ORIGINAL RESEARCH

Post-Discharge Hospital Utilization Among Adult Medical Inpatients With Depressive Symptoms

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BACKGROUND: Little evidence exists to determine whether depression predicts hospital utilization following discharge among adult inpatients on a general medical service.

OBJECTIVE: We aimed to determine whether a positive depression screen during hospitalization is significantly associated with an increased rate of returning for hospital services.

DESIGN: A secondary analysis was performed using data from 738 English-speaking, hospitalized adults from the Project RED randomized controlled trial (clinicaltrials.gov Identifier: NCT00252057) conducted at an urban academic safety-net hospital.

MEASUREMENTS: We used the nine-item Patient Health Questionnaire (PHQ-9) depression screening tool to identify patients with depressive symptoms. The primary endpoint was hospital utilization, defined as the number of emergency department (ED) visits plus readmissions within 30 days of discharge. Poisson regression was used to control for confounding variables.

RESULTS: Of the 738 subjects included in the analysis, 238 (32%) screened positive for depressive symptoms. The unadjusted hospital utilization within 30 days of discharge was 56 utilizations per 100 depressed patients compared with 30 utilizations per 100 non-depressed patients, incident rate ratio (IRR) (confidence interval [CI]), 1.90 (1.51–2.40). After controlling for potential confounders, a higher rate of post-discharge hospital utilization was observed in patients with depressive symptoms compared to patients without depressive symptoms (IRR [CI], 1.73 [1.27–2.36]).

CONCLUSIONS: A positive screen for depressive symptoms during an inpatient hospital stay is associated with an increased rate of readmission within 30 days of discharge in an urban, academic, safety-net hospital population. *Journal of Hospital Medicine* 2010;000:000–000. © 2010 Society of Hospital Medicine.

KEYWORDS: depression, hospital discharge, patient safety, readmission, rehospitalization.

Fully 19% of Medicare patients are readmitted to the hospital within 30 days of discharge.[1] This represents a large amount of potentially avoidable morbidity and cost. Indeed, projects to improve the discharge process and post-hospital care have shown that as much as one-third of hospital utilization in the month after discharge can be avoided.[2] Consequently, the rate of early, unplanned hospital utilization after discharge has emerged as an important indicator of hospital quality and the Centers for Medicare and Medicaid Services (CMS) has proposed a policy to decrease payments to hospitals with high rates of early unplanned hospital utilization. Thus, there is great interest in identifying modifiable risk factors for rehospitalization that could be used to refine intervention models and lead to improvements in quality of care, patient outcomes, and cost savings.

To date, known predictors of readmission include: lower socioeconomic status,[3] history of prior hospitalization[4] and advanced age,[5] length of stay greater than 7 days,[6] a high burden of comorbid illnesses (based on Charlson score),[7] poor social support,[8] and specific diagnoses (eg, congestive heart failure, chronic obstructive pulmonary disease [COPD] and myocardial infarction).[5,9,10] In addition, unplanned readmissions and emergency department (ED) visits have been linked to polypharmacy and adverse drug events related to treatment with medications such as warfarin, digoxin and narcotics.[11,12] Another characteristic that has also been linked to readmission is depression;[13] however[5]

reports supporting this association are from studies of elderly patients or with patients who have specific diagnoses (eg, congestive heart failure [CHF], COPD, myocardial infarction).[14–16]

Depression is common, affecting 13% to 16% of people in the US, and is recognized as an important risk factor for poor outcomes among patients with various chronic illnesses.[17–19] The mechanisms by which depression can be linked to health outcomes and health service utilization have been studied in age-specific or disease-specific cohorts such as cardiac patients or frail elders and include both physiologic factors such as hypercoagulability and hyperinflammatory conditions, as well as behavioral factors such as poor self-care behaviors and heightened sensitivity to somatic symptoms. How these mechanisms link depression to health outcomes and hospital utilization in a general medical population is not clearly understood. Kartha et al.[13] reported findings indicating that depression is a risk factor for rehospitalization in general medical inpatients, but the study sample was relatively small and the study design methodology significantly limited its generalizability.[12] It would be useful to provide supporting evidence showing depression as an important risk factor for readmission in the general medical in-patient population using more rigorous study methods and a larger cohort.

