%, 25% and 50%

	PAC A\$	Control A\$	Significance p value (95% CI)
Not discounted			
Hospital costs	8390.59 (8936.44)	10160.97 (9998.57)	0.024 (236.76 to 3304.01)
Total costs	9142.28 (8936.44)	10686.90 (9998.57)	0.048 (11.00 to 3078.25)
Discounted 10%			
Hospital costs	8390.59 (8936.44)	10046.15 (9885.58)	0.033 (131.87 to 3179.27)
Total costs	9142.28 (8936.44)	10572.08 (9885.58)	0.066 (-93.89 to 2953.51)
Discounted 25%			
Hospital costs	8390.59(8936.44)	9872.40 (9714.61)	0.054 (-26.96 to 2990.59)
Total costs	9142.28 (8936.44)	10398.33 (9714.61)	0.103 (-252.72 to 2764.83)
Discounted 50%			
Hospital costs	8390.59 (8936.44)	9583.83 (9430.65)	0.115 (-291.01 to 2677.50)
Total costs	9142.28 (8936.44)	10109.76 (9430.65)	0.201 (-516.77 to 2451.74)

Summary of key results

A considerable amount of outcome data has been presented in this chapter. This section summarises the key components of the study and the results presented thus far.

Sample selection

- 946 patients, 65 years and greater, in four hospitals were thought to be PAC eligible.
- 679 patients were consented. 81 patients were excluded mainly due to transfer to another hospital, death and crucial missing data.
- 598 patients were recruited for study follow-up, 311 in the intervention group and 287 in the control group (63% of the original sample).

Demographic characteristics

- The demographic differences between trial status groups were not significantly different in terms of age, gender, income, education and health insurance status. The median age of patients in both groups was approximately 76 years of age. About 60% of patients were female.

Medical characteristics

- The baseline medical characteristics of patients in PAC and control groups were not significantly different in the following domains:
 - ◆ Percentage of unplanned index admissions
 - ◆ Ratio of medical to surgical patients
 - ◆ Primary diagnosis of the index admission
 - ◆ Percentage of patients who had unforeseen complications during their index admission
 - ◆ Number of comorbid conditions
 - ◆ Number of medications prescribed
 - ◆ Unplanned admissions to hospital 12 months before trial recruitment

Patient outcomes

- There was no difference in survival between PAC and controls. Six percent of the cohort in both groups died in the 6 month follow-up period.
- Quality of life as measured by the AQoL instrument had a greater overall improvement in the intervention group ($p = 0.05$). Looking at specific domains within the questionnaire, the control group had a higher independent living score at baseline. The PAC group however, had a statistically greater improvement in this domain at the second round interview ($p = 0.004$).

- Increases in independent living scores and overall AQL scores were significantly correlated with hospital utilisation in the 6 month follow-up period.
- Health status as measured by the SF-36 questionnaire showed no significant changes in the overall physical and mental aggregate scores after one month follow-up when comparing the two groups. Looking at specific domains, PAC subjects had a higher baseline general health score ($p < 0.05$). At one month, the general health scores of the PAC group declined and the scores of the control group actually improved. This change was significant ($p = 0.002$).
- At baseline, the general health score of the SF-36 was significantly correlated with a reduction in hospital utilisation. Increases in vitality and physical function scores were negatively correlated with hospital utilisation.
- Carer burden as measured by the Carer Strain Index at one month was not significantly different.

