Introduction

Throughout Europe and the United States, legal and illegal immigration are at the forefront of current news and policy discussions. Undocumented immigrants (UDIs) represent an estimated 6.7% of the population of Texas (1.65 million people). Nationally, noncitizens number approximately 25 million and UDIs number approximately 11.2 million.¹ There is a growing body of research into health-care cost and utilization among UDIs in the US.²⁻⁵

Trauma literature from the southwest US has documented a relatively new trend involving smuggling of immigrants in overloaded vehicles.⁶ Previous reports from Arizona included a retrospective search of newspaper articles, which identified 38 crashes from 1999 to 2003, but our literature search did not reveal similar data available for Texas. For many years, this phenomenon has been experienced at our hospital in the form of numerous multicasualty trauma activations due to overloaded vehicles that are being chased by border patrol (BP). These events often involve many victims brought to the hospital in a short period of time and can quickly overwhelm trauma center capacities, especially in smaller border towns.⁷

While many areas of the country have a large enough UDI population to study their associated trauma care, our hospital, by its location in Southern Texas, is geographically located such that it is one of only a few facilities able to collect data on those individuals who sustain trauma in border-crossing attempts and related activities. The purpose of this investigation was to contribute to the body of knowledge about this unique subset of trauma patients and to help inform policy and administrative procedures.
decisions at the level of the hospital system, law enforcement system, and disaster management. We conducted a secondary analysis of a prospectively collected trauma registry to evaluate the characteristics and costs associated with the care of patients brought to the emergency department (ED) by BP/Immigration and Customs Enforcement (ICE). Our prestudy hypothesis was that there would be a large number of UDIs presenting with significant traumatic injuries from motor vehicle accidents who incur significant costs to our hospital system.

**Materials and Methods**

**Study design**

This was a secondary analysis of a prospectively collected database of patients presenting with traumatic injuries and under custody of BP/ICE from 2011 to 2014.

**Setting**

The study was conducted at Texas A&M/CHRISTUS Spohn Memorial Hospital in Corpus Christi, Texas, which is a level-two trauma center and serves an innercity population. The annual ED census is 45,000 patients. This location in south Texas is approximately 150 miles by road from the closest border with Mexico.

**Population**

All patients presenting to our center with traumatic injuries and under the custody of BP during the study period were enrolled retrospectively, including those not admitted and those who were not designated trauma team activations. The population studied was considered a protected population, and the Christus Spohn Institutional Review Board approved the study protocol prior to the initiation of data collection. Due to the nature of the study, consent was waved.

**Study protocol**

Potential patients were identified using the Trauma Registry based on their insurance/payor of “other,” or that they were discharged to “other,” and then the electronic medical record was opened to confirm that the patient did not have a social security number, and that they were also under the custody of BP. Pertinent demographic and other data were then extracted from the Trauma Registry, and charge and cost data were obtained from financial records.

**Statistical analysis**

For each patient, date of service, age, sex, race, mechanism of injury (MOI), length of stay (LOS), Glasgow Coma Scale (GCS) score on arrival to the ED, condition at discharge, hospital charges, and hospital cost were obtained. Data were entered into Excel for Windows. Univariate analyses of the data were performed in Excel, and STATA (STATA Software (Statacorp LLC, College Station, Texas, USA) was used to perform bivariate analyses. Bivariate analyses were performed using Chi-squared test, ANOVA, and correlation coefficient. A multivariate ordinary least squares method of linear regression was used to identify variables significantly associated with hospital charges controlling for confounding factors.

**Results**

A total of 128 patients were enrolled from 2011 to 2014. The study group was 100% Hispanic, young (average age 28 years), and majority (79.7%) were male. Table 1 shows detailed population characteristics and outcome data. Average LOS was 13.2 days, but the maximum was 210 days. Motor vehicle accidents accounted for 75% of trauma patients brought to our center under the custody of BP/ICE.

Of the 128 patients, over 4 years, 78 (61.0% of total) co-presented on the same calendar day as other study patients, suggesting that they were members of multiple-casualty accidents. Of special note, thirty patients of the total (23.4%) presented on 4 distinct calendar days in separate months. On detailed review of the electronic medical record, these patients were noted to be fleeing BP in vehicles before being involved in multiple-casualty accidents. These four accidents alone resulted in total hospital charges of $6.8M for those thirty patients.

