Violence in Mexico and Healthcare Access: Evidence from the U.S.-Mexico Border Region

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Abstract:

Eleven to 50% of residents in the US-Mexico border region cross into Mexico for healthcare for reasons including low-priced provider options and looser prescribing requirements in Mexico. Violent crime has risen rapidly in northern Mexico since 2007, increasing risks associated with crossing for healthcare. Using state inpatient discharge databases for California, Arizona, and Texas (2005-2010), we estimate the effect of crime on the probability a hospital discharge was for an ambulatory care sensitive condition (ACSC) using a difference-in-difference approach. A one unit increase in homicide rates in the nearest Mexican municipality for the prior three months was associated with a 0.36 percentage point increase in the probability of being discharged for an ACSC in border counties. The effect was larger for uninsured patients, who may be more reliant on the Mexican healthcare system. Expanding access in the border region may mitigate these effects by providing an alternative source of care.

Keywords: violence; US-Mexico border region; access to care; preventable hospitalizations

Introduction:

Hospitalizations for ambulatory care sensitive (ACS) conditions, those for which appropriate outpatient care can prevent hospitalization or early interventions can reduce complications, are a costly issue for the US health care system (Agency for Healthcare Research and Quality 2012). In 2008, total national costs associated with ACS conditions were $26.4 billion (Agency for Healthcare Research and Quality). Rates of ACS admissions at the region level are often considered an indicator of primary care access, with more admissions for ACS conditions indicating lower access. ACS hospitalization rates have been shown to be associated with socioeconomic status, insurance, race and ethnicity, outpatient care access, and primary care supply (Weissman, Gatsonis, and Epstein ; Billings et al. ; Bindman et al. ; Laditka, Laditka, and Mastanduno ; Basu, Friedman, and Burstin).

The US-Mexico border region (US counties within 100 km of the border) is an important region for study of ambulatory healthcare access as the population has high rates of many known risk factors for increased ACS hospitalization rates. This population, of which almost half is of Hispanic race, has high rates of uninsurance, poverty, and chronic disease, and low rates of health professional supply (Bastida, Brown, and Pagán 2007; United States-Mexico Border Health Commission).

A significant proportion of border region residents cross into Mexico to obtain healthcare and purchase pharmaceuticals due to low-priced provider options in Mexico, dissatisfaction with the US healthcare system, and cultural preferences (Byrd and Law ; Escobedo and Cardenas ; Pisani, Pagan, Lackan, and Richardson ; Potter, White, Hopkins, Amastae, and Grossman ; Su, Richardson, Wen, and Pagan). Estimates from early 2008 showed that among a population-based sample in Texas border counties, over a third had crossed into Mexico in the previous year for either a doctor's visit (37%) or medication purchases (43%) (Su, Richardson, Wen, and Pagan). Border crossing is significantly more common among the uninsured, the low-income, the non-elderly, and those of Hispanic ethnicity (Bastida, Brown, and Pagán 2007; Byrd and Law ; Landeck and Garza). Individuals do not generally seek care in Mexico for inpatient or emergency conditions (Su, Richardson, Wen, and Pagan).

Beginning in late 2006, violence in northern Mexico significantly increased. This increase may have affected patterns of cross-border care, jeopardizing border residents' ambulatory healthcare access at multiple points along the border. Medical tourism in Tijuana was reduced by an estimated 50% in 2010 due to fear of violence and increased border wait times (O'Connor and Booth). An estimated 30 to 50% of private clinics and pharmacies in Juarez and Tijuana have closed (Homedes ; O'Connor and Booth), negatively affecting provider supply on the Mexican side of the border. Previous research on the effect of violence on legal US entries and self-reported healthcare access found reduced border crossing from Mexico into the US associated with increased homicide rates, but no association between homicide rates and self-reported access for residents of border counties (Geissler 2013). However, markers of reduced access (such as ACS admissions) may be more sensitive than self-reported data.

We use inpatient discharge databases from three border states (California, Arizona, and Texas) to measure the association between homicide rates in the Mexican municipality (an administrative unit similar to a US county) of the closest border crossing and the likelihood of discharge for an ACS condition.