Hospital utilisation

- At baseline, there was no difference in hospital utilisation patterns between groups, 12 months prior to trial recruitment as well as during their index admission.
- During the 6 month follow-up period, there was no difference in unplanned readmissions, emergency department visits and hospital bed day utilisation using non-parametric tests to compare the two groups.
- 24.6% of PAC and 27.6% of control patients were readmitted to hospital after trial recruitment. Readmitted patients were more likely to be medical patients, have a longer initial length of stay and have more unplanned admissions in the preceding 12 months than non-readmitted patients. Readmitted patients also had more comorbidities, were on more prescribed medications and had a higher mortality rate.
- Looking at the differences between PAC and control patients who were readmitted to hospital, PAC subjects had more emergency department visits in the 12 months prior to trial recruitment and consumed significantly less hospital days in the follow-up period.
- Using stepwise logistic regression, predictors of unplanned readmission were longer index lengths of stay, being admitted to hospitals A and B, having previous unplanned admissions and having more medications prescribed on discharge from hospital. Trial status was not a predictor of unplanned readmissions to hospital.
- There was no difference in time to first readmission between PAC patients and controls.
- In order to elucidate the predictors for hospital bed day utilisation, a general linear regression model was constructed. Factors that predicted increased bed day utilisation included having previous unplanned admissions, being in the control group, having a longer index length of stay and being admitted to hospitals A and B.
- Specific characteristics of patients in hospitals A and B were examined to account for the higher readmission and bed day utilisation rates. Patients in hospitals A and B had a higher number of patients with unplanned admissions in the preceding 12 months. there were also more patients with unplanned index admissions and a larger ratio of medical patients in their cohort.

Community service utilisation

- Service utilisation data was obtained for 187 patients (31.3% of the sample) in the 12 months before recruitment phase and 244 subjects (40.8% of sample) in the 6 month follow-up period.
- The main services used prior to the intervention was meals on wheels, followed by nursing, home care and personal care. Controls used more meals on wheels and nursing services, while the PAC subjects used more home care.
- The main services used in the follow-up period in descending order were nursing, meals on wheels, home care and personal care. The control group used more meals on wheels services while the PAC group used more nursing care and personal care.

Cost analysis

- There were no differences between groups in terms of community service utilisation costs before and after trial recruitment.
- Hospital utilisation costs were significantly lower in the intervention group with the mean cost per PAC patient calculated at A\$7783.14 and the mean cost of the control group at A\$9425.36 per patient ($p = 0.024$).
- Total costs, including the cost of the intervention, were also significantly lower in the PAC group using average costs/ bed day. The average total cost per patient, was A\$8390.59 compared to the control group, with an average per patient of A\$10160.97 ($p = 0.024$, 95% CI, \$236.76 to 3304.01).
- Using sensitivity analysis to account for marginal bed day costs in the control group, when average bed day costs were discounted by 10%, total costs between groups were no longer significantly different. At a discount rate of 25%, hospital utilisation costs were not statistically different between the 2 groups.

Chapter 4

Discussion

In this chapter, the main study findings are discussed. Reference is also made to specific methodological issues that may have had an impact on the study results. The initial section of the chapter deals with the randomisation process and the study design. The core findings in relation to patient outcomes, quality of life measures and service utilisation patterns are then examined. Finally the cost outcomes of the study are discussed as well as its application to the future of the post acute program.

Study methodology

Sample selection

As this study focused on the older patients in the trial, it is important that the population sampled was representative of the overall older PAC population. In the study, 61% of patients who were considered PAC eligible were 65 years of age or greater. This is not significantly different from the overall PAC population in Victoria over the year 98/99, where 58% of patients were 65 years and older (PAC program client activity 1998/99).

Design of the study

The design of the study was as a randomised controlled trial. This is considered the gold standard in terms of health services research. This study is unique in that it examined a state implemented health service with a rigorous, multicentre experimental design. Most previous studies have looked at testing new services in single centre experiments. Additionally, no randomised controlled studies have been performed in Australia looking at specific government implemented services that bridge the gap from hospital to the community. The medical record review/audit also provided additional information, for example medication usage and whether admissions were planned or unplanned. All case note reviews were performed by the same reviewer thus removing some of the bias involved when multiple reviewers are used.

Demographic characteristics of the sample

The median age of patients in both groups was 76.4 years and 60% of the sample was female. Other factors like main source of income, education, health insurance status and presence of a health care card were also not significantly different between groups. The majority of patients were on the pension and approximately 10% qualified for a health care card. As the social, economic and educational

characteristics were not significantly different between the two groups, this suggested that the integrity of the randomisation process was maintained.