Hospital charges, as well as hospital costs, were obtained for each patient’s visit. For the 128 patients, total charges were $20.6M, total costs were $4.5M, and total payments were $0.99M as shown in Table 2.

Bivariate analysis revealed that MOI differed by gender ($P = 0.021$), but we did not identify significant relationships with respect to mechanism and LOS ($P = 0.67$), mechanism and initial GCS ($P = 0.21$), mechanism and discharge status ($P = 0.94$), or gender and discharge status ($P = 0.70$).

Initial GCS and LOS were negatively correlated, with correlation coefficient of $-0.2744$ ($P = 0.0017$). Mean charges did not differ by MOI ($P = 0.61$) or gender ($P = 0.43$). In the multivariate analysis, the only variable that associated with increased charge was LOS.

| Table 1: Population and outcome characteristics |
|-----------------------------------------------|
| **Continuous data** | **Mean±SD** | **Range** |
| Age | 28±8.7 | 15-50 |
| GCS | 12.8±4.43 | 3-15 |
| LOS | 13.2±29.8 | 0-210 |

| **Categorical data** | **Frequency of Occurrence** |
|----------------------|----------------------------|
| Race | Hispanic: 100% |
| Gender | Male: 79.7% Female: 20.3% |
| Mechanism | MVC: 75% Fall: 13.3% Auto versus ped: 8.6% Assault: 0.8% Other blunt: 2.3% |
| Disposition | DC alive: 92.2% Transfer: 3.1% Deceased: 4.7% |
| SD: Standard deviation, GCS: Glasgow Coma Scale: LOS: Length of stay: MVC: Motor vehicle crash, DC: Discharge |

| Table 2: Charges, costs, and payments |
|---------------------------------------|
| **Mean±SD ($)** | **Range ($)** | **Total ($)** |
| Charges | 162,152±295,441 | 2723-1,868,087 | 20.6 M |
| Costs | 35,459±69,851 | 428-439,682 | 4.50 M |
| Payments | 7795±22,668 | 0-186,405 | 0.99 M |

SD: Standard deviation.
**Discussion**

At our hospital, UDIs are not specifically identified as such. They are seen, admitted, and discharged like other patients. An exception is when an UDI is brought to the hospital with BP. This may occur, for instance, in the context of fleeing from BP and sustaining trauma, or after BP becomes involved in a medical case such as dehydration or rhabdomyolysis in a crossing attempt. At our institution, multiple-casualty incidents involving UDIs seem to occur sporadically and are typically memorable for their extreme violence to the patients and sudden strain on the emergency systems. This was one of the factors prompting this study to explore the phenomenon.

Rodriguez et al.\(^7\) presented two incidents on 2 subsequent days involving overcrowded vehicles used to smuggle UDIs. That study noted the overwhelming effect that the crashes had on the local trauma systems near Phoenix, Arizona, and especially the rural emergency medical services closest to the accident, which typically have limited resources and personnel. As our center has only two major trauma resuscitation rooms, typically only see one major trauma per day, and has one trauma surgeon on-call with a single backup surgeon, a sudden influx of three or more victims of a van roll over during a BP chase, similarly, has the potential to strain our resources as well.

Our data revealed that there were 128 UDIs who presented under the custody of BP/ICE over the 4-year look back period, with an average charge of $160,886 and average LOS of 13.2 days. Tragically, these patients, typically young, are frequently gravely injured or disabled and lose many quality life-years. Our observed in-hospital mortality of 4.7% does not account for those patients who were deceased on scene. A related study in Arizona\(^6\) specifically examining cases of overloaded vehicles identified 38 crashes involving 663 passengers, 49% of whom were injured, 9% mortally, via newspaper article review. Our methods differed in that we identified our patients after arrival to our hospital. This allowed us to examine many more characteristics and data points about these patients. In addition, we included patients with mechanisms other than motor vehicle crash (MVC) brought to the hospital by BP/ICE agents. To our knowledge, ours is the first study of its type to examine costs and charges, as well as other injury and demographic information for this population.