We hypothesized that depressive symptoms would be an independent risk factor for early unplanned hospital utilization after discharge for all medical patients. Therefore, we conducted a secondary analysis of the Project RED clinical trial dataset to assess the association between a positive depression screen during inpatient hospitalization and the rate of subsequent hospital utilization.

Methods

Data from the Project RED clinical trial were reviewed for inclusion in a secondary analysis. Complete data were available for 738 of the 749 subjects recruited for Project RED.

Project RED Setting and Participants

Project RED was a two-armed randomized controlled trial of English-speaking adult patients, 18 years or older, admitted to the teaching service of Boston Medical Center, a large urban safety-net hospital with an ethnically diverse patient population. A total of 749 subjects were enrolled and randomized between January 3, 2006 and October 18, 2007. Patients were required to have a telephone, be able to comprehend study details and the consent process in English, and have plans to be discharged to a US community. Patients were not enrolled if they were admitted from a skilled nursing facility or other hospital, transferred to a different hospital service prior to enrollment, admitted for a planned hospitalization, on hospital precautions, on suicide watch, deaf or blind. The Institutional Review Board of Boston University approved all study activities. A full description of the methods for the Project RED trial has been described previously.[2]

Outcome Variable

The primary endpoint was rate of hospital utilization within 30 days of discharge from the index admission, defined as the total number of ED visits and readmissions per subject within 30 days of the index discharge. Hospital utilization rates within 60 and 90 days of the index hospitalization discharge were also analyzed as secondary outcomes. Any ED visit in which a subject was subsequently admitted to the hospital was only counted as a readmission. Outcome data were collected by reviewing the hospital's electronic medical records (EMRs) and by contacting subjects by telephone 30 days after discharge. Dates of hospital utilization occurring at Boston Medical Center were obtained from the EMR, while those at other hospitals were collected through subject report. Subjects who could not be reached within 60 days of discharge were assumed alive.

Primary Independent Variable

The primary independent variable of interest was depressive symptoms defined as a positive score for minor or major depression on the nine-item Patient Health Questionnaire (PHQ-9) depression screening tool.[20] A dichotomized variable was created using a standardized scoring system to determine the screening cut-off for major or minor depressive symptoms.[19]

Statistical Analysis

Demographic and other characteristics of the subjects were compared by depression status (Table 1). Potential confounders were identified a priori from the available literature on factors associated with rehospitalization. These included age, gender, marital status, health literacy score (rapid estimate of health literacy in adult medicine tool [REALM]),[21] Charlson score,[22] insurance type, employment status, income level, homelessness status within past three months, hospital utilization within the 6 months prior to the index hospitalization, educational attainment, length of hospital stay and Project RED study group assignment. Bivariate analyses were conducted to determine which covariates were significant confounders of the relationship between depression and hospital utilization within 30 days of discharge. Chi-square tests were used for categorical variables and t-tests for continuous variables.

Age, length of stay, and Charlson score were used as continuous variables. Gender, marital status, frequent prior utilization (0–1 vs. 2 or more), and homelessness were treated as dichotomous variables. Categorical variables were created for, educational attainment (less than eighth grade, some high school, high school graduate, some college, college graduate), insurance type (Medicare, Medicaid, private insurance or free care), income level (no income, less than $10,000 per year, $10,000–20,000, $20,000–50,000, $50,000–

