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Effects of an Ambulation Orderly Program among Cardiac Surgery Patients

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Abstract

Background—Despite the known benefits of ambulation, most hospitalized patients remain physically inactive. One possible approach to this problem is to employ Ambulation Orderlies (AOs) – employees whose main responsibility is to ambulate patients throughout the day. For this study, we examined an AO program implemented among post-cardiac surgery patients and its effect on patient outcomes.

Methods—We evaluated post-operative length of stay, hospital complications, discharge disposition, and 30-day readmission for all patients who underwent coronary artery bypass and/or cardiac valve surgery in the nine months before and after the introduction of the AO program. In addition to pre-post comparisons, we performed an interrupted time series analysis to adjust for temporal trends and differences in baseline characteristics.

Results—We included 447 and 478 patients in the pre- and post-AO intervention groups, respectively. Post-operative length of stay was lower in the post-AO group, with median (IQR) of 10 (7,14) days versus 9 (7,13) days ($p<0.001$), and also had significantly less variability in mean monthly length of stay (Levene's test $p=0.03$). Using adjusted interrupted time series analysis, the program was associated with a decreased mean monthly post-operative length of stay (-1.57 days,

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All authors had access to the study data and had a role in writing this manuscript.

p=0.04), as well as a significant decrease in the trend of mean monthly post-operative length of stay (p=0.01). Other outcomes were unaffected.

Conclusion—The implementation of an AO program was associated with a significant reduction in post-operative length and variability of hospital stay. These results suggest that an AO program is a reasonable and practical approach towards improving hospital outcomes.

Keywords

Ambulation; Mobility; Hospital Outcomes; Cardiac Surgery

INTRODUCTION

Multiple studies have confirmed that early ambulation following surgery can help decrease post-operative complications, expedite functional recovery, improve overall well-being, shorten hospital length of stay, and reduce morbidity and mortality.^{1–4} Among elderly patients in particular, lack of activity during their hospitalization is independently associated with higher mortality, decline in functional status, increase in readmission rates, and greater rates of nursing home placement.^{5–7}

However, nearly 50% of elderly patients are bedbound or have low mobility during their hospitalization, despite lack of a clear medical indication.⁸ In fact, among patients who were considered able to walk, approximately 73% did not walk at all during a three hour period.⁹ Studies have shown that nurses infrequently initiate ambulation for their patients and that nurses, doctors, patients, and physical therapists all cite lack of time and dedicated staff as a major barrier to patient mobility.^{10–13}

One possible solution is the use of “Ambulation Orderlies (AOs)” – specific employees whose primary responsibility is to assure patient mobility. These “AOs” can help to support overworked staff and may be a practical, cost-effective way to improve patient outcomes through increased ambulation. Such programs could have wide applicability across all kinds of medical settings, but detailed information on them are lacking.

Our hospital hired its first AOs in 2013, to help patients on the post-cardiac surgical floor ambulate more frequently while recovering from their procedure. The purpose of this study was to evaluate this program’s impact on hospital outcomes, patient ambulation, and staff satisfaction, thereby examining its effectiveness and feasibility in the clinical setting.

METHODS

Study design & source

This study used a quasi-experimental design, applying pre-post intervention analyses and interrupted-time series approaches. All data were obtained from information collected at Baystate Medical Center (BMC), a roughly 700-bed academic teaching hospital that performs about 650 cardiac surgeries per year. Following their surgery, patients are initially housed in the intensive care unit, and once stable, transferred to the post-cardiac surgery

floor. The post-cardiac surgery floor is a specifically designated 32-bed unit staffed by 13-16 nurses and 5-7 patient care technicians each day.

At BMC, information on each cardiac surgery patient is collected and stored in the Society of Thoracic Surgeons Adult Cardiac Surgery Database (STS, version 2.61, 2.73), a registry used to track cardiac surgery statistics nationwide. Patient information used to analyze hospital outcomes pre- and post- AO intervention was extracted from the STS database, including data on demographics, surgery details, and outcomes.

