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Factors Affecting the Likelihood of Presentation to the Emergency Department of Trauma Patients After Discharge

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Abstract

Study objective—We determine the rate at which trauma patients re-present to the emergency department (ED) after discharge from the hospital and determine whether re-presentation is related to race, insurance, and socioeconomic factors such as neighborhood income level.

Methods—Trauma patients admitted to a Level I trauma center between January 1, 1997, and December 31, 2007, were identified with the hospital's trauma registry. These patients were linked to administrative data to obtain information about re-presentation to the hospital. Neighborhood income was obtained with census block data; multiple imputation was implemented to account for missing income data. Logistic regression analysis was used to determine the predictors of re-presentation.

Results—There were 6,675 patients who were included in the study. A total of 886 patients (13.3%) returned to the ED within 30 days of discharge from the hospital. Uninsured patients (odds ratio [OR]=1.64; 95% confidence interval [CI] 1.30 to 2.06) and publicly insured patients (OR=1.60; 95% CI 1.20 to 2.14) were more likely to re-present to the ED than those with commercial insurance. Residing in a neighborhood with a median household income less than \$20,000 was associated with a higher odds of re-presentation (OR=1.77; 95% CI 1.37 to 2.29). Only 13.2% of patients who came to the ED were readmitted to the hospital.

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Author contributions: KSL, JHY, DKN, and AHH conceived the study. KSL and DKN gathered and matched the various data sets used. KSL performed the statistical analysis. DKN, JHY, and AHH provided oversight and guidance. KSL drafted the article, and all authors contributed substantially to its revision. KSL takes responsibility for the paper as a whole.

Conclusion—A substantial number of trauma patients return to the ED within 30 days of being discharged, but only a small proportion of these patients required readmission. Re-presentation is associated with being uninsured or underinsured and with lower neighborhood income level.

INTRODUCTION

Nonmedical factors such as race, insurance, and socioeconomic status have a profound effect on health care quality and outcomes. Within the field of trauma, several studies have shown that race and insurance are related to measures such as the likelihood of in-hospital mortality, the amount of care received, and length of stay.^{1–6} Yet despite these findings, little is known about how these factors influence the interactions of trauma patients with the health care system immediately after discharge from the hospital.

The few articles published on the subject of postdischarge care after a traumatic injury describe the influences of both race and insurance. A large study using a national sample showed that uninsured individuals were less likely to receive recommended follow-up care after an unintentional injury.⁴ For patients discharged after a traumatic brain injury, 2 previous studies demonstrated that both race and insurance affected rehabilitation placement.^{7,8} However, a study of orofacial injury patients has shown that although unemployed black patients were most likely to miss follow-up appointments, health insurance was not a substantial predictor.⁹ None of the previous studies controlled for broad indicators of socioeconomic status such as neighborhood income level, which is likely a confounder in the relationship of insurance status with postdischarge care.

One particular issue that, to our knowledge, has not been addressed in previous literature is emergency department (ED) utilization after the discharge of admitted trauma patients. This is important to know not only to assess the full effect of the previously described disparities but also to more completely understand the differences in the economic costs and resource use associated with these patients. Furthermore, the effect of nonclinical socioeconomic factors, such as neighborhood income level, on ED utilization should be assessed. Because of the findings of previous studies, we hypothesize that factors such as race, disposition, and injury type are associated with differences in ED re-presentation rates among trauma patients. Furthermore, we believe that socioeconomic status indicators, specifically neighborhood income levels, will be a substantial predictor of these differences.

MATERIALS AND METHODS

Study Design and Setting

Using a nonconcurrent retrospective cohort design, the analysis examined trauma patients admitted to a state-verified, urban Level I trauma center during a 10-year period beginning January 1, 1997, and ending December 31, 2007.

Selection of Participants

Patients admitted to the adult trauma service at the Johns Hopkins Hospital in Baltimore, MD, were identified with the hospital's trauma registry. Patients younger than 18 years and older than 65 years were excluded, as were patients who died during their initial hospital course. Patients with multiple admissions for trauma within the study period had only their first admission included in the analysis.

