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A Standardized, Bundled Approach to Providing Geriatric-Focused Acute Care

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Abstract

Background—Computerized provider order entry (CPOE) systems in the electronic medical record and checklists may present opportunities to improve care in older hospitalized adults.

Objectives—To determine if a bundled intervention can increase detection of delirium and facilitate safer use of high risk medications.

Design—Pre-post interventional trial

Setting—Large academic medical center

Participants—Patients 70 years (n=19,949) admitted 5/1/2008 to 9/30/2011. Patients 80 years admitted after 4/26/2010 received the intervention; those admitted prior were primary controls. Patients aged 70–79 were concurrent controls.

Intervention—The intervention uses a checklist promoting delirium prevention, recognition and management, and modifies the CPOE system to provide elder focused care.

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Measurements—Frequency of orders for activating the rapid response team for altered mental status, frequency of orders for haloperidol > 0.5 mg or IV morphine > 2 mg, and discharge disposition.

Results—Patients receiving the intervention were 86.1 ± 4.6 years old and 58.2% female. The number of orders to activate the rapid response team for altered mental status increased in both patients receiving the bundle and in controls [odds ratio (OR) for the difference of differences = 1.23 (95% CI 0.68–2.24, $p=0.49$)]. Patients receiving the bundle were less likely to receive haloperidol > 0.5 mg IV/IM/PO [OR=0.60 (0.39–0.91) $p = 0.02$] and morphine > 2 mg IV [OR=0.52 (0.42–0.63), $p < 0.0001$]. More patients who received the bundle were discharged home than to extended care facilities [OR 1.18 (CI 1.04–1.35) $p = 0.01$].

Conclusion—An intervention focused on delirium prevention and recognition by bedside staff combined with computerized decision support facilitates safer prescribing of high risk medications, and possibly results in less need for extended care.

Keywords

delirium; acute care; geriatrics; medication geriatrics safety

INTRODUCTION

While adults older than 65 years account for 15–17% of the population in the United States, they account for a disproportionate number of hospital admissions and total health care costs (estimated US\$329 billion a decade ago).^{1,2} The average length of stay increases with age such that patients 65–74 years spend 6% longer in the hospital, and the oldest patients (85 years) spend 14% longer per hospitalization, when compared to adults 45–64 years.³ Complications of hospitalization and the ‘cascade to dependency’ often lead previously independent, community dwelling older adults to be discharged to skilled nursing facilities.⁴ Nearly 40% of patients 85 years and older are discharged from the hospital to an extended care facility (ECF).⁵

Specific measures can be taken to mitigate the hazards of hospitalization and illness in older patients. Inouye et al described techniques to prevent delirium in older patients.⁶ Similarly, early detection of delirium increases the likelihood that with proper care the duration and severity of the delirium can be reduced.⁷ These interventions can reduce the cost of post-hospital care.⁸

Recognizing age-related changes in pharmacokinetics and pharmacodynamics is an important component to appropriate medication prescribing to mitigate the risk of delirium. The Beers list of potentially inappropriate medications and the STOPP application highlight specific drugs that should be avoided or used with caution in elders.⁹ However, even when clinically indicated, these medications are often inappropriately prescribed.^{10,11} This may be in part due to inadequate education of physicians in principles of geriatric medicine.¹² Leveraging computerized provider order entry (CPOE) systems to warn providers of the potential hazards of certain medications in older adults at the time of prescribing has been shown to decrease the inappropriate use of some high risk medications.¹³

Other efforts to improve quality have focused on the use of checklists. The airline industry is commonly cited for using checklists prior to take-off to increase passenger safety. Leaders in quality improvement in health care have transferred this idea to “bundles” aimed at eliminating ventilator associated pneumonia and central line infections.¹⁴ It is uncertain whether such an approach can improve the care of elderly hospitalized patients.

In this setting, we designed a bundled intervention to address the risks of hospitalization in older adults. Specifically, the bundle provides staff with a bedside checklist for patients 80 years and older admitted to the hospital and decision support in the CPOE system. The bedside checklist prompts staff to screen for delirium and to implement delirium prevention and management strategies. The CPOE system provides decision support for antipsychotic and opioid analgesic ordering. To understand the effects of this geriatrics bundle, we designed a pragmatic clinical trial using a pre-post intervention design with concurrent controls.