Intervention

Since May 8, 2013, BMC has had at least one AO working on the post-cardiac surgery floor for eight hours each day, seven days a week, 365 days per year. The primary role of the AO is to ensure patient ambulation. They are high school graduates who are trained and supervised by nursing and inpatient cardiac rehabilitation staff to provide safe and appropriate patient care. Once a patient is cleared for ambulation by nursing or rehabilitation therapists, he or she is visited by an ambulation orderly 1-4 times a day. The AO spends approximately 3-10 minutes walking with each patient around the floor, at a pace set by the patient.

Prior to May 8, 2013, patients were encouraged to ambulate by the nurses, patient care technicians, physical therapists, and inpatient cardiac rehabilitation staff, who often walked with them when they could. However, there were no set guidelines on how many times staff members were required to walk with their patients, and ambulation levels were not recorded. Therefore, information on patient ambulation was unavailable prior to AO implementation, and consequently, direct comparison of ambulation levels was not possible.

Study patients

We included patients in our study if they underwent coronary artery bypass grafting and/or valvular procedures at BMC and if they were transferred to the post-cardiac surgery floor between August 7, 2013 and February 8, 2014 (inclusive). Patients were excluded if they died during the surgery, died in the intensive care unit, or were directly discharged out of the hospital from the intensive care unit.

To compare pre-AO with post-AO outcomes, we chose to examine patients in the nine months before and after the implementation of the AO program. During this period, we did not identify any major initiatives that would be expected to have had an affect on hospital outcomes, patient ambulation, or staff/patient satisfaction.

Study outcomes

Given that we expected the AOs to have the most significant impact on recovery time, our primary study outcomes were post-operative length of stay, as a representation of their length of stay on the post-cardiac floor. Secondary outcomes included total hospital length of stay, death within 30 days of discharge, readmission within 30 days of discharge, discharge to home (rather than nursing home, hospice, or other hospital), and any hospital complication. Hospital complications included peri-operative events, post-operative

infections, neurological complications, pulmonary issues, renal failure, rhythm disturbance requiring permanent device, and atrial fibrillation, as included in the STS database.

Statistical analysis

Characteristics between the pre- and post-AO groups were compared using student's t-, Mann-Whitney U, and chi-square tests as appropriate. We assessed differences in outcomes using student's t- and Mann Whitney U tests for length of stay and chi-square test for rates of discharge home, readmission, and complication. We used Brown-Forsythe (for medians) and Levene's (for means) tests to assess for significant variation in average monthly length of stay. Statistical significance was defined as an alpha of 0.05.

In order to evaluate any temporal trends that may have affected outcomes over time and to adjust for any baseline differences between groups, we conducted a piecewise regression analysis. By dividing the data into monthly intervals, with AO implementation (May 8, 2013) as the intervention point, we treated the study as an interrupted time series.¹⁴ We performed a multivariable piecewise regression on clinically relevant and carefully chosen factors using backward selection criteria, with $p < 0.20$ to keep and $p < 0.10$ to stay in the final model. Statistical analyses were performed using JMP®, Version 12.0.01 (SAS Institute Inc., Cary, NC, 1989-2014) as well as Microsoft Excel (2010).

Ambulation counts

When the program first began in May 2013, AOs did not record the number of times that patients were ambulated, but by late winter of 2014, they had started keeping daily records. Accordingly, the actual ambulation frequency of every patient in the cohort is unknown. However, we estimated the ambulation impact by examining a sample of 72 sequential patients who were on the floor from March 18th to April 21st, 2014. All 72 patients had complete AO data for their entire length of stay on the floor and otherwise met all inclusion and exclusion criteria. We used means and medians to calculate the number of times per day each patient walked with the AO, as well as the total number of times each patient was walked during their entire stay on the floor. Ambulation performed by cardiac rehabilitation staff, nurses, or physical therapists was not available. Patients who were deemed "independent" were no longer visited by AOs, and records of their ambulation were not kept.