Methods:

Analytic Approach and Hypotheses:

Using hospital discharge records from three border states (AZ, CA, TX), we use a difference-in-difference empirical approach at the discharge level to examine the association between homicide rates and admissions for ACS and marker conditions. Marker conditions are nondiscretionary admissions with clear diagnostic criteria, for which the provision of outpatient care has little impact on the need for hospitalization (Billings et al.). Since marker admissions should not be affected by variables related to healthcare access such as physician supply (Basu, Friedman, and Burstin ; Billings et al.), the approach is a case-control study design. We hypothesize that for patients residing in border counties, higher homicide rates in the nearest Mexican municipality will increase the likelihood of a discharge being for an ACS condition rather than a marker condition. We hypothesize that patients residing in non-border counties will be less sensitive to violent conditions in Mexico as it is less common for non-border populations to seek ambulatory care in Mexico. Additionally, we hypothesize that after controlling for socioeconomic and demographic characteristics of patients in border counties, discharges from these counties will have a lower likelihood of being for an ACS condition given the supply of care available in Mexico not accounted for by the model.

Data and Analytic Sample Construction:

Hospital discharge records from AZ, CA, and TX were used to identify discharges for patients aged 18-64 years between January 1, 2005 and December 31, 2010 with a diagnosis of at least one ACS or marker condition. Discharges from California hospitals were obtained from the Office of Statewide Health Planning and Development and contained discharges from all acute-care short term hospitals (State of California Office of Statewide Health Planning and Development). Arizona discharges were obtained from the Healthcare Cost and Utilization Project of the Agency for Healthcare Research and Quality and contained discharges from all acute-care short term hospitals (Arizona State Inpatient Databases (SID)). Texas discharges were obtained from the Texas Department of State Health Services and contained discharges from acute-care short term hospitals subject to reporting requirements[1] (Texas Hospital Inpatient Discharge Public Use Data File). These discharge data contain limited patient information (e.g. age, gender, ZIP code/county of residence) as well as *International Classification of Diseases*, *Ninth Edition*, Clinical Modification (ICD-9) diagnosis codes for the hospital stay and codes for procedures conducted during the stay.

Discharge records were excluded from the analysis if they were missing key data; age and primary diagnosis code were used in identifying ACS and marker conditions, and discharge quarter and patient residence was necessary to determine the homicide rate of the nearest border crossing. Most missing demographic information was a result of censoring by the data providers to protect patient confidentiality. Records were excluded if the source of admission indicated transfer from another hospital to avoid double counting patient stays for the same episode of care. Discharges were also excluded if the patient residence was not in the same state as the hospital. In Texas, certain short-term acute care hospitals were not required to report their data. We matched reporting hospitals to a complete list of hospitals as recorded by Centers for Medicare and Medicaid Services Provider of Services files to determine non-reporting hospitals (Centers for Medicare and Medicaid Services). Hospitals accounting for 98 percent of acute discharge days in Texas had full data over the study period (authors' calculations). We excluded patients observed in the data who resided in a county that had a non-reporting hospital as we did not observe all hospital discharges for these locations; this was a small subset (0.76%) of the

[1] Hospitals located in counties with population less than 35,000; those located in counties with population greater than 35,000 but with fewer than 100 hospital beds and not in a Census-designated urban area; and those that do not seek insurance payment or government reimbursement are exempt from the reporting requirements (Texas Department of State Health Services Center for Health Statistics).

sample with marker or ACS conditions. Additionally, we excluded discharges that had missing gender, primary payer, or length of stay information.

We included discharges that were identified as ACS conditions using the Prevention Quality Indicators Module of the QI SAS ® software, Version 4.4 (Agency for Healthcare Research and Quality). These consisted of discharges for diabetes short- and long-term complications, chronic obstructive pulmonary disease or asthma, hypertension, heart failure, dehydration, bacterial pneumonia, urinary tract infection, angina, uncontrolled diabetes, and lower-extremity amputation for patients with diabetes. These conditions are considered preventable with high-quality outpatient care (Agency for Healthcare Research and Quality). We also included discharges that were identified as marker conditions (Billings). These included discharges for appendicitis with appendectomy (ICD-9 codes 540, 541, or 542 with principal procedure of 47.0 or 47.1), acute myocardial infarction (ICD-9 code 410 with length of stay greater than 5 days or disposition of death), intestinal obstruction (ICD-9 code 560), and hip/femur fracture (ICD-9 code 820 for those ages 45 and older). These conditions are not considered preventable in the short-term (weeks to months) and thus there should be minimal fluctuation in rates across regions (Billings). For a very small number of cases (n=61), the discharge contained both an ACS and marker condition; we assigned these to the marker condition.