TABLE 1. Baseline Characteristics of Study Subjects by Depression Screen Status

Characteristic	Depression Screen*		
	Negative (n = 500)	Positive (n = 238)	P Value
Race, No. (%)			
White	140 (30)	66 (30)	
Black	268 (58)	117 (54)	
Hispanic	47 (10)	29 (13)	0.760
Insurance, No. (%)			
Private	95 (19)	22 (9)	
Medicare	69 (14)	30 (13)	
Medicaid	214 (43)	143 (61)	
Free care[†]	118 (24)	40 (17)	<0.001
Education, No. (%)			
<8th grade	33 (7)	21 (9)	
Some high school	82 (17)	52 (22)	
High school grad	192 (38)	90 (38)	
Some college	126 (25)	51 (22)	
College grad	67 (13)	22 (9)	0.135
Health Literacy[‡]			
Grade 3 and below	64 (13)	44 (19)	
Grade 4–6	54 (11)	22 (10)	
Grade 7–8	156 (32)	73 (32)	
Grade 9 and above	213 (44)	89 (39)	0.170
Income, $, No. (%)			
No income	61 (12)	37 (16)	
<10K	77 (15)	61 (26)	
10–20K	96 (19)	35 (15)	
20–50K	97 (19)	34 (14)	
50–100K	35 (8)	7 (2)	
No answer	132 (27)	64 (27)	0.002
Employment status, No. (%)			
Full time	142 (28)	34 (14)	
Part time	57 (11)	30 (13)	
Not Working	297 (59)	171 (72)	<0.001
Age, mean (SD), years	49.9 (16.0)	49.6 (13.3)	0.802
Gender: No. (%) Female	239 (48)	133 (56)	0.040
Have PCP,[§] No. (%) Yes	399 (80)	197 (83)	0.340
Marital status,[‖] No. (%) unmarried	365 (73)	201 (85)	<0.001
Charlson score,[¶] mean (SD)	1.058 (1.6)	1.56 (2.39)	0.001
RED study group,[#] No. (%)			
Intervention	243 (49)	127 (53)	0.22
Length of stay, days, mean (SD)	2.5 (2.8)	3.1 (3.8)	0.016
Homeless in last 3 months, No. (%)	45 (9)	30 (13)	0.130
Frequent utilizer,** No. (%)	159 (32)	104 (44)	0.002

NOTE: Some columns may not add up to 100% due to omission of "Other" categories.

Abbreviations: PCP, primary care provider; PHQ9, Patient Health Questionnaire-9; REALM, Rapid Estimate of Health Literacy in Adult Medicine tool; SD, standard deviation.

* Positive depressive symptom screen determined by PHQ9 screen tool, a nine-item 4-point Likert scale, standard scoring algorithm to screen for major and minor depression. A score of 5 or higher indicates a positive depression symptom screen.[17]

[†] Free Care is a Massachusetts state program for uninsured patients.

[‡] Health literacy categories correspond to total score as determined by REALM.[18]

[§] "Have PCP" refers to subject self-identifying PCP at time of Project RED study enrollment.

[‖] "Unmarried" marital status includes subjects identified as divorced, widow, single, partnered.

[¶] Charlson Comorbity Index Score reflects the cumulative increased likelihood of 1-year mortality. The higher the score the more severe the comorbid condition. A 33% increase in risk for death is reflected in a 1-point increase in weights. The minimum score is 0. There is no maximum score.[19]

[#] Project RED study intervention group refers to subjects who received the 3-armed discharge intervention.

** Frequent Utilizer is defined as a subject with 2 or more hospital utilizations in 6 months prior to Project RED clinical trial index admission.

100,000, no answer), level of health literacy (grade 3 and below, grade 4–6, grade 7–8, grade 9 or above) and employment status (working full-time, working part-time, not working, no answer).

The 30-day hospital utilization rate reflects the number of hospital utilization events within 30 days of discharge per subject. The same method was used to calculate hospital utilization rates within 60 and 90 days of discharge respectively. The unadjusted incident rate ratio (IRR) was calculated as the ratio of the rate of hospital utilizations among patients with depressive symptoms versus patients without depressive symptoms. Data for hospital utilization at 30, 60, and 90 days are cumulative.

Poisson models were used to test for significant differences between the predicted and observed number of hospitalization events at 30 days. A backward stepwise regression was conducted to identify and control for relevant confounders and construct the final, best-fit model for the association between depression and hospital reutilization. A statistical significance level of $P = 0.10$ was used for the stepwise regression. To evaluate potential interactions between depression and the Project RED intervention, interaction terms were included. Two-sided significance tests were used. P values of less than 0.05 were considered to indicate statistical significance. All data were analyzed with S-Plus 8.0 (Seattle, WA).

In addition, a Kaplan-Meier hazard curve was generated for the first hospital utilization event, ED visit or readmission, for the 30-day period following discharge and compared with a log-rank test.