Staff satisfaction

We evaluated staff satisfaction with the AO program using a nine question anonymous survey that was distributed on paper to nurses and patient care technicians on the post-cardiac surgery floor in May 2015. Six questions utilized the five-item Likert-scale, two were short answer questions, and one question was for overall comments about the AO program.

RESULTS

Hospital outcomes comparing pre- vs post-AO data

We identified a total of 447 sequential patients in the pre-AO group and 478 sequential patients in the post-AO group. Using May 8th, 2013 as our cutoff point, we found no

statistical difference in age, sex, race, or type of surgical procedure between the two groups, suggesting no major significant demographic shift during the study period (Table 1).

In comparing pre- and post-AO outcomes, total and post-operative lengths of stay were significantly lower in the post-AO group, and there was no difference in adverse events, discharge disposition, or readmission rates (Table 2). Median total and post-operative lengths of stay each decreased by one day in the post-AO group, while the mean post-operative stay decreased by approximately 1.3 days.

Piecewise regression analysis of total and post-operative length of stay showed that during the nine months prior to the AO intervention, there was no significant change in either outcome. The introduction of the AO program was associated with an immediate decrease in both the total and post-operative lengths of stay, as well as a decrease in the average stay per month. In the univariate analysis, statistical significance was only achieved for decrease in monthly trend following AO intervention for post-operative length of stay (Table 3). However, when adjusted for STEMI presentation, presence of congestive heart failure, and post-operative serum creatinine level (factors chosen via backward selection), there was a statistically significant decline in post-operative stay as well as in monthly trend (Table 4).

Notably, we found that the introduction of the AO program resulted in significantly reduced mean and median variability in post-operative length of stay ($p=0.03$ for means; $p=0.05$ for medians). This was confirmed by visual assessment showing that after the implementation of AOs, there was a decrease in within-month variability of length of stay, as well as in average median monthly length of stay (Figure 1). Overall, these findings are consistent with the results of the unadjusted and the piecewise regression analyses as shown in Tables 2, 3, and 4.

Ambulation Frequency

Of the 72 patients for whom ambulation data was obtained, one patient remained in infection isolation and was never ambulated by the AOs. All other patients were ambulated at least once during their entire stay, and most patients (82.7%) were ambulated at least once per day until judged to be independent. Among those who were walked, each patient ambulated between 1 to 4 times, with a mean ($\pm$ SD) of 1.8 ± 0.6 times, per day with an AO. In total, patients ambulated a mean of 5.9 ± 4.1 times during their entire post-operative stay.

Staff satisfaction

Eighteen of the 26 daytime nurses and patient care technicians responded to our survey, giving us a response rate of 69%. Overall, responses showed strong support of the AO program (Table 5). On average, staff felt that the AOs provided over an hour of extra time each day that they could devote to other non-ambulation focused tasks.

DISCUSSION

By comparing outcomes before and after the period of AO intervention, we found that total and post-operative lengths of stay were shorter by over one day following the intervention. This association remained significant even after accounting for other patient factors and

temporal trends in the 18 months surrounding the intervention. Furthermore, the program was associated with decreased monthly variances in length of stay. The implementation of the AO program seemed to have no impact on mortality or morbidity, while being associated with high staff satisfaction.

To our knowledge, this is the first time that the use of an “ambulation orderly” has been described in the literature. However, our results remain quite similar to those of other studies using different interventions to achieve similar goals of increased patient ambulation and/or activity – mainly, that the hospital length of stay decreased by about one day.^{2,3,5,15} The interventions described by these studies are much more involved, ranging from the use of multi-disciplinary teams to extra physical therapy sessions. Compared to these studies, our program using ambulation orderlies is simpler and likely more cost-effective. A review of multi-disciplinary interventions showed that such programs decreased hospital costs by \$278 per patient per stay.⁵ Since our program uses fewer resources and ambulates patients on individual needs, we suspect that the cost-savings would be much greater.

