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SECTION III
REGULAR AND SPECIAL FEATURES

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Delays until Surgery after Hip Fracture Increases Mortality

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The objective of this study was to analyze whether a delay in time from admission until surgical treatment increased the mortality rate for patients with a closed hip fracture. We used the day of the week of admission as an instrumental variable to pseudorandomize patients. We analyzed 18,209 Medicare recipients who were 65 years of age or older and had surgical treatment for a closed hip fracture. Patients for whom the delay between admission and surgery was 2 days or more had a 17% higher chance of dying by Day 30. Using instrumental variables analysis, we found a similar 15% increased risk of mortality in patients with delays until surgery of 2 or more days. Based on these results, we found that a delay of 2 or more days significantly increased the mortality rate. This suggests that delay to surgery independently affects mortality, therefore additional study on the effect of smaller delays on outcome is needed.

Whether an increased time between diagnosis and treatment increases the mortality rate of patients who have sustained a hip fracture is unclear; the literature to date is inconclusive.[8,11,16,20,30,31] The purpose of this study was to address this controversy.

The mortality rate associated with isolated fractures of the proximal femur (often associated with osteoporosis) is higher than rates with most other conditions seen by orthopaedic surgeons. Baker et al[4] reported that hip fractures were responsible for ½ of all acute postoperative mortality among patients with orthopaedic conditions. The 1-year mortality after hip fracture has been estimated in the range of 14–36%.[3,17,29]

From a research standpoint, the difficulty in answering the question of whether a delay is an independent risk factor for mortality is rooted in the fact that sicker patients most likely are the ones who have delays until surgery; these patients will have a higher postoperative mortality, not so much because of the delay, but because of their poor health. Delay, in such a case, is merely a marker for comorbidities and not necessarily a cause of mortality. In technical terms, the presence of medical comorbidities is a confounding effect.

In the past, researchers have attempted to circumvent the problems of confounding by retrospectively stratifying patients by health status to control for illness severity.[8,11,16,20,30,31] Stratification is not a perfect method because our means of rating patient illness severity are limited: unobserved differences in patient illness severity may elude detection by diagnostic coding systems that were established primarily to serve billing, and not research.[18]

Theoretically, the best way to resolve this question is to do a prospective randomized trial. In such an experiment,

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patients who present to the emergency room with a hip fracture could be assigned randomly to one of two groups: patients sent for surgery as quickly as possible, and patients sent for surgery only after imposing an arbitrary specified delay. In this method, even if one could not assess health risk accurately, the random assignment of large numbers of patients to treatment groups will neutralize any bias attributable to health status. However, a trial of this nature could not be done for logistic and ethical reasons.

Because a classic stratification method and a prospective randomized trial are not feasible, it is worthwhile to address the question of hip fracture mortality with an instrumental variables analysis. Instrumental variables analysis was developed by economists years ago, but only more recently has been applied to questions in medicine.[2,5,6,10,12,13,18] An instrumental variable is a patient parameter that allows a population of patients to be separated retrospectively into random groups. To serve as an instrumental variable for assessing treatment outcome, the parameter in question must meet the following criteria: (1) it is randomly present in all subjects; (2) it influences the choice of treatment provided; but (3) it does not influence outcome directly; rather, it influences outcome only to the extent that it influences the treatment.

If one can identify an instrumental variable, one can retrospectively analyze a population that was not randomly assigned to treatment groups, and yet make inferences as if prospective randomization was done. This is done by dividing the population on the basis of the presence or absence of the instrumental variable and doing a logistic regression analysis to see the marginal effect of the instrumental variable on outcome. This can be called pseudorandomization, because the patients were not randomly assigned to treatment groups, but were randomly distributed into groups (on the basis of the instrumental variable) that have different probabilities of receiving a specific treatment.

The day of the week that a patient presents to the hospital seems to meet the criteria to serve as an instrumental variable to study surgical delays in patients with hip fractures. The day of the week on which the fracture occurs is random. It has been shown that delay in surgery is more likely to occur for patients with hip fractures who present to the emergency room on Saturday, Sunday, or Monday.[13,19] The third criterion cannot be proven, but one can assume that the day of the week should not influence outcome, except to the extent that patients who present to the emergency room during a weekend are prone to delay.