METHODS

Patient Population

This study was conducted at a large, urban, academic hospital in Boston, Massachusetts. The hospital provides primary and tertiary care with 621 inpatient beds and approximately 40,000 inpatient admissions per year. The intervention targeted all patients 80 years and older admitted to the hospital’s general medical and surgical floors excluding the intensive care units, the inpatient psychiatry unit, and the inpatient oncology unit. To address potential secular trends, we measured outcomes in a concurrent control group consisting of all patients aged 70–79 years admitted to the hospital excluding the same services as that of the intervention group. The pre-intervention period was from May 1, 2008 to April 26, 2010 and the intervention period was from April 27, 2010 to September 30, 2011. Patients in the bundled intervention group received both a bedside checklist and an enhanced CPOE interface with embedded decision support.

Bedside Checklist

Before the implementation of the geriatrics bundle, all patients admitted to the medical center’s general wards were followed with a standard bedside monitoring form. This form is used to document up to 24 hours of patient specific information including 1) vital signs (temperature, blood pressure, pulse, respiratory rate, and oxygen saturation), 2) input and output (intravenous and oral intake, urinary and fecal output), and 3) blood glucose measurement. Each day, a new monitoring form is placed at the bedside. Older and younger patients have historically received the same standard monitoring forms.

Recognizing that older patients have specific care needs that are distinct from the needs of younger patients, a group of geriatricians, hospitalists, and nurses designed a supplemental checklist to go with the standard bedside monitoring form. The checklist includes delirium screening using a twice daily Richmond Agitation and Sedation Scale (RASS) score and a daily test of attention administered by the patient’s nurse, thereby incorporating key elements of the Confusion Assessment Method (CAM).^{15,16} For delirium to be detected

with the CAM, there must be acute onset/fluctuating course and inattention as well as an altered level of consciousness or disorganized thinking. We incorporated a daily test of attention into the form by asking the patient to list the months of the year backwards. If the patient is unable, then the patient is asked to state the days of the week backwards. If unable, the patient is then asked to count backwards from 10 to 1. If the patient is unable to do any of these three tests of attention and this is a new finding, it is considered a positive screen for delirium. Similarly, to evaluate for the altered level of consciousness aspect of the CAM, we use the Richmond Agitation and Sedation Scale (RASS)¹⁵ twice daily for each patient. If the patient scores anything other than a zero, one, or minus one and this is a new finding, this is considered a positive screen for delirium. As the RASS is calculated twice a day and the test of attention is done daily and documented on the checklist, any changes in patient's status over time should be recognized by the nursing staff over the course of an 8 or 12 hour shift. When a patient screens positive for delirium, the system recommends the nurse call a "trigger", the local terminology for activation of the institution's rapid response team for an "acute change in conscious state".¹⁷ "Acute change in conscious state" has been included as criteria to activate the rapid response team at our institution since the rapid response team program began in 2005. Other clinical situations warranting notification of the rapid response team include: hemodynamic instability (SBP < 90, HR < 40 or > 130), respiratory distress (RR < 8 or > 30, SaO₂ < 90% in spite of oxygen, need for a non-rebreather), urine output < 50 cc in 4 hours, and marked nursing or family/patient concern. In our institution, the trigger leads to a detailed evaluation by the patient's primary care team, including the physician of record (attending physician). In the case of a trigger for "acute change in conscious state", the team examines the patient for inciting causes of delirium, adjusts or prescribes medication if appropriate, and considers requesting geriatrics or psychiatry consultation.

The bundled intervention prompts nurses to follow a standard care plan for geriatric patients (Figure 3). The bundle also includes a checklist which prompts providers to incorporate delirium prevention strategies into routine care. Staff is prompted each day to review the need for ongoing use of tethering devices including telemetry and indwelling urinary catheters since these have been associated with delirium. Moreover, while simply removing tethers can facilitate patient mobility, the checklist prompts staff to ensure that each patient spends time out of bed twice daily, thus promoting mobility and reducing the risk for functional decline associated with prolonged bed rest.