There are no recommendations on the goal number of times surgical patients should be ambulated post-operatively. One study examined a program which used dedicated staff to help ambulate patients, as well as developed patient-specific goals for ambulation.⁷ It found that patients walked an average of 5-6 times during their entire hospital stay, with dedicated staff as well as on their own and with family. In our study, patients ambulated about six times with the AOs during their entire stay, not including the number of times patients may have ambulated on their own. Therefore, we conclude that our program achieves at least the same amount of walks per patient stay as those that are more inclusive.

An advantage of our study is the number of patients included in our analysis. Based on mean and standard deviation of post-operative length of stay, our two sample sizes (pre-AO and post-AO groups) provide a power of over 90% when using an alpha of 0.05, to detect a reduction of at least one day in total hospital length of stay. While our study did not use a clinical trial design, its study population was significantly larger compared to prior studies examining exercise-focused interventions, and by using representative patient data, the study likely has greater external validity.

Another strength lies in the duration of time over which we examined the effects of the AO program. We adjusted for patient factors as well as for temporal trends, by using piecewise regression analysis. Our adjusted results show that there was an initial decrease in post-operative length of stay after implementation of the AO program, with further reductions over time and with reduced month-to-month variability. This may reflect an early “adjustment period”, when AOs were still learning their responsibilities. We also believe that the program brought about a cultural shift among the staff, with greater focus on promoting overall patient ambulation. Furthermore, the staff likely had more time to focus on other patient tasks, leading to more standardization of patient care and less variability in overall outcomes.

Our study’s major limitation is the lack of information on ambulation levels prior to the AO program. Based upon nursing input as well as the primary reason for the program, we

assume that there was substantially less patient ambulation occurring beforehand. However, a direct association between the program and patient ambulation cannot be definitively made.

In addition, we do not know whether the mechanism of improvement in hospital outcomes was by an increase in patient ambulation or whether an unidentified factor may have caused the significant change in our initially flat baseline trend. It is possible that having more staff involved in patient care allowed for earlier detection of adverse events that lead to improved outcomes. In that case, though, we would expect the rate of complications, deaths, and/or readmission rates following the intervention to decrease, which was not the case. Staff responses to our survey suggest that the benefit of the AOs was their focus on ambulation. While a randomized control study would be more ideal in eliciting the actual association between the program and hospital outcomes, our study still illustrates the practicality and effectiveness of the intervention when implemented in a “real world” clinical setting.

A third limitation is that while we used statistical analyses to examine temporal trends, we cannot account for all possible institutional or cultural changes that may have affected hospital outcomes during our 18-month time period, such as changes in peri-operative care or in staff expertise. However, all study authors agreed that there were no identifiable initiatives for reducing hospital stay during the study period.

Overall, our study succeeds in showing how a simple intervention such as the use of AOs can have a significant impact on hospital outcomes among post-cardiac surgery patients. We perceive that our AO program would be easily applicable to similar patient populations who are especially vulnerable to immobility, for example those with prolonged intensive care unit stays or who are admitted for decompensated heart failure.

CONCLUSION

By showing how the use of ambulation orderlies are significantly associated with improved hospital outcomes, our study introduces an attractive way of providing better patient care among post-cardiac surgery patients. Not only does it help patients achieve a higher level of ambulation, the program was well received by the staff. Our intervention appears to be cost-effective and is simple to implement, needing only minimal oversight by nurses and inpatient cardiac rehabilitation. Further research may help to encourage adoption of this program as part of routine inpatient care for specific patient populations.

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References

1. Cockram J, Jenkins S, Clugston R. Cardiovascular and respiratory responses to early ambulation and stair climbing following coronary artery surgery. *Physiother Theory Pract.* 1999; 15:3–15. DOI: 10.1080/095939899307856