Medical characteristics of patients

In order to subdivide patients into groups that could be analysed, features of the admission, which could predict future patient outcome, were also defined. This included whether the patient had an unplanned index admission, the percentages of medical and surgical patients, whether patients had unforeseen complications in their index admission as well as the number of patient comorbidities. An assessment was also made on the numbers of medications prescribed on admission and discharge from hospital.

The baseline characteristics of patients were determined to see if any differences existed between PAC and control subjects. The results reflected no significant differences between the groups, once again confirming that there was no bias from the randomisation process. The typical patient enrolled in the study had an unplanned index admission (>65% of the cohort), had an equal probability of being a medical or surgical patient and had a 30% chance of having a complication in the index admission. They also had 2 comorbid conditions and were prescribed 4 medications on admission and 6 medications on discharge.

The most common primary cause of admission was cardiac disease. Respiratory and musculoskeletal causes, mainly in the form of orthopaedic admissions, formed the bulk of other diagnoses. These three diagnoses contributed 56% of the total diagnostic categories in control and intervention groups. A previous study (Street, 1995) in Victoria, also identified cardiovascular, musculoskeletal (orthopaedic or rheumatological) and respiratory conditions as large diagnostic categories for their sample of older patients discharged from hospital, with these three conditions constituting approximately 50% of their study population.

Patient outcomes

Patient survival

There was no difference in patient survival both in terms of proportion of patients who died (6% of control and PAC groups) and also using a comparison between groups examining time to death from trial recruitment ($p = 0.84$ by log rank analysis). This is not a surprising finding as most previous studies have not shown mortality differences when performing health service interventions in patients discharged from hospital. The only intervention that has shown a mortality benefit is the study by Stewart et al (1998) in South Australia. Their intervention comprised of pre-discharge counselling and a home visit by a pharmacist and a study nurse, which focused on medication use, compliance and identifying other problems after discharge from hospital. This resulted in a reduction in mortality, which appeared to be sustained over 18 months in a cardiac subgroup of patients. The mechanism by which this intervention had its effect however remains unclear and has not been replicated in other studies.

Assessment of quality of life and health status questionnaires

The proportion of patients who completed the second round interviews, one month after trial recruitment was 80% of the original consented population. The proportion of intervention to control patients was not significantly different from the original cohort thus suggesting that there was not a systematic bias in terms of questionnaire completion rates. As discussed in the methods section, the questionnaires were administered by telephone interview, a method that has been validated in previous studies (Weinberger et al, 1994; Watson et al, 1996) and is recommended for older patients to improve completion rates.

Assessing the AQoL questionnaire, at baseline, the only significant difference was in the independent living score where the PAC group had significantly lower scores (median = 0.35) compared to the control group (median = 0.43). The independent living scores looks at three specific domains of functioning. These include activities of daily living, ability to self care as well as mobility around the house and community (Hawthorne et al, 1999). There were no other differences in questionnaire scores at baseline in the other domains measured by the AQoL instrument.

After one month, both groups improved in their independent living scores. The PAC group, however, had a significantly greater improvement compared to the control group. The PAC group also had a greater improvement in the overall quality of life score. This does provide strong support for the PAC program in that it appears to improve overall quality of life measured by the questionnaire. In particular the ability to self care and mobilise appears to be the component that is most affected by the intervention.

This result however contrasted sharply with the SF-36 questionnaire. Out of the eight domains measured by the SF-36, the only difference at baseline was in the health perceptions or general health scale. The PAC group had a significantly higher general health score compared with the control group. At one month follow-up interviews, the general health score of the PAC group however declined. The control group, on the other hand recorded an improvement in general health scores. These differences were statistically significant ($p = 0.002$). All other scores including the composite aggregate physical and mental health scores showed no significant changes between groups.

There are several explanations as to the cause of the contradictory results between the two questionnaires. The two questionnaires have fundamentally different characteristics with the SF-36 designed as a generic health status measure and the AQoL being a more specific health related quality of life instrument. One could hypothesise however that if quality of life improved over the one month follow-up period, it would be most unlikely that an individuals perception of general health would decline in the corresponding period. This brings into question the validity of the instruments in measuring changes over relatively short periods of time. The SF-36 instrument has been widely validated in terms of its reliability and validity as an instrument. Studies of the survey's responsiveness however have lagged behind tests of validity, which concentrate on cross sectional rather than longitudinal tests

(McHorney CA, 1996). Responsiveness is defined as the ability of an instrument to detect meaningful change within individuals over time.