Accordingly, if patients were divided into two groups (those who presented to the hospital on Saturday, Sunday, or Monday, and those who presented Tuesday through Friday), we could achieve pseudorandomization of our population of patients with hip fractures. Patients in the former group most likely will be prone to longer delays before surgery, independent of their health status. If delay still increases mortality after adjusting for patient severity, then the mortality rate in the group of patients who presented during the weekend would be higher. This increased mortality then can be attributed to the delay, as there are no other differences between the groups except the risk for delay.

To be a good instrumental variable, the association in regression models seen between the instrumental variable and the treatment group should be strong; that is, the day of the week a patient presents should strongly influence whether a delay occurs (the second criterion).[5] Likewise, the instrumental variable and outcome should be only weakly associated (the third criterion). This is because not all patients admitted during the weekend have a delay in surgery, and not all patients who are admitted during the weekend have a delay independent of their health status (sick patients also are admitted during the weekend).

These considerations highlight the main difference between true randomization and pseudorandomization on the basis of an instrumental variable. Randomization assigns a given treatment to a given patient. By contrast, the value of the instrumental variable only reflects a probability of receiving a given treatment. The results of the instrumental variables analysis therefore are statistical arguments about marginal effects.[12] Nonetheless, powerful inferences are possible, and in situations in which randomization is not feasible, instrumental variables analysis may offer the strongest possible conclusions.

This study addresses the controversy in the literature as to whether a delay from admission until surgical treatment of hip fractures increases the risk of mortality. To do so, we used instrumental variables analysis, which overcomes the confounding effect of comorbidities.

MATERIALS AND METHODS

An historic cohort study was done based on a Pennsylvania Medicare database covering 21 months from 1995–1996. The database contained all admissions for patients who were at least 65 years old who sustained closed fractures of the hip and had surgical treatment. Time until surgery from the time of admission was measured in days. Thirty-day mortality was the outcome of interest. Severity adjustments were made based on an established model used in a previous study for surgical patients.[21] Approval from our institutional review boards was obtained.

The data were drawn from the following: (1) Medicare Inpatient 100% Standard Analytic File, State of Pennsylvania 1995 and 1996; (2) Medicare Physician/Supplier Part B, State of Pennsylvania 1995 and 1996; (3) MedisGroups® severity score data set from the Pennsylvania Health Care Cost Containment Council (PHC-4) database, 1995 and 1996; and (4) Vital Statistics File updated to 1997.

During a 21-month period from 1995–1996, using specific International Classification of Diseases Codes,[15] we identified all patients who had closed transcervical, intertrochanteric, subtrochanteric, or unspecified fractures of the neck of femur. Patients with pathologic or open fractures were excluded. Only patients who were 65 years or older were included. Procedure codes then were used to select only patients who had a closed reduction internal fixation, open reduction internal fixation, endoprosthesis, total hip arthroplasty, or unspecified procedure of the hip. Nineteen thousand five hundred eleven patients met these criteria. Of these, 1302 (6.7%) had missing data on the time until the procedure. Therefore, 18,209 patients were included in the sample.

Data were drawn from vital statistics and from the Pennsylvania Health Care Cost Containment Council (PHC-4). From the PHC-4, the MedisGroups® severity score was obtained. The MedisGroups® severity score is a physiologic-based score which was developed to rank patient severity. It is an established and validated scoring system.[7,14,23,25,26,28]

The final database therefore contained all admissions to acute care hospitals for surgical treatment of a hip fracture in patients 65 years or older in Pennsylvania during a 21-month period.

The outcome variable of interest was 30-day mortality measured from the date of admission. The predictor variable of interest was the time from admission until surgery. The time until surgery was established by calculating the number of days between the date of admission and the date of the surgical procedure. Time is a continuous variable, but given the nature of the database, delay was recorded discretely as no delay, 1 day, 2 days, 3 days, and so on. A 1-day delay was noted if there was a 1-calendar day difference between the admission date and the date of procedure. Longer delays were defined in a similar way. This is consistent with other studies in the literature, but is less precise than a system that is based on a shorter time unit such as hours.[8,11,16,20,30,31]

The covariates obtained from the Medicare database included age, gender, principal diagnosis, principal treatment, admission through the emergency room, the MedisGroups® severity score, and numerous comorbidities shown in Table 1.

Descriptive analysis of the patient population was done. Univariable analysis then was done for 30-day mortality by delay groups. A multivariate model was developed. Variables were selected for inclusion in a model if they were found to be significant for 30-day mortality ($p \leq 0.20$) by univariable analysis.