Hospital charges (which are billed to the patient or insurer) are generally not equal to actual costs accrued in providing care; charges are typically higher. Costs can be calculated in several different ways. The subject is complex, and true cost to the health-care system is somewhat nebulous given the multitude of factors at play for each individual patient in time, from costs of hiring laboratory personnel to groundskeeping costs.\(^8\) The facility-specific cost-to-charge ratio (CCR) at our institution based on Centers for Medicare and Medicaid Services (CMS) data is 0.197 for the year 2013,\(^9\) while the CCR in this subset of patients is similar but higher, at 0.219. Based on the same CMS data, nationwide CCR varied from 0.067 to 1.12, with the median being 0.31. Given the complexity of obtaining accurate cost data, hospital charges are often used in the literature as a surrogate for actual costs.\(^10\) Furthermore, the two terms are frequently confused or inadvertently interchanged. At our institution, costs are calculated using a volume-based costing (VBC) methodology, in which direct and indirect costs are allocated to patients based on services provided in the facility based on revenue. Department expenses are allocated to patients based on patient charges. VBC is the most commonly used of several costing methodologies.\(^11\)

In addition to both charge and cost data, we obtained the payment information of the study patients. Reimbursement for caring for these patients does not meet hospital costs ($0.99M vs. $4.5M). In a small-to-moderate center like ours, a $1M annualized loss for such patients could in many years be the difference between profitability and loss for the hospital.

The frequency of multiple-casualty events can strain a trauma system already operating near capacity. These findings should be examined by trauma systems operating near the border with Mexico for planning and readiness purposes. Given that many of the accidents, particularly the multi-casualty accidents, may have been being pursued by law enforcement, strategies for minimizing harm in pursuit situations may be warranted, while balancing the need to enforce laws.\(^12\)

**Limitations and future questions**

This study has several limitations which warrant discussion. Our study protocol would exclude any American citizens under the custody of BP, as may be the case with some smugglers or drivers. However, these individuals certainly add to the health burden of illegal immigration. In addition, our methodology for identifying UDIs presenting with BP has the potential to exclude patients if they were registered as “self-pay” rather than ICE/BP as the payor, or if they were no longer under BP custody at the time of discharge. As a consequence, the true numbers of patients and financial impact on our center are likely larger than identified in this article.

Similarly, our study data only give some insight into the overall cost related to patients brought in for trauma by BP in our state. In addition to our facility, we suspect some patients were air transported to major medical centers in other cities (e.g., San Antonio). Patients with minor injuries would likely be seen in smaller rural EDs closer to the border.

In addition, prehospital information regarding the circumstances of the accidents could not be independently confirmed beyond reviewing the history and physical of the patients, themselves often based on trauma bay hearsay. For this reason, definitively stating how many patients sustained injuries while being pursued by BP is difficult. However, the vast majority of the clinical notes reviewed by study authors in the MVC cohort had some reference to fleeing or being pursued by BP.

Future study is warranted to determine the larger scope of the cost and resource burden UDIs place on our health-care system.
Future work on this subject could also include examination of nonsurgical, nontrauma medical cases related to BP, including dehydration and rhabdomyolysis in patients attempting to cross the border during periods of extreme heat.

**Conclusions**

In Southern Texas, UDIs apprehended by BP/ICE and brought to our trauma center utilized significant resources with a mean LOS of 13.2 days, mean hospital charges of $162,152 per patient, and cost of care of $4,503,000 for the 128 patients identified over the 4-year study period. Payments received for their care was $990,000.

**Compliance with ethical standards**

- All study authors (Drs. Kane, Richman, Xu, Wentling, Krall, Johnson, and Blow) declare that they do not have any financial and/or other conflicts of interest to disclose
- The study protocol was approved by our hospital’s Institutional Review Board (IRB) prior to the initiation of data collection. As the study protocol involved retrospective analysis of readily available clinical data, informed consent was waived by the IRB
- Patient data were de-identified for the purpose of reporting and were stored in compliance with the existing US regulations for patient confidentiality.

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Nil.

**Conflicts of interest**

There are no conflicts of interest.

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