Concerns by authors have also been voiced in the application of the SF-36 to older patients. Parker and colleagues (1998) examined 1014 hospital inpatients 65 years and older and found that self-completion, cognitive dysfunction, disability and age were all associated with poor response rates. The authors went on to question the utility of the SF-36 as a routine health status measure in older hospital inpatients. Other authors like Hobson (Hobson and Meara, 1997; Hobson et al, 1997) have raised similar concerns when using the SF-36 questionnaire in older subjects with Parkinson's disease and stroke.

In previous studies, looking at post acute and discharge planning interventions, the only improvement in quality of life was shown in the study by Rich et al (1995) which looked at discharge and post discharge interventions performed by nursing coordinators, on patients with congestive cardiac failure. The instrument used in this instance was the Chronic Heart Failure Questionnaire. This improvement in health related quality of life was consistent with other outcomes of the study, which showed a marked reduction in hospitalisations and unplanned readmissions over a six month follow-up period. Other studies, which used the SF-36 failed to show any improvements. Most notably, the study by Stewart et al (1998) which showed an improvement in survival and a reduction in total unplanned readmissions failed to demonstrate an improvement in SF-36 scores measured at one and three months after trial recruitment.

In our study, declines in the SF-36 general health perceptions score was not significantly correlated with increased readmissions ($r^2 = 0.009$, $p = 0.941$) or hospital utilisation patterns ($r^2 = -0.009$, $p = 0.841$) in the follow-up period. This suggests that the SF-36 may be limited in its ability to be responsive to changes in health status over short term periods in smaller hospital related samples, particularly in older patients.

While the AQoL instrument is relatively new, it has been shown to be a valid and reliable instrument. Importantly, the instrument was developed in Victoria, Australia comparing a hospital based population with community norms. This may remove some of the cultural biases that accompany health status measures developed in overseas populations. The improvement in overall AQoL scores and independent living scores are also consistent with the reduction in hospital utilisation patterns and patient readmission that occurred in the PAC group. An improvement in independent living scores and overall AQoL scores were both negatively correlated with hospital utilisation and unplanned readmissions in the 6 month follow-up period. This provides further evidence of the validity of the instrument in detecting changes in quality of life over the one month follow-up period.

Patient readmission

At baseline there were no differences in terms of hospital utilisation when looking at unplanned admissions and emergency department visits 12 months before trial recruitment. There was also no significant difference between the PAC and control

groups' index length of stay. This once again suggests that the integrity of the randomisation process was maintained and the intervention could be tested without contamination by other confounders.

During the follow-up period, there was no difference in the proportion of patients who were readmitted to the same hospital, 26% in each group. This finding is similar to Stewart's study (1998) which found that despite the fact that the number of readmissions in the intervention group was reduced, there was no difference in the proportion of patients readmitted to hospital. The PAC intervention therefore did not prevent readmissions to hospital.

Readmitted patients when compared with non-readmitted patients were more likely to have a longer index length of stay and had increased hospital utilisation in the form of unplanned admissions as well as emergency department visits, 12 months before recruitment. In terms of index admission characteristics, readmitted patients also had more comorbidities, were on more medications and were more likely to be medical admissions. These findings confirm previous studies performed locally and overseas. The study by Stewart and colleagues (1998) in South Australia identified 'high risk' patients as being on two or greater medications, having unplanned admissions in the 6 months prior to admission and being greater than 60 years of age. Similarly, Naylor et al (1994) used a risk screening procedure, which incorporated patients who had multiple hospitalisations during the previous 6 months as being at risk. This risk screening protocol had been derived from a previous study examining readmitted patients to hospital (Naylor, 1991).