Outcomes and Covariates

The outcome variable was a binary indicator for each discharge where a value of one indicates that the admission was ACS and a value of zero indicates that the admission was a marker condition. We estimated the association between this outcome and a vector of lagged homicide rates in the Mexican municipality adjacent to the border crossing nearest the patient's residence. Mexican municipalities were matched to patient residence using Google maps to find driving distances (Caruso and Médard de Chardon); the match was done using the most specific location information available in the discharge data. The majority of discharges (97%) were matched based on 5-digit ZIP code of patient residence. Where the 5-digit ZIP code was not available due to censoring, we used 3-digit ZIP codes and county of residence. Homicide rates were calculated on a monthly basis using data on the number of homicides from the Mexican National Institute of Statistics and Geography (INEGI; Instituto Nacional de Estadistica y Geografia) and matched to admission month. For the denominator of the homicide rate, population estimates were available in 2005 and 2010; intercensal year populations were estimated using linear interpolation. Patient demographics including age category (18-39 years and 40-64 years), sex, and primary payer were available from the discharge data. Patient socioeconomic status was measured using the 2008 ZIP code level income quartile calculated using median household income for the four states in the US-Mexico border region (CA, NM, AZ, TX) (Nielsen-Claritas) county level unemployment rates (United States Department of Labor Bureau of Labor Statistics). Regional characteristics included annual county level physician to population ratios (US Department of Health and Human Services) and a categorical indicator of metropolitan status (i.e., metropolitan, micropolitan, neither) (United States Census Bureau).

Statistical Methods:

We adapt the empirical technique developed by Basu and colleagues (2002) using a model based at the discharge, rather than area, unit of analysis. This allows for a careful base case to which for comparison of the presence of ACS hospitalization. The marker conditions are a somewhat homogenous group of conditions unlikely to have substantial variation in incidence over time or be influenced by physician or specialist supply in the region (Basu, Friedman, and Burstin). This technique was as the border region is growing rapidly in population (United States-Mexico Border Health Commission) and thus there may be differential measurement error in population estimates between border and non-border counties. Furthermore, using this technique minimizes the impact of missing data due to demographic censoring in California and non-reporting hospitals in Texas.

The empirical model was specified as follows using a logit model:

$$\Pr(ACSadmission_{dast}=1|X_{dcst}) = \exp\{X\beta\}/(1+\exp\{X\beta\})$$

with $X\beta = \beta_0 + \beta_1 H_{as,lag(t)} + \beta_2 Border_{as} + \beta_3 (H_{as,lag(t)} * Border_{as}) + \beta_4 X_{dast} + \beta_5 Z_{ast} + \mu_s + m_t + y_t$

(Eqn 1)

where *d* indexes the discharge, *a* indicates the area (e.g., ZIP code level), *s* indicates the state, and *t* is the time period (admission month). The outcome variable, *ACSadmission*, is a binary indicator as described; *H* is a vector of three months of lagged homicide rates in the nearest Mexican municipality (i.e., t-1, t-2, and t-3); *Border* is a binary variable indicating whether the area is within a border county; *X* is a vector of individual characteristics from the discharge data including age, sex, insurance status, and state of residence; *Z* is a vector of regional characteristics including county physician supply, ZIP code level income quartile, county unemployment rates, and county metropolitan status; μ_s are state level fixed effects to control for time-invariant state characteristics; m_t are admission-month[2] fixed effects to control for seasonality in hospital utilization; and y_t are year fixed effects to control for secular trends in

[2] For Arizona, discharge month and year were available instead of admission. Since the mean length of stay in the sample is 4.4 days, the practical difference between discharge month-year and admission month-year is negligible and we use the discharge date as the admission date.

hospital discharges. In California, only admission quarter was available in the data; we randomly assigned each discharge to a month within a quarter. Robust standard errors were used.

The marginal effect of interest is, for patients residing in border counties, the change in probability of a discharge being for an ACS condition rather than a marker condition associated with a one unit increase in the homicide rates for the three months prior (i.e., combined β_3). Bias corrected confidence intervals were calculated for the combined marginal effect using bootstrapping with 100 replications. Additionally, we calculate the average marginal effect for patient residence in a border county and use the delta method to calculate standard errors for this effect.

Dataset construction and ACS/marker identification were conducted using SAS 9.2 (SAS Institute; Cary, NC); regression analyses used Stata 12.1 (StataCorp; College Station, TX). An alpha level of 0.05 was considered statistically significant.