Data Collection and Processing

To fully gauge all of their interactions with the hospital system, trauma registry records were linked to the hospital's administrative case mix database by deterministic linkage with

medical record number, birth date, and admission/discharge dates. Linking the trauma registry to the hospital administrative data set enabled collection of additional information about the index admission, as well as future presentations to the ED and subsequent readmission to the hospital. This comprehensive data set, which also included information about the patient's medical history, medication use, and diagnostic tests, was then used for all analyses.

Insurance status was divided into 3 categories: commercial (private, health maintenance organization, workers' compensation, automobile insurance), public (Medicare, Medicaid, Title V, Medical Assistance), and uninsured (self-pay, Medicaid pending/applied). Patients were categorized into 3 racial groups, as determined by self-report at presentation to the ED or, in the case of those unable to give report, as determined by the admissions intake coordinator. Race was categorized as black, white, and other. A patient's medical record number and birth date were used to identify whether he or she presented to the ED within 30 days of discharge and was subsequently readmitted to the hospital.

Injury type (blunt versus penetrating) and injury severity by the Injury Severity Score were abstracted from the trauma registry. Other demographic information (age, sex, disposition, length of stay) was also obtained from the trauma registry. Charlson Index scores were calculated to control for a patient's comorbidities by using *International Classification of Diseases, Ninth Revision (ICD-9)* diagnosis codes in the administrative database and a publicly available algorithm.¹⁰ Reason for representation was determined with *ICD-9* codes for the principal diagnosis listed in the administrative case-mix data. The reasons were divided into the following categories: trauma (*ICD-9* code 800 to 957.9), complication (*ICD-9* 958 to 959.9, 996 to 999.9), dressing attention (*ICD-9* v58.3), pain (any *ICD-9* code with the words "pain" or "ache" in the code description¹¹), psychiatric (*ICD-9* 290 to 319), and other. If a patient had a re-presentation code designating trauma, it could not be determined whether this referred to a new traumatic injury or to the initial index event.

With the administrative database, patients' addresses were geocoded with ArcGIS 9.3 (ESRI, Redlands, CA) and linked to 2000 census block groups, the smallest publicly available unit and a common proxy for neighborhood characteristics.¹²⁻¹⁴ Median household income according to census block group was identified for each patient with a valid address from the 2000 US census. Median annual family income was grouped into 3 categories: low (<\$20,000), middle (\$20,000 to \$40,000), and high (>\$40,000). Income was log transformed when included in regression models.

Primary Data Analysis

Baseline characteristics of the study population were examined overall and by re-presentation status with *t* tests and χ^2 tests, which were implemented as appropriate. Logistic regression was used to estimate the association of insurance status, race, and neighborhood level income with re-presentation to the ED. Their association with the outcome was examined with and without adjustment for factors previously identified as potential confounders of trauma outcomes or of representation to the ED in the literature. These factors included age,^{15,16} sex,^{17,18} disposition,⁸ Injury Severity Score,^{19,20} comorbidities,^{21,22} type of trauma,²³ and length of stay.^{1,2} To examine the relative influence of race, insurance status, and neighborhood level income, independent of the others, we generated multivariate models including all 3 factors. Models were built with a hypothesis-driven approach including covariates that were selected a priori according to the literature cited above. Multiple imputation was used to account for missing income data within a subset of patients, a method that has been validated in previous trauma literature.²⁴ Log income values were imputed with linear regression based upon all other variables in the final regression model, including re-presentation to the ED, with a total of 50 imputations. All

analysis was performed with Stata (version 11; StataCorp, College Station, TX), with significance defined as $P < .05$. This project received approval from the Johns Hopkins University School of Medicine Institutional Review Board.

RESULTS

A total of 7,925 trauma admissions that met all inclusion criteria were identified in the trauma registry. There were 764 (9.6%) patient visits that were not included because of recidivism during the study period. Of the remaining sample, 275 (3.8%) patients could not be matched to the administrative database on the basis of medical record number, birth date, and admission/discharge dates and were excluded from the analysis. Another 211 (2.9%) patients were excluded because of missing demographic data, leaving a total of 6,675 patients who were included in the study. Of these patients, we were able to obtain neighborhood level household income data for 4,935 (73.9%) patients, which was lower than expected. Those whose address did not match according to the US street address match were considered to have missing data. Missing income data was associated with being black and being underinsured ($P = .017$ and $P = .001$, respectively). In a sensitivity analysis including only complete cases, we found no qualitative differences in the estimates of association compared with models including imputed data.