2. Kalisch BJ, Lee S, Dabney BW. Outcomes of inpatient mobilization: a literature review. *J Clin Nurs*. 2014; 23:1486–1501. DOI: 10.1111/jocn.12315 [PubMed: 24028657]
3. Pashikanti L, Von Ah D. Impact of early mobilization protocol on the medical-surgical inpatient population: an integrated review of literature. *Clin Nurse Spec*. 2012; 26:87–94. DOI: 10.1097/NUR.0b013e31824590e6 [PubMed: 22336934]
4. Wenger NK. Early ambulation physical activity: myocardial infarction and coronary artery bypass surgery. *Heart Lung*. 1984; 13:14–18. [PubMed: 6607241]
5. de Morton NA, Keating JL, Jeffs K. Exercise for acutely hospitalized older medical patients. *Cochrane Database Syst Rev*. 2007; (1) Art. No.: CD005955. doi: 10.1002/14651858.CD005955.pub2
6. Markey DW, Brown RJ. An interdisciplinary approach to addressing patient activity and mobility in the medical-surgical patient. *J Nurs Care Qual*. 2002; 16:1–12.
7. Tucker D, Molsberger S, Clark A. Walking for Wellness: a collaborative program to maintain mobility in hospitalized older adults. *Geriatr Nurs*. 2004; 25:242–245. DOI: 10.1016/j.gerinurse.2004.06.009 [PubMed: 15311202]
8. Brown CJ, Friedkin RJ, Inouye SK. Prevalence and outcomes of low mobility in hospitalized older patients. *J Am Geriatr Soc*. 2004; 52:1263–1270. DOI: 10.1111/j.1532-5415.2004.52354.x [PubMed: 15271112]
9. Callen BL, Mahoney JE, Grieves CB, Wells TJ, Enloe M. Frequency of hallway ambulation by hospitalized older adults on medical units of an academic hospital. *Geriatr Nurs*. 2004; 25:212–217. DOI: 10.1016/j.gerinurse.2004.06.016 [PubMed: 15311196]
10. Barber EA, Everard T, Holland AE, Tipping C, Bradley SJ, Hodgson CL. Barriers and facilitators to early mobilisation in intensive care: a qualitative study. *Aust Crit Care*. 2015; 28:177–82. DOI: 10.1016/j.aucc.2014.11.001 [PubMed: 25533868]
11. Brown CJ, Williams BR, Woodby LL, Davis LL, Allman RM. Barriers to mobility during hospitalization from the perspectives of older patients and their nurses and physicians. *J Hosp Med*. 2007; 2:305–313. DOI: 10.1002/jhm.209 [PubMed: 17935241]
12. Doherty-King B, Yoon J, Pecanac K, Brown R, Mahoney J. Frequency and duration of nursing care related to older patient mobility. *J Nurs Sch*. 2014; 46:20–27. DOI: 10.1111/jnu.12047
13. Hoyer EH, Brotman DJ, Chan KS, Needham DM. Barriers to early mobility of hospitalized general medicine patients. *Am J Phys Med Rehabil*. 2015; 94:304–312. DOI: 10.1097/PHM.000000000000185 [PubMed: 25133615]
14. Wagner AK, Soumerai SB, Zhang F, Ross-Degnan D. Segmented regression analysis of interrupted time series studies in medication use research. *J Clin Pharm Ther*. 2002; 27:299–309. [PubMed: 12174032]
15. Peiris CL, Taylor NF, Shields N. Extra physical therapy reduced patient length of stay and improves functional outcomes and quality of life in people with acute or subacute conditions: a systematic review. *Arch Phys Med Rehabil*. 2011; 92:1490–1500. DOI: 10.1016/j.apmr.2011.04.005 [PubMed: 21878220]

Figure 1. Median (interquartile range) monthly post-operative length of stay (LOS)

As can be seen, there was an overall decrease in LOS in the months following the date of AO implementation (May 8, 2013) compared to the months prior. The figure also shows that the variances of the LOS were also lower in the post-AO months. This was supported by the fact that there was a statistically significant difference in variability of means (Levene's test $p=0.03$) and of medians (Browne-Forsythe $p=0.05$). The slopes for the pre- and post-AO lines were obtained from the unadjusted piecewise regression results shown in Table 3.

Table 1

Patient characteristics by pre- and post-AO group.