Subgroup Analyses:

We did subgroup analyses to determine whether certain subgroups that were *a priori* expected to be more likely to seek care in Mexico were differentially affected by the increased homicides. Specifically, we examined changes in the probability of being discharged for an ACS condition in two subgroups: the uninsured and underinsured (i.e., discharges with the primary payer of self-pay, charity care, no charge, or Medicaid) and those residing in ZIP codes in the lowest income quartile. We included discharges for patients with a primary payer of Medicaid as patients may enter the hospital without knowledge that they are eligible for Medicaid and be retroactively insured in the program (Chattopadhyay and Bindman); additionally, interruptions in Medicaid coverage are common (Bindman, Chattopadhyay, and Auerback).

Sensitivity Analyses:

In addition to the subgroup analyses, we conducted three sensitivity analyses. Since individuals may take time to update their preferences surrounding the risk of seeking care in Mexico, it is not immediately obvious which homicide rate has the most effect on patient behavior. As the primary analysis and subgroup analyses were conducted using a vector of the three month lag of homicide, we estimate a specification using only the one month lagged homicide rate (i.e., t-1).

As there was more censoring of patient demographic data (e.g., sex, age, admission month) in the California discharge data than in the Texas or Arizona data, we conducted a sensitivity analysis restricted to these two states and including age in five-year categories.

Information on patient race was available in the discharge data, but was not included in the main analysis as these data are often inconsistent with patient reports of race/ethnicity (Moscou, Anderson, Kaplan, and Valencia). We conducted a sensitivity analysis including a categorical indicator of patient race. If race information was missing, we grouped this in with "Other" race.

Results:

Analytic Sample:

The analytic sample included 1,873,407 discharges containing an ACS or marker condition (Figure 1). Approximately 10% of total hospital discharges for those aged 18-64 were for ACS or marker conditions. Of these 1,873,407 discharges, 1,503,590 (78%) were for ACS conditions. Patient residences matched to 24 unique Mexican municipalities. The plurality of matches was to Tijuana, with 46.2% of discharges.

383,796 (20.5%) discharges were for patients residing in a border county (Table 1). When compared with discharges in non-border counties, discharges in border counties were less likely to be for ACS than marker conditions. Discharges were significantly more likely to be in Arizona, with 49.4% of discharges in border counties in Arizona. Discharges for patients in border counties were more likely to be covered by Medicaid and had shorter length of stay. Discharges were more likely to be for male, younger (18-39 years), and Hispanic patients in border counties than non-border counties. Discharges in border counties were more likely to have patient residence in areas with higher unemployment rates and lower income quartiles. Physician supply was lower for discharges in border counties.

Analysis:

Results for the estimation of Equation 1 (Table 2) show a significant positive association between homicide rates and the relative probability of being discharged for an ACS versus marker condition in border counties. A one unit increase (1 homicide per 100,000 population) in the homicide rate persistent over the three months prior was associated with a 0.36 percentage point increase in the probability of being discharged for an ACS condition versus marker for patients in border counties. Using this marginal effect, an increase of one standard deviation (6.1 homicides per 100,000 population) was associated with a 2.2 percentage point increase in the probability of being discharged for an ACS condition versus marker for those in border counties. As expected, in non-border counties there was no association between homicide rates and the probability of being discharged for an ACS versus marker condition.

Patient residence in a border county was associated with a 1.3 percentage point decrease in the probability of being discharged for ACS versus marker controlling for covariates included in the model. Patients residing in higher income ZIP codes were less likely to be discharged for an ACS condition, as were men, those with private insurance, those living in a metropolitan area, and younger patients. Higher physician supply in the county of patient residence was associated with a lower likelihood of being admitted for an ACS condition.

Subgroup Analyses:

For the uninsured and underinsured, the effects of homicide rates are similar but of slightly larger magnitude than those in the full sample (Table 3; Panel A). For discharges where the primary payer was self-pay, charity care, no charge, or Medicaid, there was a significant positive association between homicide rates and the relative probability of being discharged for an ACS versus marker condition in border counties. In border counties, a one unit increase (1 homicide per 100,000 population) in the homicide rate persistent over the three months prior was associated with a 0.47 percentage point increase in the probability of being discharged for an ACS condition versus marker. Patient residence in a border county was, on average, associated with a 1.7 percentage point decrease in the probability of being discharged for ACS versus marker controlling for covariates included in the model.