To address the issue of selection bias, an instrumental variables analysis was done. Instrumental variables analysis separates patients on the basis of variables that influence treatment, but do not independently influence outcome. The instrumental variable of interest in this study was the day of the week of admission.

We confirmed in a previous study (unpublished data) that the time delayed until surgery for hip fractures was different for different days of the week. Ho et al[13] also found that patients admitted on Saturday, Sunday, or Monday were more likely to have a delay until surgery. Accordingly, we divided patients in the database into two groups: patients admitted on Saturday, Sunday, or Monday, and patients admitted on Tuesday, Wednesday, Thursday, or Friday.

This instrumental variable was tested in terms of its correlation with delay and its correlation with mortality. An apt instrumental variable is one highly correlated to treatment choice (delay versus no delay), but which is not tightly correlated with outcome. A two-stage regression model then was analyzed using day of admission as the instrumental variable.[18]

RESULTS

Eighteen thousand two hundred nine patients met the criteria for inclusion in this study. The average age of the patients was 82.4 years (range, 65 – 118 years). Seventy-nine percent were women. Forty-nine percent sustained an intertrochanteric fracture of the hip. Fifty-six percent had an open reduction internal fixation of the fracture. Eighty-one percent were admitted from the emergency department. One percent of the patients were transferred from another acute care hospital. Forty percent had a MedisGroups® severity score of two.

Using an established technique developed by one of the authors (JHS) to determine preexisting comorbidities, 48% of patients were found to have had preexisting hypertension, 19% had congestive heart failure, 19% had chronic pulmonary obstructive disease, and 17% had diabetes.[1,21,22,24]

There was a 6.77% mortality rate within 30 days of index admission to the hospital. Among the variables analyzed, the strongest predictors of 30-day mortality were having a MedisGroups® severity score greater than three, being male, and having cancer, congestive heart failure, liver disease, or renal failure. There was no difference in the 30-day mortality by type of fracture or type of surgery.

Patients who had a delay in surgery of 2 or more days more often were male, were admitted emergently, had a higher MedisGroups® severity score, and had at least one comorbidity (Table 1). A delay in time until surgery remained a predictor of mortality at 30 days despite adjusting for patient severity, except at the 1-day mark. The adjusted odds ratio for a delay of 2 or more days was significant ($p = 0.02$) at 1.17 for 30-day mortality, meaning that there was a 17% higher risk of dying among the patients who had a delay until surgery (Table 2).

Delay was a significant predictor, despite adjusting for patient severity. However, because there was a concern that delay was a marker for unobserved severity not adjusted for in the model (and which could not be measured by the available variables in the database), an instrumental variables analysis based on day of admission was done to confirm that delay was a significant independent predictor of mortality and not a confounder.

TABLE 1. Patient Characteristics: Univariate Analysis by Delay Greater Than 2 Days

Variable	Percentage of Patients with Delays Less Than 2 Days	Percentage of Patients with Delays of 2 or More Days	Univariate Analysis p Value
Patients (N = 18,209)	78% (N = 14,252)	22% (N = 3957)	
Mean age (years; standard deviation)	82.7 (7.3)	82.4 (7.3)	0.666
Gender			<0.001
Male	20%	24%	
Female	80%	76%	
Principal diagnosis			<0.003
Femoral neck fracture	34%	37%	
Femoral intertrochanteric fracture	50%	47%	
Femoral subtrochanteric fracture	3%	3%	
Unspecified fracture of the femoral neck	13%	13%	
Principal procedure			<0.001
Closed reduction internal fixation	6%	6%	
Open reduction internal fixation	57%	54%	
Endoprosthesis, hemiarthroplasty	34%	35%	
Total hip arthroplasty	3%	4%	
Hip procedure unspecified	0.08%	0.03%	
Emergent admission	80%	83%	0.006
Transfer from acute care hospital	1%	1%	0.336
MedisGroup® Severity Score (A higher score represents greater severity)			
1	16%	12%	<0.001
2	41%	37%	
>3	7%	13%	
Missing	35%	39%	
Comorbidities			
Myocardial infarction	5%	6%	0.041
Arrhythmia	10%	15%	<0.001
Congestive heart failure	17%	25%	<0.001
Angina	5%	5%	0.850
Hypertension	48%	48%	0.779
Aortic stenosis	4%	5%	0.001
Seizure	3%	4%	<0.001
Stroke	10%	12%	<0.001
Chronic obstructive pulmonary disease	18%	21%	<0.001
Psychosis	16%	17%	0.073
Liver dysfunction	1%	2%	0.007
Renal failure	2%	3%	<0.001
Noninsulin-dependent diabetes	17%	19%	0.001
Insulin-dependent diabetes	2%	2%	0.031
Paraplegia	3%	3%	0.057
Electrolyte and fluid abnormality	6%	7%	0.003
Cancer	14%	14%	0.758