CPOE Modifications

The proprietary CPOE system at our hospital shares characteristics with systems elsewhere. Since all inpatient orders are placed using this electronic system it provides an opportunity to guide clinician behavior. The CPOE system automatically identifies patients who will receive the bundled intervention. Providers place orders the same way for these patients as they do for all inpatients, but automatic defaults were modified to address the needs of older patients. For instance, the activity screen previously read: "Activity as tolerated." This was changed to either "Activity: Ambulate twice daily if patient able" or "Activity: Out of bed to chair for meals." The enhanced CPOE interface for the patients receiving the bundle also provides information when ordering antipsychotic and opioid analgesics. While an existing

customized warning system targeting Beers medications offered some decision support within CPOE prior to the implementation of geriatrics bundle, medications like antipsychotics and opioids were thought to offer additional opportunities for embedded decision support.¹³ Specialists at our institution created the analgesic and antipsychotic guidance interface in the CPOE system. The analgesic guidance page encourages the use of low-dose opioid analgesics rather than higher doses recognizing that many older adults are naive to the effects of opiates. The antipsychotic page describes the caveats of prescribing this class of medications in elderly patients, and recommends doing so at low initial doses and only when absolutely necessary.

Implementation of the Intervention

There were four main components of the intervention that were key to its success. (Figure 2) First, the intervention was targeted to a population likely both to benefit from the intervention and to be readily identified by staff and the CPOE system. Units where patients were already receiving specialized care plans (e.g., intensive care units, inpatient psychiatry) were excluded. Second, the decision support required for success of the intervention was carefully designed for this target population. Third, outcomes focused on key intervention components were pre-determined and monitored. Finally, throughout the intervention, educational curricula were created and offered to staff across clinical disciplines - including nursing, physician staff and residents.

Timeline

The intervention started with the bedside checklist on three units in November 2009 to ensure feasibility with routine nursing care and documentation. The CPOE modifications and further dissemination of the bedside checklist began on April 26, 2010. Unit-based educational sessions were held for staff during the first 6 weeks of the program. Physicians received broadcast emails describing the initiative.

Measurements

We studied the intervention using a before/after design, measuring the effect of the geriatrics bundle on specific, pre-defined outcomes. The primary outcomes of this study were the frequency of orders for activating the rapid response team for an acute change in conscious state, frequency of orders for haloperidol exceeding 0.5 mg IV/IM/PO, and frequency of orders for morphine exceeding 2 mg IV (the recommended starting doses in the modified CPOE system). Secondary outcomes collected include: length of stay, in-hospital mortality, intensive care unit stay during admission, discharge disposition, 3 day and 30 day readmission rates, any trigger, and trigger for marked nursing concern. Outcome data were provided by our hospital's decision support staff. The Committee on Clinical Investigations (IRB) determined the investigation was a quality improvement project and declined human subjects review.

Data Analysis

Baseline socio-demographic characteristics for the control population and the intervention cohort were collected for the pre-intervention and the post-intervention period. Outcomes

were collected for both the intervention and the control group in the pre-and post-intervention periods. For each of the dichotomous outcomes, we fit a logistic regression model to evaluate the impact of the intervention. Since some patients had more than a single hospitalization during the study period, we used generalized estimating equation (GEE) methods to account for within-patient correlation. Independent variables were case mix index, time period (pre versus post), age group (70–79 versus 80+) and the time period-age group interaction. We focus on the interaction term as it represents the difference between the groups (i.e., the patients age 80 and over who were eligible for geriatrics bundle compared to patients in their 70s who were not targeted for the intervention) in terms of the change from pre- to post-intervention. We report odds ratios with 95% confidence intervals for the interaction term and p-values from the Wald test. For length of stay, we followed the same approach, except that we used a linear GEE model and report the β coefficient and 95% confidence interval for the interaction term, essentially a “difference of differences” approach.

RESULTS

Demographic characteristics

Table 1 summarizes the demographic characteristics of four groups: those aged 80 and older in both the pre- and post- intervention time periods, and the concurrent controls aged 70–79 in both time periods. The 80+ groups were of similar mean age before and after launch of the intervention. When compared to the concurrent control group (70–79 years) over the same time period, the 80+ patients were more likely to be female.