Characteristic	Pre-AO Group N = 447	Post-AO Group N = 478	p-value
Demographics			
Age in years, mean ± SD	68.0 ± 11.9	68.6 ± 12.0	0.46
Male sex, n (%)	299 (66.9)	331 (69.2)	0.44
Caucasian, n (%)	418 (93.5)	430 (90.0)	0.07
Surgical procedure			
CABG, n (%)	202 (45.2)	238 (49.8)	0.36
Valve, n (%)	171 (38.3)	165 (34.5)	
CABG and valve, n (%)	74 (16.6)	75 (15.7)	
Cardiac presentation prior to CABG			
Stable angina, n (%)	32 (7.2)	63 (13.2)	<0.001
Unstable angina, n (%)	116 (26.0)	94 (19.7)	
Symptoms, unlikely ischemic, n (%)	86 (19.2)	122 (25.5)	
STEMI, n (%)	8 (1.8)	16 (3.4)	
NSTEMI, n (%)	82 (18.3)	96 (20.1)	
No symptoms or angina, n (%)	123 (27.5)	87 (18.2)	
Operative urgency			
Elective, n (%)	226 (50.6)	253 (52.9)	0.72
Urgent, n (%)	209 (46.8)	211 (44.1)	
Emergent, n (%)	12 (2.7)	14 (2.9)	
Number of bypass grafts in CABG procedures (n=589)			
Arterial grafts, median (IQR)	1 (1,1)	1 (1,1)	0.89
Venous grafts, median (IQR)	2 (1,2)	2 (1,2)	0.09
Prior cardiovascular intervention			
Prior CABG, n (%)	21 (17.4)	22 (16.1)	0.59
Prior valve procedure, n (%)	19 (15.7)	19 (13.9)	
Prior PCI, n (%)	57 (47.1)	70 (52.6)	
Other prior intervention, n (%)	24 (19.8)	26 (19.0)	
Cardiac risk factors			
Dyslipidemia, n (%)	357 (80.0)	381 (79.7)	0.95
Hypertension, n (%)	361 (80.7)	383 (80.1)	0.81
Current smoker, n (%)	82 (18.3)	130 (27.2)	0.001
Family history of CAD, n (%)	52 (11.6)	51 (10.7)	0.64
Diabetes, n (%)	172 (38.4)	176 (36.8)	0.60
Hemoglobin A _{1c} (%), mean ± SD	6.2 ± 1.5	6.2 ± 1.3	0.61
Body mass index (kg/m ²), mean ± SD	28.9 ± 6.5	28.9 ± 5.2	0.92
Comorbidities			
Dialysis, n (%)	9 (2.0)	13 (2.7)	0.48
Peripheral vascular disease, n (%)	67 (15.0)	63 (13.2)	0.43

Characteristic	Pre-AO Group N = 447	Post-AO Group N = 478	p-value
Prior myocardial infarction, n (%)	152 (34.0)	184 (38.5)	0.16
Congestive heart failure, n (%)	185 (41.4)	158 (33.1)	0.01
Atrial fibrillation, n (%)	142 (58.2)	158 (59.6)	0.74
Stroke, n (%)	35 (48.0)	31 (36.4)	0.14
Additional factors			
Ejection fraction (%), mean $\pm$ SD	53.1 $\pm$ 14.5	52.4 $\pm$ 14.4	0.50
Post-op creatinine (mg/dL), mean $\pm$ SD	1.5 $\pm$ 1.0	1.5 $\pm$ 1.2	0.07
Intra-aortic balloon pump use, n (%)	42 (9.4)	37 (7.7)	0.36
Cardiac rehabilitation referral, n (%)	405 (91.6)	442 (92.7)	0.24

SD = standard deviation; CABG = coronary artery bypass grafting; STEMI = ST elevation myocardial infarction; NSTEMI = non-ST elevation myocardial infarction; IQR = interquartile range; PCI = percutaneous coronary intervention; CAD = coronary artery disease.

Table 2

Patient outcomes by pre- and post-AO group.