For patients residing in ZIP codes in the lowest income quartile , the association between homicide rates and the probability of being discharged for an ACS condition in border counties was slightly smaller in magnitude and not significant at the 5% level (Table 3; Panel B). For this population, patient residence in a border county was, on average, associated with a 2.2 percentage point decrease in the probability of being discharged for ACS versus marker condition controlling for covariates included in the model.

Sensitivity Analyses:

We examined a one month lagged homicide rate in place of the vector of lagged rates used in the primary analyses (Table 4; Panel A). For the main analytic sample, the results were qualitatively similar; a one unit increase in the lagged homicide rate was associated with a statistically significant 0.19 percentage point increase in the probability of a discharge being for an ACS versus marker condition in border counties. The effect was not significant in non-border counties.

When the sample was limited to discharges in Texas and Arizona, results were similar in magnitude and direction to the primary analysis (Table 4; Panel B). For patients in border counties, a one unit increase in the homicide rate persistent over the three months prior was associated with a statistically significant 0.34 percentage point increase in the probability of being discharged for an ACS versus marker condition. The effect in non-border counties was smaller but was statistically significant, with homicide rates positively associated with probability of being discharged for an ACS versus marker condition. Patient residence in a border county was, on average, associated with a statistically significant 1.5 percentage point decrease in the probability of being discharged for an ACS versus marker condition.

Finally, we controlled for race in addition to the other covariates in the model using the main analytic sample. Results showed that results of the association with homicides was very similar to the primary analysis (Table 4; Panel C), with a significant positive association between homicide rates and the probability of being admitted for an ACS versus marker condition. There was a smaller but statistically significant positive relationship in non-border counties as well. After controlling for race, patient residence in a border county was, on average, associated with a statistically significant 0.2 percentage point decrease in the probability of being admitted for an ACS versus marker condition. Being African-American was associated with significantly higher odds of being discharged for an ACS versus marker condition than being white. Being of Hispanic race is associated with lower odds of being discharged for an ACS marker condition than being white.

Discussion:

We use a common measure of access to ambulatory care with an innovative method using patient level hospital discharge data to examine the impact of homicides in northern Mexico on access to care in US border counties over the period of 2005-2010. Using data on hospital discharges in California, Arizona, and Texas, we found a positive relationship between homicide rates in the nearest Mexican municipality and the probability of being discharged for an ACS versus marker condition for patients residing in border counties, but no significant association in non-border counties. To interpret the effect, an increase of one standard deviation (6.1 homicides per 100,000 population) was associated with a 2.2 percentage point increase in the probability of being discharged for an ACS versus marker condition. The size of this effect is similar to the change in patient access resulting from a nearby safety net hospital closure in California during the 1990-2000 period (Mobley, Kuo, and Bazzoli). The association between homicide rates and the probability of being admitted for an ACS versus marker condition was stronger for the un- and underinsured, but was not significant for patients residing in a ZIP code in the lowest income quartile among border states. The results in border counties persisted when changing the specification of the homicide rate measure and when controlling for more precise age categories and patient race.

These results suggest two important findings: a) access to ambulatory care in Mexico may be reduced due to the violence in northern Mexico, with measurable changes in potentially preventable hospitalizations, and b) access to ambulatory care in Mexico may contribute to lower than expected rates of ACS conditions in US hospitals. Reducing hospitalizations for ACS conditions is an important policy priority to reduce healthcare costs (Agency for Healthcare

Research and Quality 2011), and thus recognizing and ameliorating barriers to accessing outpatient care is important.

Patient residence in a border county is associated with a reduced probability for being discharged for an ACS versus marker condition. This is true after controlling for local economic conditions, patient age, insurance status, and physician supply. The effect is smaller, but still statistically significant, when controlling for patient race. This suggests that while border counties are underserved (United States-Mexico Border Health Commission) and affected by reduced access to ambulatory care in Mexico in some regions, residents are better able to access ambulatory care than is suggested by the regional physician supply. This may mean that efforts in border regions such as provision of free care by public health departments in border regions to immigrant communities may be having a measurable positive impact on access for these populations. Additionally, the cross border care available in Mexico likely contributes to this improved access, despite changes due to the violence in northern Mexico. This may have important policy implications, including the expansion of cross-border health insurance products, which to this point have been limited in scope (Bustamante, Ojeda, and Castaneda).