These results were tested in a logistic regression model with the binary dependent variable being 'having an unplanned readmission'. The logistic regression analysis attempted to identify medical and baseline admission characteristics that could predict unplanned readmissions to hospital. Having unplanned readmissions in the 12 months preceding trial recruitment was the most important patient characteristic that predicted readmission to hospital. Other factors included the number of medications on discharge from hospital, where being on more medications conferred an increased risk as well as having a longer index length of stay. The length of stay variable presumably was a proxy measure for complexity of the primary admission.

Two other factors that significantly predicted unplanned readmissions to hospital were being admitted to Hospitals A and B. In order to examine specific characteristics of the hospitals that may have contributed to this phenomenon, an interhospital comparison was performed using non-parametric tests for medical and admission characteristics. The patient mix in Hospitals A and B was significantly different compared to Hospitals C and D in several areas. Firstly, proportionately more patients recruited for the study from Hospitals A and B were medical patients and had an unplanned index admission. Using non-parametric tests, there were also more patients at Hospitals A and B who had unplanned admissions in the previous 12 months. Although there were significantly more respiratory patients in these two hospitals, regression analysis failed to identify any particular diagnostic group with a significantly greater risk of readmission. Interestingly, this contrasts with previous literature, where patients with congestive cardiac failure and chronic obstructive airways disease are at greater risk of readmission to hospital. Due to the large

numbers of diagnostic groups in the trial, however, there was probably insufficient power to detect risk of readmission in specific diagnostic categories.

Hospital bed day utilisation

Although there was no difference in readmission rates between the two groups when patients were readmitted to hospital, the PAC group did use significantly less bed days compared with the control group. The median number of hospital days used in the PAC group on readmission to hospital was 8.5 days compared to the control group which used a median of 12 days ($p = 0.024$, Mann Whitney). The only differences between the groups for patients readmitted was the number of emergency department visits in the 12 months prior to trial recruitment. The PAC group actually had a greater number of emergency department visits (mean 0.13 for PAC and 0.03 for controls). None of the other patient characteristics including diagnostic group and characteristics of the index admission was significantly different between the two groups.

Stepwise general linear regression analysis was performed to look at variables which predicted bed day utilisation in the follow-up period. Admission characteristics that were significantly associated with an increase in hospital bed day utilisation included unplanned admission in the 12 months prior to trial recruitment, having a longer index length of stay and being a control patient. Admissions to hospitals A and B were also risk factors which correlates well with increased readmission rates in these two centres.

These results provide strong evidence that the PAC intervention does have an impact in reducing hospital bed day utilisation. This is important from a resource allocation perspective, the implications of which will be discussed further in the cost analysis section. The mechanism behind this outcome may relate to the fact that patients on the PAC program may have an established and supportive community service structure, which expedites their discharge when they are readmitted to hospital.

PAC does not seem to have an impact on the initial or index length of stay thus suggesting that there is an initial period of inpatient management where service provision needs to be organised by case coordinators. The benefits seem to arise in subsequent readmissions to hospital where less bed days are used compared with controls. In other words, the impact of this period of case management and discharge planning is reflected in follow-up admissions, where a substantial saving in hospital bed day use is made.

Community service utilisation

Community service utilisation data was obtained from 30 service providers. These were the main service providers in each region. These providers were obtained from individual PAC databases as the services that were sourced most by PAC coordinators after discharge from hospital. This may explain the bias towards obtaining more PAC

patient data compared to control patients in the follow-up phase. Service data was obtained for 59% of intervention patients and 41% of controls in the 6 month follow-up period. Although community service data was only obtained for 187 patients (104 PAC and 83 controls) in the 12 months prior to trial recruitment phase, the ratio of PAC to control patients was not significantly different from the ratio between the groups in the original sample.

This method of data extraction was thought to be the most accurate method of sourcing data as it actually measures services that have been provided to the patient and looks at the costs associated with the services provided. This includes services purchased privately and paid for by patients in the trial from the main community providers in each region. This removes much of the bias associated with asking subjects to recount the duration and frequency of services they have received, which can be notoriously unreliable.

Other methods have been used to obtain community service data. Patient diaries or log books have commonly been used. Examples of this method of service data collection include the study by Rich and colleagues (1995) looking at discharge interventions for patients with congestive cardiac failure and locally in the Post Acute community services study (Street et al, 1995). These methods are, however, subject to inaccuracies as they rely on patient compliance. Previous research has shown that compliance among patients is extremely poor (Haynes et al, 1996).