The patients in our sample tended to be black (71.6%), uninsured (68.5%), and men (79.6%). The majority of patients had no identifiable comorbidities, with a Charlson score of zero (83.8%), and experienced mild injuries, with an Injury Severity Score of less than 9 (54.5%) (Table 1). Overall, a total of 886 patients (13.3%) re-presented to the ED within 30 days of discharge. A greater proportion of uninsured (14.6%) and publicly insured (13.8%) patients re-presented compared with those with private insurance (8.1%) ($P < .001$ for each respective comparison). Black patients also presented to the ED after discharge at a higher rate than white patients (14.6% versus 9.2%, respectively; $P < .001$). Table 1 has the complete distribution of the rates of re-presentation stratified by various groups.

Patients with public insurance and no insurance lived in neighborhoods with lower median household income levels compared with patients with commercial insurance. The average neighborhood median household income for black patients was \$19,605, which was lower than the average median household income for white patients (\$31,875). Patients who had experienced a penetrating trauma were also more likely to reside in low-income neighborhoods (Table 2).

Table 3 presents the relative odds of re-presenting to the ED within 30 days after discharge. According to a logistic regression model, with multiple imputation to account for missing household income data, uninsured patients (odds ratio [OR]=1.64; 95% confidence interval [CI] 1.30 to 2.06) and publicly insured patients (OR=1.60; 95% CI 1.20 to 2.14) were more likely to re-present to the ED than those with commercial insurance.

Furthermore, residing in a neighborhood with a median household income of less than \$20,000 was associated with a higher odds of re-presentation (OR=1.77; 95% CI 1.37 to 2.29). If patients were discharged to a rehabilitation, nursing, or acute care facility, they were significantly less likely to return to the ED than patients who were discharged to home (OR=0.31; 95% CI 0.21 to 0.45). Injury severity was also found to predict re-presentation to the ED, with patients who experienced more severe injuries being more likely to return to the ED within 30 days of discharge than those with milder injuries. In stratified analysis with patients divided into 2 cohorts by calendar year, no period effects were detected (data not shown).

Table 4 lists the reasons for re-presentation with their associated readmission rate. Of the 886 patients who represented to the ED within 30 days of discharge, only 117 (13.2%) patients required readmission to the hospital. There were an even greater number of patients (124; 14.0%) who represented to the ED for dressing attention, of whom none were admitted to the hospital.

LIMITATIONS

Our sample population consisted solely of patients at a single urban, academic Level I trauma center and is not necessarily representative of trauma institutions nationwide. This was evidenced by the fact that the patients in our sample were predominantly black, uninsured, and male. Also, a substantial percentage of patients in the study had experienced a penetrating trauma (41.2%). Therefore, our findings might not be easily extrapolated to trauma care throughout the country. These differences in demographics could explain why the percentage of patients re-presenting to the ED is substantially higher than that found in a previous prospective, observational study published by Malhotra et al,²⁵ which found that trauma patients used the ED at a rate of 7.5% within 4 weeks of discharge.

Furthermore, patients who re-presented to a hospital other than the trauma center they were discharged from could not be included in our analysis. However, despite this limitation, we were still able to identify a substantial number of patients who re-presented to the ED. The study conducted by Malhotra et al²⁵ found that 75% of the patients in their sample who represented to the ED did so at the trauma center they were discharged from. Although this provides some confidence that we included the majority of ED re-presentations, it is unclear how this phenomenon would change our results.

The reliance on census-based data to measure income in our analysis rather than individual-level data does have implications for the interpretation of the results. Neighborhood income as a proxy for socioeconomic status has been used in a variety of research studies, ranging from the epidemiology of infectious pathogens, to glucose self-monitoring in patients with diabetes, to outcomes of serious brain injury.^{12,13,26} The use and validity of this method have been evaluated by numerous epidemiologic studies.^{27–32} Indeed, in the current study, median household income was a substantial predictor of readmission to the ED and was a key variable in the analysis. Whether this is an important factor independent of individual income is unclear, and neighborhood income should not be interpreted as an individual's income. However, this analysis does highlight the importance of including neighborhood-level data when investigating epidemiologic relationships involving race, insurance status, or any variables related to socioeconomic status.