Results

A total of 28% of subjects were categorized as having a positive depression screen. More women (36%) had positive depression screens than men (28%). Among patients with a positive depression screen, 58% had a history of depression and 53% were currently taking medications at the time of enrollment, compared with 25% and 22% respectively for subjects with a negative depression screen. Table 1 presents the means or percentages for baseline characteristics by depression status in the analytic cohort. Subjects with Medicaid for insurance had a higher rate of depression (61%) than subjects with Medicare (13%), private insurance (9%), or those who qualified for the Free Care pool (17%) which is the Massachusetts state funding for healthcare to uninsured persons. Subjects who were unemployed, unmarried, or who reported earnings less than $10,000 per year were also more likely to screen positive for depression. In addition, depressed subjects had a higher severity of co-morbid disease and longer length of stay for the index hospitalization. Patients categorized as frequent utilizers (2 or more prior admissions) for the 6 months prior to the index hospitalization were also more likely to be depressed. Of further note, is the relatively younger average age among both depressive

TABLE 2. Number of Hospital Utilizations, Hospital Utilization Rate, Unadjusted IRR at 30, 60 and 90 Days by Depression Screen Status*

Hospital Utilization	Depression Screen*			
	Negative, n = 500 (68%)	Positive, n = 238 (32%)	P Value	IRR (CI)
No. of hospital utilizations[†]	140	134		1.90 (1.51,2.40)
30-day hospital utilization rate	0.296	0.563	<0.001	
No. of hospital utilizations[†]	231	205		1.87 (1.55,2.26)
60-day hospital utilization rate	0.463	0.868	<0.001	
No. of hospital utilizations[†]	324	275		1.79 (1.53,2.10)
90-day hospital utilization rate	0.648	1.165	<0.001	

Abbreviations: CI, confidence interval; ED, emergency department; IRR, incident rate ratio.

*Depression screen determined by scoring of Patient Health Questionnaire-9 (PHQ9). Depressive symptom score of 5 points or higher is designated as positive.[17]

[†]Number of hospital utilizations include all ED visits and hospital readmissions following discharge from Project RED index admission. ED visits leading to hospital admission are counted as one event. Sum reflects cumulative number of events over 30, 60 and 90 days.

TABLE 3. Adjusted Incident Rate Ratio of Hospital Utilization Within 30 Days of Discharge

Characteristics	IRR	CI	P Value
Depression symptoms*			<0.001
Positive	1.73	1.27–2.36	
Negative	REF	1.0	
Gender			<0.001
Male	1.87	1.47–2.40	
Female	REF	1.0	
Marital status[†]			0.005
Married	0.625	0.44–0.89	
Unmarried	1.0	REF	
Frequent utilizer[‡]			<0.001
2+ prior visits	2.45	1.92–3.15	
<2 prior visits	1.0	REF	
Study group[§]			0.054
Intervention	0.76	0.55–1.06	
Control	1.0	REF	
Employment			
Part time	1.40	0.85–2.30	0.095
Not working	1.67	1.15–2.44	0.003
Other	0.52	0.07–3.85	0.262
Full time	1.0	REF	
Charlson Score[‖]	0.98	0.92–1.04	0.250
Group* depression[¶]	0.84	0.52–1.36	0.236
Age	1.00	0.99–1.01	0.375

Abbreviations: CI, confidence interval; ED, emergency department; IRR, incident rate ratio, PHQ9, Patient Health Questionnaire-9.

*Positive depressive symptom screen determined by PHQ9 screen tool, a nine-item 4-point Likert scale, standard scoring algorithm to screen for major and minor depression. A score of 5 or higher indicates a positive depression symptom screen.[17]

[†]Unmarried refers to subjects whose self-reported marital status includes divorced, single, partnered or widowed.

[‡]Frequent utilizer: 2 or more ED or hospital admissions visits in prior 6 months from index admission.

[§]Refers to Project RED study group assignment.

[‖]Charlson Comorbity Index Score reflects the cumulative increased likelihood of 1-year mortality. The higher the score the more severe the comorbid condition. A 33% increase in risk for death is reflected in a 1-point increase in weights. The minimum score is 0. There is no maximum score.[19]

[¶]Interaction term of Project RED study group assignment and depressive symptom category (positive or negative).

patients (49.6 years) and non-depressive patients (49.9) of these study subjects.