Other studies have not been specific about community service data collection. For instance, the study by Stewart et al (1998) sourced data from a sample of less than 25% of their study population and the methods by which community utilisation data was obtained was unclear from the study methodology. While there are limitations in the community service data that has been collected in that there is not data for the whole sample, there seems to be methodological problems in most studies that attempt to quantify service utilisation in the community. A centralised unit record number would solve most of these difficulties but there are privacy issues that need to be considered by government and community bodies prior to the introduction of such a system.

Within the limitations of the service data obtained, there was a shift in percentage of services used before and after trial recruitment. The amount of nursing services increased after hospitalisation from about 30% of all services obtained to being in excess of 50%. This certainly replicates previous work performed in Victoria by Street (1995), where nursing services increased after discharge from hospital. There were also significant differences in service use between the 2 groups. For example, with nursing, the PAC group used more of this service after trial recruitment as compared to controls who used more nursing services in the 12 months prior to randomisation. The PAC group also used a greater percentage of personal care services in the 6 month follow-up period. These results seem to indicate that PAC affects the distribution of services, presumably tailoring services to patient requirements. It is not clear if changes in service distribution have any direct effect on patient outcomes. This area needs to be examined in future research.

Cost analysis

The cost analysis data encompasses three main components in the 12 months prior to recruitment and the 6 month follow-up phase. These are the community service utilisation costs, hospital utilisation costs and the total cost for each group. For each of the cost data, the methodology and results are discussed. The limitations of the data presented are also examined.

Community service utilisation costs

In the 12 months prior to trial recruitment, cost data for services obtained were available in 31.3% of the sample. There were no significant differences in the costs between the PAC and control groups when a t-test was performed comparing the arithmetic mean of the two groups. The average cost for PAC patients was A\$696.54 compared to control patients who had an average cost of A\$1189.25 ($p = 0.130$; 95% CI, -\$147.53 to \$1132.94). The comparison of arithmetic means using the t-test is recommended in comparing costs between groups (Thompson & Barber, 2000). This is because cost evaluations that have an impact on medical policy require the analysis of total health care costs, which is a figure extrapolated from the average cost per patient.

Following trial recruitment, community service utilisation costs averaged over 6 months follow-up was A\$459.29 for PAC patients as opposed to A\$523.93 for control patients. Once again these differences were not statistically significant ($p = 0.516$; 95% CI, -\$135.35 to \$268.61). If we assume that these costs remained constant over a 12 month follow-up period, the average cost for each PAC client increased by 31.9% compared to controls where the average cost per client decreased by 11.9%. This is not surprising as the PAC intervention is geared to purchase services for patients in order to improve the transition from hospital to the community.

The limitations of this data are the completeness of cost data in analysing community service utilisation. In a review of all randomised controlled studies examining costs, in 1995, Barber and Thompson (1998) noted that completeness of cost data was only available in 53% of the studies. Of these studies, only three reported that their data was complete. This suggests that most studies are not designed adequately to capture cost data as the primary outcome measure. The problems with obtaining adequate costs with community utilisation have been discussed previously. Importantly, however, the differences in costs associated with community service use were not statistically significant. These results therefore had a limited impact on calculation of total costs.

Hospital utilisation costs

Hospital utilisation costs was imputed from calculating the average cost for a bed day and multiplying it by length of stays of patients in their index admission and all subsequent unplanned readmissions in the 6 month follow-up phase. Although the

original methodology aimed to capture WIES cost data to provide a funder's or government's perspective in evaluating the benefits of the program, this method was limited by incomplete data obtained from the Victorian Admissions Episodes database. The average bed day cost was calculated using results from the National Hospitals Costing Study of 50 public hospitals in Victoria (NHCCD, 1999). Although a more accurate estimate of costs would have been to follow-up each individual and cost each component of their admission, the logistics and budgetary implications of this process would have been beyond the scope of this study.