Finally, we were unable to obtain data about whether patients were referred to the ED from an outpatient clinic or whether they arrived from a rehabilitation facility or nursing home. In these cases, a patient would have less autonomy in determining whether to use the ED for care. If these data had been available, these patients would have been considered separately in the analysis. We also could not determine whether a patient had been prescribed any follow-up at discharge or whether an appointment had already been scheduled. Thus, there was no information about patients missing or attending an outpatient appointment and still re-presenting to the ED for care.

DISCUSSION

Our study found that 13.3% of patients discharged after a traumatic injury returned to the ED within 30 days. Furthermore, the analysis demonstrates that there are certain identifiable populations who are more likely to re-present to the ED after a trauma. With respect to insurance, uninsured and publically insured patients were more likely than commercially

insured patients to re-present to the ED. Residing in a neighborhood with lower median household income was also associated with increased odds of re-presentation compared with living in a higher-income neighborhood. Although black patients tended to come from neighborhoods with a lower median household income, race was not found to be an independent predictor of re-presentation.

These findings differ from those of previous studies that showed that race was a significant determinant of outcomes after trauma, and the results highlight the difficulty and importance of untangling the complex relationships between race, insurance, and neighborhood-level factors such as income as they relate to health care outcomes. Although this study was not designed to determine causality, there are a few possible interpretations of our findings. Studies have shown that being uninsured or having government-sponsored insurance decreases one's ability to obtain ambulatory appointments.^{33,34} Thus, one possible explanation for our results is that insurance status and low income are related to an inability to access appropriate follow-up care in an outpatient clinic, which leads to a reliance on the ED for nonurgent issues. Although the host institution does have a trauma clinic, during the study period, patients would have to call and make an appointment to schedule follow-up, typically in 1 to 2 weeks after discharge, depending on whether follow-up was indicated. The trauma clinic does have a policy to register patients for their first follow-up appointment after discharge, irrespective of the presence of insurance. However, it is unknown whether lack of insurance inhibited patients from calling to set up their first follow-up visit. In part based on this study, the discharge practices on the adult trauma service have been modified so that patient follow-up appointments are now made before patients are discharged from the hospital.

This interpretation assumes that there are either real or perceived financial barriers to accessing care and that these factors are more influential than any racial or cultural disparities that might exist. Neighborhood income could also be a proxy for other socioeconomic indicators such as education and environmental factors that could influence an individual's decision or the necessity to use the ED for care. Neighborhood-level factors could also be related to a patient's clinical profile in a manner that would influence the decision to present to the ED for care.

These findings could also simply be a manifestation of overall ED utilization rates by these various populations irrespective of their trauma status and recent discharge. Although it is a widely held notion that uninsured patients crowd EDs, this assumption is not necessarily supported by the literature. A recent meta-analysis published by Newton et al³⁵ came to the conclusion that although publicly insured individuals were more likely to present to the ED, the relationship of ED utilization between the uninsured and privately insured patients was unclear. Several studies have also shown that, similar to our study, low income status is a more important factor than race in predicting ED usage.³⁶⁻³⁹

Although the findings of this study do not show that patients suffer clinically because they use the ED more, the results do carry possible economic implications. Although some patients do use the ED for urgent issues that an outpatient clinic cannot handle, our analysis showed that pain and dressing attention accounted for approximately 29% of the patients who re-presented, of whom only 3.5% were subsequently admitted. These figures suggest that a number of patients within our sample could have been better served in an outpatient setting. Several studies have shown that the ED is an expensive and inefficient place to deliver nonurgent medical care, which makes these statistics particularly worrisome.³⁵ Preventing potentially avoidable ED utilization by trauma patients may help ease crowding in EDs across the country and improve their ability to deliver quality care. A formal cost

analysis needs to be undertaken to determine whether there is a more cost-effective way to care for trauma patients after discharge.

The ED has long been viewed as the provider of last resort for populations who have been marginalized by other parts of the health care system. Although there are numerous studies that have examined utilization rates for all ED patients, this is the first study to our knowledge that investigates predictors of ED utilization among discharged trauma patients. The hyperacuity and unpredictable nature of trauma offer a unique opportunity to study a patient population that is free from other potential confounders such as adverse selection that often exist in studies of chronic conditions. A recent study examining patients with a variety of discharge diagnoses found that race and receiving social security income were positive predictors of rehospitalization within 30 day of discharge.⁴⁰ However, the analysis was limited to Medicare beneficiaries and did not examine uninsured populations. Thus, more research is needed to determine whether the associations described in this article can be generalized to other populations.