We found that day of the week was, as expected, correlated with treatment. The mean time from admission until surgery was 1.17 days (standard deviation, 1.52 days). Admission on Saturday, Sunday, or Monday was associated with a mean delay of 1.22 days compared with a mean delay of 1.13 days for patients admitted Tuesday, Wednesday, Thursday, or Friday ($p < 0.001$; Table 3). Furthermore, being admitted on Saturday, Sunday, or Monday was highly predictive of a delay in surgery of 2 or more days (t statistic, 7.88; $p < 0.001$).[27] The second criterion, that the day of admission during the week influenced the choice of treatment (delay less than 2 days or delay of 2 or more days), was met.

The two groups (those admitted on Saturday, Sunday, or Monday versus those admitted Tuesday through Friday) were similar in terms of relative health. There were only two variables that differed between the two groups (Table 4): the percentage of patients admitted from the emergency room, and the percentage of patients with chronic obstructive pulmonary disease. The number of admissions from the emergency room was greater in the patients admitted during the weekend. This variable was

TABLE 2. Analysis of Delay versus Mortality: Unadjusted and Adjusted Results

Outcome		Odds Ratio	p Value
	Unadjusted		
30-Day mortality			
	Delay >1 day†	1.08	0.226
	Delay >2 days‡	1.41	<0.001
	Delay >3 days*	1.54	<0.001
	Adjusted		
30-Day mortality			
	Delay >1 day†	1.00	0.981
	Delay >2 days‡	1.17	0.02
	Delay >3 days*	1.21	0.048

†Sample was divided into two groups: delay less than 1 day, and delay of 1 or more days, from admission until surgery.

‡Sample was divided into two groups: delay less than 2 days, and delay of 2 or more days, from admission until surgery.

*Sample was divided into two groups: delay less than 3 days, and delay of 3 or more days, from admission until surgery.

not a strong predictor of mortality. This difference therefore is unlikely to be significant. The diagnosis of chronic obstructive pulmonary disease was a strong predictor of mortality, and therefore differences in rates between the groups could be important. However, this diagnosis was more common in patients admitted Tuesday through Friday. This difference therefore would favor the null hypothesis; that is, if anything, the patients admitted during the weekend were healthier. Despite this difference, the effect of delay of 2 or more days remained significant. Moreover, the unadjusted mortality rate by admission group (Saturday, Sunday, or Monday versus Tuesday through Friday) was not significant in this sample (Table 5). Therefore, we think that the third criterion was met; the day of the week of admission did not influence outcome directly, influencing the outcome only to the extent that it influenced treatment.

TABLE 3. Day of Admission by Mean Delay in Time until Surgery

Day of Admission	Mean Delay in Days (standard deviation)	p Value
Saturday	1.23 (1.39)	<0.001*
Sunday	1.24 (1.50)	
Monday	1.20 (2.22)	
Tuesday	1.14 (1.46)	
Wednesday	1.15 (1.27)	
Thursday	1.12 (1.38)	
Friday	1.13 (1.28)	
Day of Admission Groups		
Saturday, Sunday, Monday	1.22 (1.35)	<0.001*
Tuesday, Wednesday, Thursday, Friday	1.13 (1.35)	

*Two-sided p value using a chi square test based on categories 0, 1, 2, 3, and 4 or more days delay

Using the instrumental variable, a delay until surgery of 2 days or more was a significant predictor of 30-day mortality ($p = 0.047$); there was a 15% increase in the mortality risk attributable to delay (Table 6).

DISCUSSION

Whether operative delay increases the mortality risk after surgery for hip fracture remains controversial. Although some studies have shown such an association,[8,11,16,20,30,31] an independent relationship has not been proved. This is because the presence of an underlying medical condition, attention to which required a delay of surgery, may have been a confounding variable. In clinical practice, the sickest patients most often have a deliberate delay to optimize their health status before surgery. These also are the patients most likely to die.