The earlier results that hospital length of stay is significantly reduced in the PAC group among readmitted patients is reflected in the results of costs of hospital utilisation per patient. The control group was significantly more costly with an average hospital utilisation cost of A\$10160.97 compared to the PAC group where the mean cost was A\$8390.59 ($p = 0.024$, mean difference of \$1770.38; 95% CI, \$236.76 to \$3304.01). Sensitivity analysis was performed to discount marginal bed days as the end-of-stay bed days may cost less than the average bed day in hospitals. The difference in hospital utilisation costs remained statistically significant until marginal bed days were discounted at 25% of average bed day costs ($p = 0.054$, 95% CI, -\$26.96 to \$2990.59).

Total costs

The test for any health service intervention, apart from specific health outcome measures, lies in its ability to be cost effective. In order to provide a measure of the cost benefits of the PAC service in older patients, it was important to measure the input costs to the program as well as the costs associated with service consumption in the hospital and community areas.

In order to measure the cost of the intervention, the costs of the PAC service was obtained by obtaining the average cost per patient of running the service on a statewide basis, excluding the costs of community services purchased. This figure reflects the costs of running the PAC program, taking into account wages of PAC coordinators and the infrastructure that supports the service.

The cost per PAC patient was calculated at A\$292.40. For each PAC patient therefore, total costs were the sum of PAC coordination (\$292.40), hospital utilisation costs and community service utilisation costs. As community costs was obtained in only 40.8% of trial patients in the follow-up period, the average cost for PAC and control patients were extrapolated to the whole sample to calculate the total costs.

The differences in costs were significantly different between the 2 groups with a mean difference of A\$1421.79 ($p = 0.050$; 95% CI, -\$1.54 to \$2845.12). The average total cost for each PAC patient was A\$8801.18 as opposed to A\$10222.97 in the control group. The cost saving was predominantly generated from a reduction in hospital costs associated with shorter hospital lengths of stays in readmitted patients in the PAC group. Using sensitivity analysis, at a marginal bed day rate discounted by 10%, the difference in total costs was no longer statistically significant ($p = 0.066$, 95% CI, -93.89 to \$2953.51). Importantly however, even with a discount rate of 50%, the mean PAC group costs remained lower (A\$ 8390.59) than the control group

(A\$9583.83) although this difference was not significant ($p = 0.201$, 95% CI, - \$516.77 to \$2451.74). At worst, therefore, the intervention remained cost neutral with the costs of the program offset by the savings generated by a reduction in hospital utilisation.

There were limitations in the calculation of total costs. Firstly, the costs did not include costs of pharmaceuticals, over-the counter medications, assistive devices and indirect costs (eg productivity losses by patients and caregivers). There was no difference, however in number of medications prescribed at discharge from hospital. Carer burden although not measured in terms of costs, was measured by questionnaire through the administration of the Carer Strain Index. This was not significantly different in both groups. Other limitations included the fact that discharge planning by social workers in the control group was not costed. Exclusion of these costs may therefore have underestimated the benefits of the intervention. Additionally, community service utilisation data was more complete in the PAC group. This may have led to the overestimation of community service costs in the PAC group compared with controls.

Other studies have also had limitations when evaluating cost-effectiveness of specific interventions. Two previous randomised controlled studies using discharge planning and post acute interventions have been shown to be cost effective. Both show predominant improvement through a reduction in hospital utilisation patterns (Naylor et al, 1999 and Rich et al, 1995). The methods of calculating these costs were however variable. Naylor and co-authors used medicare reimbursements to estimate costs. Using this method does amplify the importance of costs associated with hospital use as opposed to community service costs, which may have been purchased outside the medicare reimbursement system. In the study by Rich and colleagues, cost data was only obtained in 57 patients or 20.3% of the study population. This may have limited the accuracy of the data when extrapolating costs across the whole study population.