Despite its limitations, this study provides compelling evidence that disparities with regard to insurance and neighborhood-level factors such as income exist after the discharge of trauma patients from the hospital. There are likely numerous explanations for the discrepancies described in our study that influence these patients after their hospitalization. However, regardless of the underlying cause, further research is needed to investigate how the system can be more efficient in taking care of these vulnerable populations. Specifically, additional studies examining the reasons for re-presentation to the ED and their relationship to access to outpatient follow-up care need to be undertaken. This focus has become even more critical at a time when recent economic decline has not only decreased household incomes nationally but also deprived millions of Americans of their insurance and forced millions more to rely on government-sponsored health care.⁴¹ Improving follow-up care for these patients will not only improve individual health care quality and outcomes but also reduce the strain on overburdened EDs throughout the country.

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Editor's Capsule Summary

What is already known on this topic

Unscheduled return to the emergency department (ED) has been proposed as a marker for low-quality ED or inpatient care.

What question this study addressed

What demographic factors explain 30-day visits to a trauma center ED after the discharge of hospitalized trauma patients from that trauma center?

What this study adds to our knowledge

Trauma patients who were uninsured, publicly insured, discharged to home, or from a lower-income neighborhood were more likely to have a return visit to the trauma center ED.

How this is relevant to clinical practice

These data suggest that individual- and population-level factors are associated with ED visits after hospital discharge, although specific cause-and-effect relationships could not be confirmed.

Table 1

Baseline characteristics and re-presentation rates to the ED within 30 days of discharge for all trauma patients admitted from January 1, 1997, to December 31, 2007.

| Baseline Characteristics | Total Patients in Sample | Re-presented to the ED, n (% of Total) |
|--|-----------------------------|--|
| n | 6,675 | 886 (13.3) |
| Insurance | | |
| Commercial | 1,210 (18.1) | 98 (8.1) |
| Uninsured | 4,571 (68.5) | 665 (14.6) |
| Public | 894 (13.4) | 123 (13.8) |
| Race | | |
| White | 1,496 (22.4) | 138 (9.2) |
| Black | 4,777 (71.6) | 694 (14.5) |
| Other | 402 (6.0) | 54 (13.4) |
| Sex | | |
| Female | 1,359 (20.4) | 163 (12.0) |
| Male | 5,316 (79.6) | 723 (13.6) |
| Charlson Comorbidity Index, mean (SD) | | |
| 0 | 5,594 (83.8) | 740 (13.2) |
| 1 | 815 (12.2) | 109 (13.4) |
| 2 | 131 (2.0) | 17 (13.0) |
| 3 | 135 (2.0) | 20 (14.8) |
| ISS, mean (SD) | | |
| <9 | 3,641 (54.5) | 442 (12.1) |
| 9–15 | 1,859 (27.9) | 272 (14.6) |
| 16–24 | 712 (10.7) | 112 (15.7) |
| >24 | 463 (6.9) | 60 (13.0) |
| Injury mechanism | | |
| Penetrating trauma | 2,748 (41.2) | 456 (11.6) |
| Blunt trauma | 3,927 (58.8) | 430 (15.7) |
| Disposition | | |
| Home | 5,513 (82.6) | 763 (13.8) |
| Home with services | 395 (5.9) | 66 (16.7) |
| Rehabilitation, nursing, acute care facility | 634 (9.5) | 34 (5.4) |
| Against medical advice or unknown | 133 (2.0) | 23 (17.3) |
| Median neighborhood household income, \$* | | |
| <20,000 | 1,050 (21.3) | 185 (17.6) |
| 20,000–40,000 | 2,525 (51.2) | 360 (14.3) |
| >40,000 | 1,360 (27.6) | 127 (9.3) |

| Baseline Characteristics | Total Patients in Sample | Re-presented to the ED, n (% of Total) |
|---------------------------------|-------------------------------------|---|
| Age, y, mean (SD) | 34.34 (12.10) | — |
| Length of stay, mean (SD) | 4.54 (10.20) | — |

ISS, Injury Severity Score.