Our analysis has several limitations. First, we were not able to fully control for healthcare access. We included controls for physician supply, but physician supply may not be a direct proxy for access to care for individuals (Grumback, Vranizan, and Bindman). This is particularly true in the border region, where there may be free or low-cost services provided to certain population subgroups. Second, if there are compensatory responses in the border region to reduced access due to violence, the results will underestimate the effect of changes in access to care in Mexico. There may have been additional changes in outpatient access during this period, including the expansion of retail clinics (Laws and Scott), reduction in the prices of generic prescriptions in the US (e.g., $4 prescriptions) (Zhang, Gellad, Zhou, Lin, and Lave ; Zhang, Zhou, and Gellad), and possible relocation of Mexican physicians and pharmaceuticals to the US with illegal practice and distribution (Homedes). Third, we have limited patient demographic data and significant censoring of age and gender in California; we have done analyses to determine whether the results are sensitive to this censoring and found that it was not. We cannot test sensitivity for the 9% of discharges in the data with missing age, as we cannot classify these discharges as to whether they are for ACS or marker conditions. As the censoring was based on administrative rules, we do not expect that this would have a differential effect related to the association between homicide rates and ACS/marker conditions.

We have shown that there was an increase in potentially preventable hospitalizations versus hospitalizations for marker conditions in border counties associated with increased homicide rates in the 2005 to 2010 period. This may indicate that there is reduced access to ambulatory care in Mexico, which is crucial for a population with high poverty and uninsurance rates that may rely heavily on this care for health needs (Su, Richardson, Wen, and Pagan). Mitigating this reduction in access is a crucial step for policymakers and health professionals in the border region as the violence continues to be widespread, and reducing preventable hospitalizations may be an important way to improve efficiency and reduce costs in the US healthcare system (Agency for Healthcare Research and Quality 2012).

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Figure 1: Construction of Analytic Sample