It is important to note that in order to measure the full economic implications of a particular health service, cost needs to be established as a primary outcome measure from the start of the trial. This involves performing a power analysis to show a statistical difference in costs as well as measuring all resource use by patients in the follow-up period. This study sought to test the primary hypothesis that PAC improved patient outcomes with cost effectiveness as a secondary outcome measure. While acknowledging the limitations of the cost data presented, the key finding that supports the assertion that PAC is a cost-effective program lies in the reduction of costs associated with unplanned readmissions to hospital in the follow-up period. Savings generated by a reduction in hospital utilisation costs during the 6 month follow-up period offset the costs associated with the program even after discounting marginal bed day costs by up to 50%.

Chapter 5

Conclusion

There is a shift in the emphasis of health care currently from inpatient care to community care in subacute settings. This has given rise to interventions such as the PAC program, which aims to improve the transition from hospital to the community in the face of declining lengths of stay in the acute care or hospital setting. This study represents a landmark shift in evaluating state departmental policy in the region of health service provision. It is the first randomised controlled study evaluating a state implemented intervention looking specifically at the discharge planning and post acute service provision process.

The primary hypothesis that governed this study was that PAC improved health outcomes, quality of life and reduced service utilisation in older patients. The secondary hypothesis was that PAC was a cost-effective intervention. In order to ascertain that the PAC intervention was being adequately assessed, it was important that the process of randomisation worked well. This seemed to be the case as there were no significant differences between control and PAC patients when examining their socio-demographic profiles, admission characteristics and medical diagnoses.

In terms of the primary outcome measure of survival, PAC had no impact on patient mortality in the follow-up period. PAC however had a significant impact on patient quality of life as measured by the AQoL by showing improvements in independent living scores and overall AQoL scores. This instrument although relatively young in its conception was easy to administer and has been previously validated in an Australian population. It also correlated well with other proxy measures of outcome such as readmission and hospital bed day utilisation, thus confirming its validity. The SF-36 on the other hand produced contradictory results in one domain where there was a decline in the general health perceptions score in the PAC group. This result is difficult to explain as the score did not correlate with any other outcome measures in the study. Current literature suggests that the SF-36 questionnaire may have a limited role in measuring outcomes in short term studies, particularly in older patients. Further research examining the responsiveness of the SF-36 questionnaire however needs to be performed in an Australian setting to test this hypothesis.

Although PAC had no impact on overall readmission rates, there was a significant reduction in hospital length of stay or bed day utilisation among patients readmitted to hospital who had received the intervention. This result supports the notion PAC has a role in improving the efficiency in the discharge planning process in subsequent admissions, after the initial contact and service coordination process is performed. As it is patients at high risk of readmission that seem to benefit the most from the intervention, a risk screening process that targets this particular group of patients would provide the most return from investing in the PAC program. In this study, the most potent risk factor for readmission was having previous unplanned admissions to hospital and it is apparent that this group needs to be offered the service when they present to hospital.

In analysing community service utilisation data, the reality remains that current data extraction methods are inadequate when performing health service evaluations that have these services as one of the outcome measures. There are myriads of community service providers making the task of obtaining full community service use, time consuming and costly. Other methods such as relying on patient compliance to obtain a full data set are also subject to inaccuracies. This area is a challenge that should be addressed in future research and in an era where health care costs are becoming more accountable, rationalisation of community service databases should be a priority of service and health care providers. In this study there were no significant differences associated with costs of community service provision in the periods 12 months prior to trial recruitment and in the 6 month follow-up phase.

The cost benefits of the program is ultimately the yardstick by which health providers determine whether a service model is viable. In the case of PAC the total costs mirror the hospital bed day use where costs are highest in the health sector. The savings that resulted from a reduction in hospital bed day utilisation, in the PAC group, over the follow-up period ensured that this service was cost-effective. At worse, using sensitivity analysis to discount the costs of marginal bed days, the service was cost neutral. Although cost utility analysis was not performed, with a net improvement in quality of life measures, these results provide strong support for the viability of the PAC service in improving the transition of older patients from hospital to the community.

The PAC service is a fairly generic intervention with a heterogenous patient population. Further research needs to be performed in the Australian health care setting, targeting patients at high risk of readmission with specific interventions that address the needs related to their specific diseases. These programs need to be evaluated to assess their effects on health outcomes and cost effectiveness. This should provide further information about the service models that can be erected to support older patients with specific comorbidities in the community.

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