Researchers try to control for this selection bias by stratifying patients according to the severity of coexisting illnesses.[8,11,16,20,30,31] However, because such controls are imprecise, the possibility exists that there are medical risk factors which elude detection. Therefore, even with our best methodology, the question of whether operative delay increases mortality risk may remain unresolved.

In this study, we refined the analysis by dividing patients according to an instrumental variable: admission to the hospital on Saturday, Sunday, or Monday. Using the day of the week allows us to retrospectively pseudorandomize patients with hip fractures into two groups, one of which has a stochastically greater chance of having a random (ie, nonmedical) delay for surgery. The use of regression analysis showed that admission to the hospital on Saturday, Sunday, or Monday is an independent risk factor for increased 30-day mortality, even after controlling for severity of illness. Because there is no apparent medical distinction between patients admitted on Saturday, Sunday, or Monday, and patients admitted on another day, the results suggest that such delay is harmful.

There are limitations to this study. The novel aspect of this study is the use of an instrumental variable. Instrumental variables analysis has been reported in other medical domains.[2,5,6,10,12,13,18] The use of an instrumental variable allows us to achieve pseudorandomization of the population, and offers inferences that otherwise would not be possible. However, this is an imperfect technique. In general, one limitation is low sensitivity. In some cases, the effect of the instrumental variable is too small to create a measurable difference.[9] An instrumental variable is only marginally important, and some key distinctions may be lost.

Another criticism of the instrumental variables approach is that there may be an undetected effect of the instrumental variable on outcome. The risk of such an effect is minimized by statistical analysis: one wants to see

TABLE 4. Patient Characteristics: Univariate Analysis by Day of Admission Group

Variable	Day of the Week—Admission Group		Univariable Analysis p Value
	Saturday, Sunday, or Monday	*Tuesday–Friday*	
Patients (N = 18,209)	42% (N = 7,648)	58% (N = 10,561)	
Mean age (years/standard deviation)	82.5 (7.3)	82.5 (7.3)	0.89
Gender			0.494
Male	21%	21%	
Female	79%	79%	
Principal diagnosis			0.421
Femoral neck fracture	35%	35%	
Femoral intertrochanteric fracture	50%	48%	
Femoral subtrochanteric fracture	3%	3%	
Unspecified fracture of the femoral neck	13%	13%	
Principal procedure			0.148
Closed reduction internal fixation	6%	6%	
Open reduction internal fixation	56%	56%	
Endoprosthesis, hemiarthroplasty	34%	35%	
Total hip arthroplasty	3%	3%	
Hip procedure unspecified	0.04%	0.10%	
Emergent admission	83%	80%	<0.001
Transfer from acute care hospital	1%	1%	0.459
MedisGroup® Severity Score (A higer score represents greater severity)			
1	15%	15%	0.642
2	40%	41%	
>3	9%	8%	
Missing	36%	36%	
Comorbidities			
Myocardial infarction	5%	5%	0.56
Arrhythmia	11%	11%	0.17
Congestive heart failure	19%	19%	0.25
Angina	5%	5%	0.65
Hypertension	47%	48%	0.50
Aortic stenosis	4%	4%	0.30
Seizure	3%	3%	0.40
Stroke	10%	11%	0.31
Chronic obstructive pulmonary disease	18%	19%	0.01
Psychosis	16%	16%	0.92
Liver dysfunction	1%	1%	0.70
Renal failure	2%	2%	0.84
Noninsulin-dependent diabetes	17%	17%	0.32
Insulin-independent diabetes	2%	2%	0.99
Paraplegia	3%	3%	0.26
Electrolyte and fluid abnormality	6%	6%	0.06
Cancer	14%	13%	0.73

a high correlation between the instrumental variable and the choice of treatment, but a lower association between the instrumental variable and outcome. Such associations were seen in the current study. If there was a high correlation between the instrumental variable and outcome, especially if that association is higher than the association of the instrumental variable and treatment choice, then there is some unseen effect of the instrumental variable beyond its effect on treatment.

Even if the selected instrumental variable passes statistical tests, it is not assured that it is without bias. For example, in this study it may be that admission to the hospital on the weekend is associated with higher mortality for reasons beyond delay. Such variables can exist. For instance, it may be that at a teaching hospital all patients admitted during the week are cared for by trauma specialists, whereas weekend on-call duties are shared by orthopaedic surgeons, including some who may not be as adept at caring for patients with hip fractures.