In Hospital Outcomes

Nursing staff’s recognition of acutely confused patients increased in both groups during the study period after the bundled intervention began. In unadjusted analyses, the rate of triggering for acute change in conscious state more than doubled in patients receiving the bundle and doubled in the concurrent control group. (Table 2)

Regarding prescribing practices, there was an observed decrease in the likelihood that haloperidol would be ordered in excess of 0.5 mg for patients receiving the bundle while there was an increase in the likelihood of orders for haloperidol in excess of 0.5 mg for concurrent controls over the same time period. After adjustment, patients receiving the intervention were 40% less likely ($p = 0.02$) to be ordered for haloperidol in excess of 0.5 mg. Similarly, patients receiving the intervention were less likely to be ordered for morphine in excess of 2 mg IV compared to historical controls, while the unadjusted frequency of orders for morphine > 2 mg IV increased in the concurrent control group over the study period. After adjustment, the intervention decreased the inappropriate orders for morphine by 50% ($P < 0.0001$).

To address the issue of whether the intervention changed medication prescribing practices (such as leading physicians to switch to other opioid analgesics or sedating medications), we performed a sensitivity analysis limiting the analysis of rates of inappropriate prescribing to only patients prescribed morphine or haloperidol. This analysis showed that the rate of

inappropriate morphine and haloperidol orders also went down as a percentage of total morphine and haloperidol orders. This suggests that ordering prescribers continued to order morphine and haloperidol, but did so at more appropriate dosing.

The bundled intervention had no observed effect on other in-hospital outcomes, including length of stay, in-hospital mortality, frequency of ICU stay, triggers for marked nursing concern, and overall number of triggers.

Discharge Disposition and Readmissions

Over the study period, there was an increased tendency for all patients to be discharged to extended care facilities (ECF), but the intervention attenuated this trend with significantly more patients who received the intervention being discharged to home than would have been predicted [OR 1.18 (CI 1.04–1.35) $p = 0.01$]. There was no effect of the intervention on 3 day or 30 day readmission rates.

DISCUSSION

We conducted a pragmatic clinical trial to evaluate the effectiveness of a standard, bundled intervention for hospitalized patients aged 80 and over that focused on 1) safer prescribing of sedating medications, and 2) improved recognition of delirium. Our findings indicate that the intervention improved prescribing of sedating medications - patients were significantly less likely to be prescribed haloperidol in excess of 0.5 mg or morphine in excess of 2 mg IV. There was an increased number of triggers for acute change in mental status, but this was seen in both patients receiving the intervention and in the concurrent controls. Interestingly, significantly more patients receiving the intervention were discharged to home rather than to extended care facilities than would have been expected, suggesting less in-hospital functional decline.

The amount of geriatrics input in the care of hospitalized elders is variable depending on country and region. Some have proposed models of care to address the needs of hospitalized elders, including Acute Care for the Elderly (ACE) units and the Hospital Elder Life Program (HELP), and a recent review has suggested that multicomponent delirium prevention strategies in the acute setting are cost effective.^{18,19,20} However, it is not possible for all hospitals to have ACE units or hire dedicated staff with geriatrics expertise to lead implementation of HELP. Our institution has an acute geriatrics unit but it can only accommodate 15 inpatients. Yet 47% of our medicine inpatients are 65 years or older and 22% are 80 years or older. Therefore, many elderly patients do not benefit from our acute geriatrics unit's services, and a similar situation is true at many other institutions in the US.²¹

To address this issue, alternative approaches have been developed that “generalize” geriatrics expertise throughout the hospital. For instance, Boustani et al studied the effects of an interruptive CPOE alert system in a randomized controlled trial designed to positively affect the care of cognitively impaired patients in their hospital.²² They reported no significant changes in the number of geriatric medicine consults, or use of catheters or restraints, but did see a trend towards reduction of anticholinergic medications ($p=0.11$). In

designing this bundled intervention, we used CPOE plus a standardized checklist and incorporated our intervention into standard hospital workflow using LEAN manufacturing principles.²³ This bundled intervention attempts to make it easy for providers to do the right thing at the right time for older patients.