Outcome	Pre-AO Group N = 447	Post-AO Group N = 478	p-value
Total LOS, median (IQR)	10 (7,14)	9 (7,13)	<0.001
Post-operative LOS, median (IQR)	8 (6,11)	7 (6,10)	<0.001
Post-operative LOS, mean $\pm$ SD	10.0 $\pm$ 6.5	8.7 $\pm$ 5.5	<0.001
Discharge to home, n (%)	289 (65.5)	298 (64.5)	0.74
30-day hospital readmission, n (%)	62 (14.0)	63 (13.4)	0.76
Any hospital complication, n (%)	248 (55.4)	270 (56.4)	0.76
Death at 30 days, n (%)	6 (1.3)	7 (1.4)	0.87

LOS = length of stay (in days); IQR = interquartile range; SD = standard deviation

Table 3

Unadjusted piecewise regression results for monthly length of stay by pre- and post-AO. *

	Total LOS		Post-operative LOS	
	Parameter	p-value	Parameter	p-value
Pre-AO				
β_0 = Pre-AO level (days)	12.9	<0.001	10.9	<0.001
β_1 = Pre-AO slope (days/month)	0.07	0.61	0.07	0.53
Post-AO				
β_2 = Change in LOS after AO (days)	-0.95	0.36	-1.16	0.16
β_3 = Change in slope after AO (days/month)	-0.28	0.14	-0.30	0.05

LOS = length of stay (in days); AO = Ambulation Orderly.

* Based on the model $LOS = \beta_0 + \beta_1 * time + \beta_2 * presence\ of\ AO + \beta_3 * time * presence\ of\ AO + error\ term.$

Table 4

Adjusted piecewise regression results for post-operative monthly length of stay by pre- and post-AO.*

	Post-operative LOS	
	Parameter	p-value
Pre-AO		
β_0 = Pre-AO level (days)	9.86	<0.001
β_1 = Pre-AO slope (days/month)	0.12	0.25
Post-AO		
β_2 = Change in LOS after AO (days)	-1.57	0.04
β_3 = Change in slope after AO (days/month)	-0.38	0.01
Factors included in the model[†]		
β_4 = Presented as STEMI (vs. stable angina)	-1.23	0.04
β_5 = Presence of congestive heart failure	-0.79	<0.001
β_6 = Post-operative serum creatinine level (per 1mg/dL increase)	1.63	<0.001

LOS = length of stay (in days); AO = Ambulation Orderly.

* Based on the model $LOS = \beta_0 + \beta_1 \cdot \text{time} + \beta_2 \cdot \text{presence of AO} + \beta_3 \cdot \text{time} \cdot \text{presence of AO} + \beta_4 \cdot \text{STEMI} + \beta_5 \cdot \text{congestive heart failure} + \beta_6 \cdot \text{post-operative serum creatinine} + \text{error term}$.

[†] Factors included in the model based on backward stepwise selection with criteria of $p < 0.20$ to enter and $p < 0.10$ to stay in the final model.

Table 5

Staff survey results.

	Response (mean ±SD) N = 18
Likert Style questions (1-5) *	
I enjoy working with AOs.	1.3 ± 0.59
Patients are more satisfied when AOs are present.	1.4 ± 0.61
Other floors would benefit from AOs.	1.3 ± 0.57
Patients are more physically fit when AOs are present.	1.4 ± 0.61
AOs are a safe way for patients to ambulate.	1.0 ± 0.24
AOs allow more time for other nursing activities.	1.0 ± 0.24
Estimated time saved for other nursing tasks due to presence of AOs (min/day).	68 ± 44
Sample Comments	
<i>"Our patients are much happier. Families feel safer. AOs are so helpful."</i>	
<i>"AOs are the oil that keeps the engine running."</i>	
<i>"Before orderly, nursing could not manage a full load patient assignment and still have time to walk. Only had time for 1 walk, if that. Cardiac rehab would tell pts to walk 3-4 x/day and nursing was scolded by pts/families and midlevels for not being able to make this demand. We "heart" orderlies."</i>	

AOs = Ambulation Orderlies; SD = standard deviation.

*
1 = strongly agree; 5 = strongly disagree.