* Percentages are based on a subset of patients for whom income data were available (n=4,935).

Table 2

Median household income level according to census block group of trauma patients admitted from January 1, 1997, to December 31, 2007.

| | Total, n | Median Income: Thousands of Dollars (Interquartile Range) | Less Than \$20,000, % | \$20,000-\$40,000, % | Greater Than \$40,000, % |
|-------------------------|----------|---|-----------------------|----------------------|--------------------------|
| Overall | 4,935 | 31.2 (21.9, 40.9) | 21.3 | 51.2 | 27.6 |
| Insurance | | | | | |
| Commercial | 932 | 36.8 (26.5, 50.3) | 12.6 | 43.9 | 43.6 |
| Uninsured | 3,359 | 28.0 (19.3, 37.5) | 22.5 | 53.1 | 24.4 |
| Public | 644 | 28.0 (19.3, 37.5) | 27.5 | 51.6 | 21.0 |
| Race | | | | | |
| White | 1,132 | 41.2 (31.9, 55.4) | 6.3 | 39.1 | 54.7 |
| Black | 3,536 | 27.5 (19.6, 36.5) | 26.6 | 55.0 | 18.4 |
| Other | 267 | 33.2 (27.6, 45.1) | 14.2 | 52.4 | 33.3 |
| Injury mechanism | | | | | |
| Blunt | 2,941 | 32.6 (23.8, 44.0) | 18.0 | 48.2 | 33.8 |
| Penetrating | 1,994 | 28.1 (19.8, 36.5) | 26.1 | 55.5 | 18.4 |

Table 3

Logistic regression analysis to predict relative odds of re-presentation to the ED within 30 days of discharge (n=6,675).*

| | OR (95%CI) |
|--|------------------|
| Insurance | |
| Commercial | 1 |
| Uninsured | 1.64 (1.30–2.06) |
| Public | 1.60 (1.20–2.14) |
| Race | |
| White | 1 |
| Black | 1.24 (1.00–1.53) |
| Other | 1.25 (0.88–1.76) |
| Disposition | |
| Home | 1 |
| Home with services | 0.19 (0.90–1.59) |
| Rehabilitation, nursing, or acute care | 0.31 (0.21–0.45) |
| Against medical advice or unknown | 1.24 (0.78–1.97) |
| ISS | |
| <9 | 1 |
| 9–15 | 1.29 (1.10–1.53) |
| 16–24 | 1.54 (1.22–1.94) |
| >24 | 1.42 (1.04–1.95) |
| Charlson Comorbidity Index | |
| 0 | 1 |
| 1 | 1.08 (0.86–2.18) |
| 2 | 1.28 (0.75–2.18) |
| 3 | 1.35 (0.82–2.23) |
| Neighborhood median income, \$ | |
| >40,000 | 1 |
| 20,000–40,000 | 1.42 (1.14–1.77) |
| <20,000 | 1.77 (1.37–2.29) |
| Penetrating trauma (vs blunt) | 1.15 (0.97–1.35) |
| Age, 1 y | 1.00 (0.99–1.00) |
| Sex, male | 1.00 (0.82–1.21) |
| Length of stay, days | 1.00 (0.99–1.01) |

* All covariates adjusted for in the model are included in the table.

Table 4

Reason for re-presentation to the ED.

| | Patients Who Re-presented to the ED Within 30 Days of Discharge, n (% of Overall) | Patients Readmitted From the ED, n (% of Re-presented) |
|--------------------|--|---|
| Overall | 886 | 117 (13.2) |
| Complications * | 88 (9.9) | 27 (30.7) |
| Dressing attention | 124 (14.0) | 0 |
| Psychiatric | 40 (4.5) | 12 (30.0) |
| Pain | 159 (17.9) | 10 (6.3) |
| Trauma * | 202 (22.8) | 16 (7.9) |
| Other | 273 (30.8) | 52 (19.0) |

* Trauma defined as a principal *ICD-9* diagnosis code between 800 and 957.9. Complication defined as *ICD-9* principal diagnosis code 958 to 959 (certain traumatic complications), or 996 to 999.9 (complications of surgical and medical care, not elsewhere classified).