The unadjusted hospital utilization rate at 30, 60, and 90 days post-discharge by depression status is shown in Table 2. At 30 days post-discharge, those with depressive symptoms had a higher rate of hospital utilization than those without depressive symptoms (0.563 vs. 0.296). In other words, 56 utilization events occurred per 100 patients with depressive symptoms, compared with 30 utilization events per 100 patients without depressive symptoms. The unadjusted 30-day post-discharge hospital utilization rate among those with depressive symptoms was higher compared with those without symptoms (IRR, 1.90, 95% confidence interval [CI], 1.24–2.71). A similar trend was found among subjects at 60 and 90 days post-discharge.

Poisson regression analyses were conducted to control for potential confounding in the relationship between depressive symptoms and hospital utilization rate within 30 days after discharge (Table 3). After controlling for relevant confounders, including age, gender, employment status, frequent prior hospitalization status, marital status, Charlson score, Project RED study group assignment and the interaction variable for RED study group assignment and depression, the association between symptoms of depression, and hospital utilization rate remained significant (IRR, 1.73; 95% CI, 1.27–2.36).

Figure 1 depicts the Kaplan-Meier hazard curve generated for time to first hospital utilization, stratified by depression status. While 21% of participants without symptoms of depression had a hospital utilization within 30 days, fully 29% of participants with symptoms of depression had a hospital utilization within 30 days ($P = 0.011$).

Discussion

Our study shows hospitalized patients who screen positive for depressive symptoms are significantly more likely to have a hospital visit (emergency room or rehospitalization) within 30 days of discharge than those who do not screen positive for depressive symptoms among medical patients admitted to an urban, academic, safety-net hospital. These findings are consistent with, and extend, prior reports regarding depression and rehospitalization in specific populations (ie, geriatrics) and specific diagnoses (ie, cardiovascular disease [CVD] and COPD).[10–12] We observed a 73% higher incidence rate for hospital utilization within 30 days of discharge for those with symptoms of depression. This puts symptoms of depression on par with frequent prior rehospitalization, advanced age and low social support, as known risk factors for rehospitalization.[4,5,23]
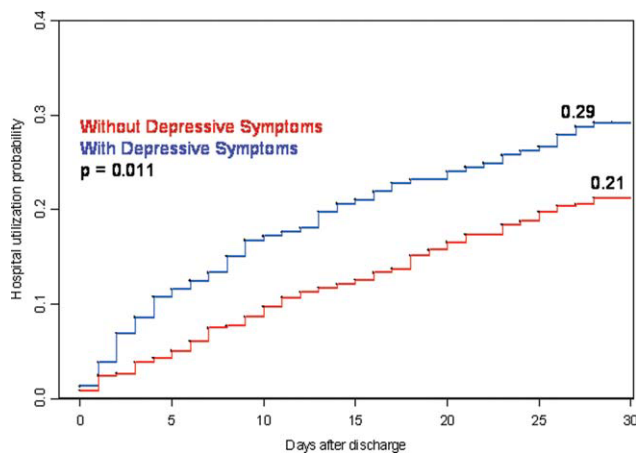
FIGURE 1. Hazard for hospital utilization among subjects with and without depressive symptoms in 30 days following hospital discharge.

Also of significance is the relatively young age of this study population (49.9 years non-depressive patients and 49.6 years for depressive patients) compared with the study cohorts used for research in the majority of the existing literature. The chief reason for the young age of our cohort is that potential subjects were excluded if they came from a skilled nursing facility or other hospital. This may limit the generalizability of our findings; however, it seems likely that interventions relating to depression and transitions of care will need to be quite different for patients that reside in long-term care facilities vs. patients that live in the community. For example, patients living in the community may have significant barriers to access post-discharge services due to insurance status and are more likely to be sensitive to variations in social support.

Early rehospitalization is associated with significant morbidity, mortality, and expense. It is also a potential marker for poor quality of care.[24] Concerns for patient safety, escalating healthcare costs, and possible change in hospital reimbursement mechanisms are fueling the search for modifiable risk factors associated with early rehospitalization. Our data provide evidence that symptoms of depression may be an important focus of attention. We do not know, however whether treating hospitalized patients who screen positive for depression will decrease early rehospitalization and emergency room utilization rates.