Through CPOE modifications, the initiative improved the prescribing of two classes of high risk sedating medications among inpatients 80 years and older admitted to the general wards of the hospital. This is important because overdosing of sedating medications can be associated with a variety of adverse effects in hospitalized elders, such as cognitive impairment, hypotension, aspiration, and falls with injury.²⁴ Another goal of the intervention was to preserve patient's functional status so that they could be discharged directly home. Our difference of differences analysis demonstrated that for every 30 patients receiving the intervention, one more than predicted was discharged to home rather than an ECF. Preventing the need for post-acute placement at discharge eliminates an additional transition of care, reduces the risk further functional decline in the ECF, and results in overall reduced costs for an episode of care.

Our study has several strengths and limitations. Among the strengths is the fact that many elements of the intervention are readily generalizable. The decision support tool guiding medication prescription within our CPOE system is transferable to other CPOE systems regardless of the practice environment. Additionally, bedside checklist can be readily transferred to other institutions. Among the limitations, we conducted a pragmatic trial in which the geriatrics bundle intervention was implemented in all patients aged 80 and over, while we used patients aged 70–79 as concurrent controls. However, some elements of geriatrics bundle may have been implemented across both age groups, as was seen in the increased frequency of triggers for “acute change in conscious state”. Another limitation is that patient's place of residence prior to hospital admission was not available in our hospital electronic database, so it is not certain that how many institutional discharges were new. We also did not have information on other classes of medications (e.g., benzodiazepines) and do not know if prescribing patterns of these medications changed as a result of the decision support recommending lower dose morphine and haloperidol. Additionally, we did not screen patients for delirium using the gold standard method, the Confusion Assessment Method (CAM), which requires acute onset/fluctuating course and inattention as well as an altered level of consciousness or disorganized thinking.²⁵ The delirium screening protocol in our intervention addressed all of these features except disorganized thinking. Further study is warranted to determine the effectiveness of identifying delirium using this approach compared to a reference standard. Lastly, our trial was conducted at a single, urban, academic center, which may limit its generalizability to non-academic, non-urban environments.

In conclusion, our findings suggest that a standardized, bundled intervention for inpatients aged 80 and older that integrated CPOE-embedded decision support and standardized care plans resulted in improved prescribing of potentially dangerous sedating medications, and fewer discharges to post-acute care facilities. Further study is warranted to evaluate the mechanisms by which this intervention has its beneficial effects and to verify its

generalizability. If confirmed in future research, it may be a cost-effective approach for generalizing appropriate care to all older patients throughout the hospital.

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Conflict of Interest Disclosures:

Elements of Financial/Personal Conflicts	Mattison		Catic		Davis		Olveczky	
	Yes	No	Yes	No	Yes	No	Yes	No
Employment or Affiliation								
		x		x		x		x
Grants/Funds								
		x		x		x		x
Honoraria								
		x		x		x		x
Speaker Forum								
		x		x		x		x
Consultant								
		x		x		x		x
Stocks								
		x		x		x		x
Royalties								
		x		x		x		x
Expert Testimony								
		x		x		x		x
Board Member								
		x		x		x		x
Patents								
		x		x		x		x
Personal Relationship								
		x		x		x		x

Elements of Financial/Personal Conflicts	Moran		Yang		Aronson		Zeidel	
	Yes	No	Yes	No	Yes	No	Yes	No
Employment or Affiliation		x		x		x		x
Grants/Funds		x		x		x		x
Honoraria		x		x		x		x
Speaker Forum		x		x		x		x

Elements of Financial/Personal Conflicts	Moran		Yang		Aronson		Zeidel	
	Yes	No	Yes	No	Yes	No	Yes	No
Consultant		x		x		x		x
Stocks		x		x		x		x
Royalties		x		x		x		x
Expert Testimony		x		x		x		x
Board Member		x		x		x		x
Patents		x		x		x		x
Personal Relationship		x		x		x		x

Conflict of Interest Disclosures:

Elements of Financial/Personal Conflicts	Lipsitz		Marcantonio	
	Yes	No	Yes	No
Employment or Affiliation		x		x
Grants/Funds		x		x
Honoraria		x		x
Speaker Forum		x		x
Consultant		x		x
Stocks		x		x
Royalties		x		x
Expert Testimony		x		x
Board Member		x		x
Patents		x		x
Personal Relationship		x		x

For all “Yes” responses, provide a brief explanation here:

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Drs. Marcantonio and Mattison had full access to all of the data in the study and take responsibility for the integrity of the data and the accuracy of the data analysis.