The current study also is limited in that timing was measured imprecisely. In our database, it was noted on which day the patient was admitted, and on which day

TABLE 5. Unadjusted Outcome by Admission Group

Day of Admission Group	Percentage of Patients (number of patients)	Percentage of Patients With Delays of 2 or More Days (number of patients)	Unadjusted 30-Day Mortality Risk (number of patients)
Saturday, Sunday, Monday	42% (7648)	25% (1873)	7.2% (548)
Tuesday, Wednesday, Thursday, Friday	58% (10561)	20% (2084)	6.5% (685)
p Value	N/A	<0.001	0.072

N/A = Not applicable

surgery was done. This omits the date of the fracture, and from a biological perspective, delay begins from the time of injury until surgery, and not from the time of admission until surgery. It is unlikely that there is a major difference in the time between fracture and admission in the two groups, but a more precise measurement would be better.

Another limitation of the recording system used is that time was measured in days: a patient admitted at 1:00 AM Tuesday morning and taken to surgery 46 hours later, at 11:00 PM Wednesday night, is said to have the same delay as a patient admitted 11:00 PM on Tuesday and taken to surgery 8 hours later at 7:00 AM Wednesday morning. This variance is likely to be evenly distributed across all days, but does limit the precision of our measurements. We therefore cannot draw an inference regarding the effect of a 12-hour delay, even if it were biologically significant.

The findings of this study must be appreciated in the context of previous work and its inherent limitations. For years, it has been recognized that hip fracture is associated with a high risk of dying within 1 year of injury.[4] It is unclear whether the injury causes hastened mortality or is a marker for preterminal fragility, namely, that the same processes that lead to fracture (falling and low body mass among others) are independent risks causing mortality.

Kenzora et al[16] found a higher mortality in patients who had surgery within 24 hours of admission compared with patients who had surgery between 2 and 5 days after admission. Mullen and Mullen[19] also found patients had a higher mortality when surgery occurred within 24 hours of admission. However, White et al[30] reported that a delay in surgery greater than 24 hours after admission caused a higher mortality. Hamlet et al[11] found that patients with fractures treated operatively within 24 hours had lower 1- and 3-year mortality rates. Sexson and Lehner[20] concluded that healthier patients fared better if they had surgery earlier versus less healthy patients who were better off having surgery after delay. Zuckerman et al[31] concluded that operative delay greater than 2 days was an important predictor of mortality within 1 year. Eiskjaer et al[8] found no significant influence of the timing of surgery on mortality.

Ho et al[13] were the first to attempt an instrumental variables analysis of this question. However, their study was limited in at least two significant ways: it included patients as young as 45 years, and included patients with open fractures. Both of these inclusion criteria create a heterogeneous population: most hip fractures are sustained in low-energy falls, whereas open fractures and fractures in younger individuals are likely to result from high-energy injuries. High-energy injuries may have a distinct pattern of mortality that is particularly difficult to characterize in retrospective reviews. For example, some degree of hypovolemic shock from bleeding may be present; this blood loss may be too small to cause death, but enough to increase the risk of death. A cardiac or pulmonary contusion also may be in that category. Furthermore, the inclusion of open fractures in the database seriously impedes the ability to draw inferences regarding the effect of time delays, because open fractures are considered surgical emergencies. Therefore, a population of patients with open and closed hip fractures does not represent a population of patients in whom surgical delay is randomly distributed.

Based on the results of the current study using instrumental variables analysis, the marginal effect of a delay of 2 or more days was a 15% increase in the risk of mortality

TABLE 6. Instrumental Variables Analysis by Delay of 2 or More Days and Admission on Saturday, Sunday, or Monday

Outcome		Percentage Point Change in Mortality (%)	p Value	95% Confidence Interval (%)
30-Day Mortality	IV Model*	15	0.047	0.21–31

*Instrumental variables model

(p = 0.047). Delay until surgery increased the risk of mortality. The results of this study raise important questions. Should patients be taken to surgery immediately after admission? Should this be the standard of care for all patients? This would require a major redirection of effort. Surgeons and operating rooms must be kept on standby alert, just as they are for patients with open long bone fractures, although in greater numbers because hip fractures are more common. Also, medical consultants must be available to provide medical clearance on a 24-hour basis. It is not clear that such an undertaking is justified in terms of its potential beneficial effects. However, programs that decrease unnecessary delays are worthwhile, and additional studies that more precisely measure the effect of delays are needed.

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