Various physiologic and behavioral mechanisms may link symptoms of depression to hospital utilization after discharge. For example, depressed patients with features of somatization may be more likely to experience worrisome physical symptoms after discharge and present prematurely for reevaluation. Patients who are sicker in some fashion not captured by our measured confounders may have symptoms of depression related to chronic, debilitating disease warranting early return to the hospital. Depression may also yield nonadherence to aspects of the discharge treatment plan leading to rehospitalization as a result of poor post-discharge disease management. For example, research shows that patients with depression following coronary artery bypass surgery are less likely to adhere with cardiac rehabilitation programs.[25] Likewise, depression among chronically ill patients such as diabetics, asthmatics, or human immunodeficiency virus (HIV)-positive patients impairs medication adherence and self-care behavior which may lead to disease relapse or recurrence.[26–28] One study examining depression effects on hypertensive medicine adherence in African Americans identified self-efficacy as a mediating factor between depression and nonadherence.[29] This implies that interventions such as self-management education, a program through which chronically-ill patients learn to better manage their illnesses through enhanced self-confidence and problem-solving strategies (including mood disorder challenges) may reduce early rehospitalization among depressed patients.[30]

There is also evidence that depression may have direct physiologic consequences. In patients with CVD, depression is associated with poor outcomes possibly related to decreased heart rate variability, hypercoagulability, high burdens of inflammatory markers, and severity of left ventricular dysfunction.[31–34] Similarly, depression among HIV/acquired immune deficiency syndrome (AIDS), diabetics and multiple sclerosis (MS) patients is linked to heightened levels of proinflammatory markers and less favorable outcomes that may signal a more severe form of the disease or an impaired response to treatment.[35–38] Indeed, MS investigators now hypothesize that the proinflammatory environment associated with the neurologic manifestations of MS are also causing depression symptoms among MS patients.[34] This theory contrasts the common belief that depression in the chronically ill manifests independent of the chronic illness or in response to living with chronic disease.

A major strength of the current study is the large dataset and the broad range of covariates available for analyses. However, several limitations should be noted. First, data on hospital utilization outside Boston Medical Center were determined by patient self-report and were not confirmed by document review. Second, we do not know the direction of the associations we report. If symptoms of depression are merely the consequence of having a higher disease burden, treatment of the underlying disease may be the most important response. While this is possible, our model does include several variables (eg, Charlson score and length of stay) that are likely to adjust for disease severity, pointing to the likelihood that symptoms of depression truly predict hospital utilization in a fashion that is independent of disease severity. Third, our results may not be generalizable to populations other than those served by urban safety-net hospitals or other populations excluded from the Project RED trial (eg, non-English speaking patients and patients from nursing homes). Finally, social factors such as substance use and social support system variables may residually confound the relationship between depression and hospital reutilization

demonstrated in this study. While this dataset does not include a measure of social support other than marital status and housing status, data is available on substance use. Analyses conducted by our colleagues using Project RED data found that in this study population depression was significantly more prevalent among substance users (29% vs. 14%) compared with non-users and that substance use is an independent risk factor for hospital reutilization (unpublished data).

Our findings linking depression to increased hospital utilization also warrant further consideration from healthcare policymakers. Central to the Obama Administration's February 2009 healthcare reform proposal is the pursuit of cost savings through reductions in unplanned hospital readmissions.[39] Thus, identifying potentially modifiable risk factors for readmission, such as depression, is of great concern to healthcare providers and policymakers across the nation. If, through testing of interventions, depression proves to be a modifiable risk for readmission, policymakers, while negotiating healthcare reform measures, must provide for the services required to address this comorbidity at the time of discharge. For example, if a patient screens positive for depressive symptoms during a hospitalization for COPD exacerbation, will the proposed payment reforms allow for mental health services during the immediate post-discharge period in order to reduce the likelihood of hospital readmission? Will those mental health services be readily available? Payment reforms that account for all necessary transitional care services will indeed help reduce readmission costs with less risk for untoward consequences.

In conclusion, our results indicate that a positive depression screen is a significant risk factor for early post-discharge hospital utilization among hospitalized adults on a general medical service, even after controlling for relevant confounders. Screening for depression during acute hospitalizations may be an important step in identifying patients at increased risk for readmission. Future research should focus on further characterizing and stratifying populations at highest risk for depression. Efforts should also include developing and evaluating targeted interventions for patients with symptoms of depression among hospitalized patients as part of discharge planning. Timely depression therapy during the hospitalization or following hospital discharge might reduce costly readmissions and enhance patient safety.

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