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Figure 1.

Schematic illustrating the two cohorts of patients followed over time, those 80 years and older before and after the intervention and the concurrent control group (70–79 years) over the pre period and the post intervention period.

Figure 2.
Delivering Geriatric Appropriate Care to All Hospitalized Elders

Outcomes

- The patient will not experience complications of falls, aspiration, or delirium during hospitalization.
- The patient will demonstrate an increase in self-care activities during hospitalization.

Interventions

- Daily tether review
- Daily test of attention, and assessment for delirium twice a day using RASS (Richmond Agitation and Sedation Scale)
- Mobilize patient out of bed to a chair BID. Ambulate in hallway BID if able.
- Minimize daytime napping.
- Encourage meals out of bed as much as possible to minimize aspiration risk.
- Minimize fall risk through use of chair and bed alarms, low beds, ambulatory aids, and assistance with toileting
- Medication review using Beers criteria.
- Encourage ADLs by the patient as much as possible

Figure 3.

Nursing care plan generated automatically for patients receiving the intervention.

Table 1

Sociodemographic data for control and intervention groups before and after the start of the intervention.

	Patients 70–79 years old (Controls)		Patients 80+ years old	
	Pre N=4919	Post N=4482	Pre N=5077	Post Intervention N=5571
Mean Age (years)	74.5±2.9	74.5±2.8	85.6±4.4	86.1±4.6
Case Mix Index (CMI) Mean *	1.8±1.6	1.7±1.5	1.6±1.4	1.5±1.4
Female (%)	47.4	48.5	57.8	58.2
English speaking (%)	87.2	88.1	86.5	85.3

* Case Mix Index = average weight of hospital's diagnosis related groups (DRG).

Comparison of outcomes before and after implementation of geriatrics bundle intervention in those aged 80 and older and in concurrent controls

Table 2

Primary Outcomes	Age 70–79 years		Age 80 years		Odds Ratio ^a (95% CI)	p-value
	Pre N=4819	Post N=4482	Pre N=5077	Post N=5571		
Morphine Dose >2 mg IV Prescribed	515 (10.7%)	514 (11.5%)	503 (9.9%)	325 (5.8%)	0.52 (0.42, 0.63)	<0.001
Haloperidol >0.5 mg Prescribed	76 (1.6%)	87 (1.9%)	122 (2.4%)	98 (1.8%)	0.60 (0.39, 0.91)	0.02
Trigger for Acute Change in Conscious State	30 (0.6%)	52 (1.2%)	36 (0.7%)	91 (1.6%)	1.23 (0.68, 2.24)	0.49
Secondary Outcomes						
Any ICU stay	637 (13.2%)	555 (12.4%)	636 (12.5%)	658 (11.8%)	0.95 (0.78, 1.16)	0.62
Any Trigger	403 (8.4%)	398 (8.9%)	515 (10.1%)	628 (11.3%)	1.04 (0.85, 1.26)	0.71
Trigger for Marked RN Concern	222 (4.6%)	226 (5.0%)	289 (5.7%)	305 (5.5%)	0.85 (0.66, 1.10)	0.22
In-Hospital Mortality	84 (1.7%)	74 (1.7%)	125 (2.5%)	154 (2.8%)	1.19 (0.80, 1.78)	0.39
Discharged Home	3634 (75.4%)	3175 (70.8%)	2954 (58.2%)	3169 (56.9%)	1.18 (1.04, 1.35)	0.01
3-Day Readmission ^b	159 (3.4%)	151 (3.4%)	176 (3.6%)	199 (3.7%)	1.02 (0.74, 1.40)	0.90
30-Day Readmission ^b	928 (19.6%)	816 (18.5%)	940 (19.0%)	1081 (20.0%)	1.16 (0.97, 1.40)	0.11
					β^a (95% CI)	
Length of Stay (Days) Mean $\pm$ Standard Deviation	4.4 $\pm$ 5.1	4.7 $\pm$ 5.2	4.2 $\pm$ 4.5	4.4 $\pm$ 4.3	-0.04 (-0.28, 0.20)	0.75

^aFor time period by group interaction from GEE model.^bLimited to patients discharged alive.