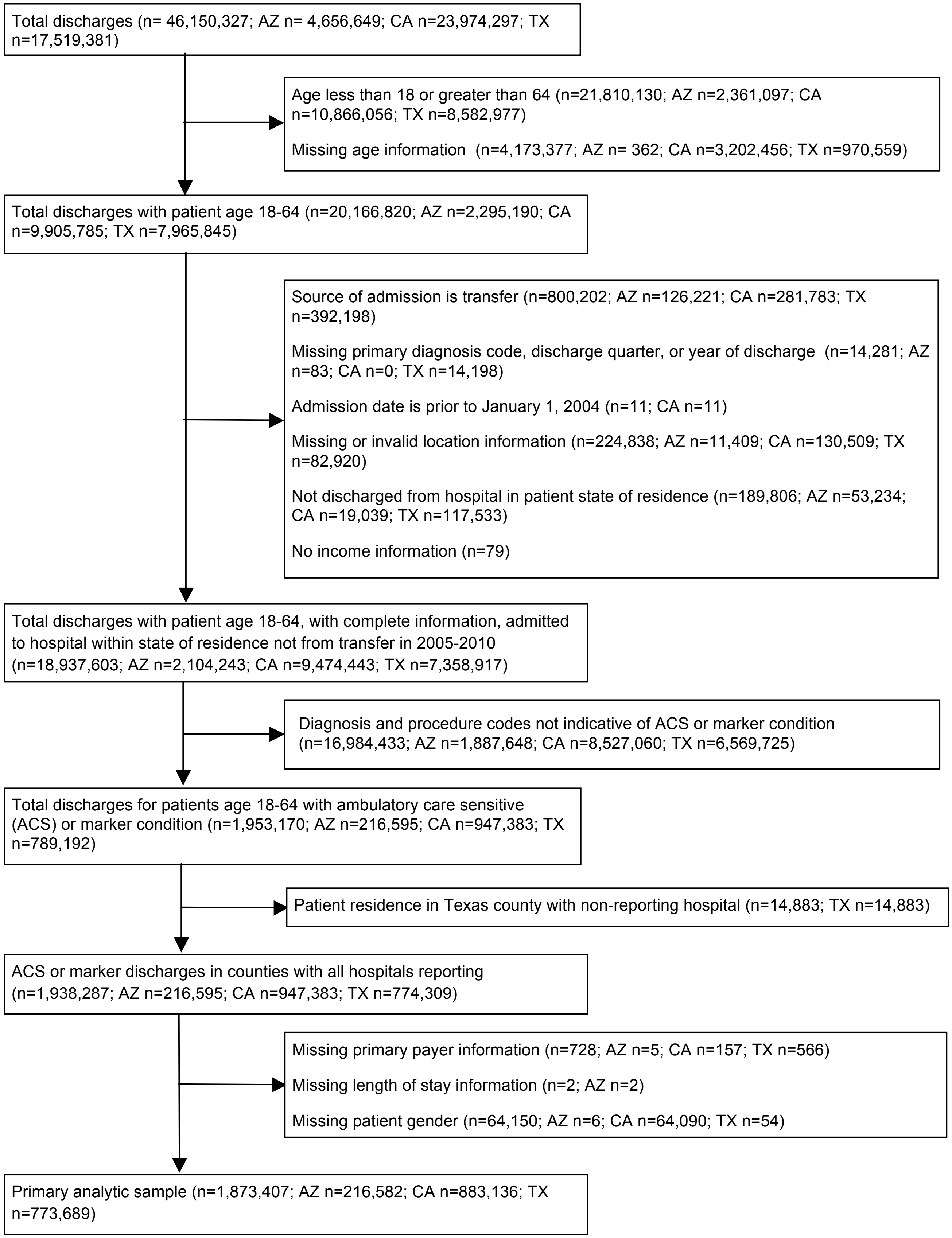

Table 1: Summary Statistics for Analytic Sample

	Patient Residence in Border County			
	Overall (N= 1,873,407)	**Non-Border** (N= 1,489,611)	**Border** (N= 383,796)	p
	Mean (Standard Deviation) or %			
Ambulatory Care Sensitive Condition (1) versus Marker (0)	78	78.3	76.9	<0.001***
Homicide Rate per 100,000 Population in Matched Municipality	3.1 (6.5)	2.6 (5.6)	5.1 (9.1)	<0.001***
Patient State of Residence				<0.001***
AZ	11.6	1.8	49.4	
CA	47.1	51.2	31.5	
TX	41.3	47	19	
Primary Payer				<0.001***
Medicare	19.3	19.5	18.4	
Medicaid	23.2	21.8	28.6	
Private Insurance	36.5	36.6	36.3	
Self-Pay/Uninsured	11	11.7	8.6	
No Charge	5.4	5.9	3.5	
Other	2.6	2.5	3.2	
Government	1.9	2	1.5	
Patient Gender				<0.001***
Male	46.4	46.2	47.4	
Female	53.6	53.8	52.6	
Age Category				<0.001***
18-39 years	24.6	23.9	27.3	
40-64 years	75.4	76.1	72.7	
Patient Race/Ethnicity				<0.001***
White	48.3	48	49.3	
Black	14.8	16.9	6.7	
Hispanic	19.3	16.4	30.6	
Asian/Pacific Islander	2.2	2.4	1.4	
Native American	0.7	0.5	1.7	
Other or Missing	14.6	15.7	10.3	
Length of Stay (Days)	4.4 (5.3)	4.4 (5.4)	4.3 (4.9)	<0.001***
Year of Discharge	2007.5 (1.7)	2007.5 (1.7)	2007.6 (1.7)	<0.001***
Admission Month	6.4 (3.5)	6.4 (3.5)	6.4 (3.5)	<0.001***
County Unemployment Rate	7.1 (3.3)	7.0 (3.1)	7.3 (3.8)	<0.001***
Income Quartile of Patient Residence (5-digit ZIP)				<0.001***
0 to 24th percentile (less than	28.5	27.2	33.7	

$48,850)				
25th to 49th percentile ($48,850-$63,953)	27.2	27.7	25.2	
50th to 74th Percentile ($63,954-$88,000)	26.1	25.6	28	
75th to 100th percentile ($88,001 and greater)	18.2	19.5	13	
County Metropolitan Status				<0.001***
Neither	2.4	2.7	1.3	
Micropolitan Area	4.7	5.1	3.1	
Metropolitan Area	92.8	92.1	95.6	
County MDs per 1,000 Population	2.3 (1.0)	2.4 (1.1)	1.9 (0.8)	<0.001***
Driving Distance (km) to Nearest Border Crossing	430.6 (263.7)	506.3 (238.9)	136.9 (96.9)	<0.001***
Any ACS Condition Discharge	78	78.3	76.9	<0.001***
Acute ACS Condition Discharge	27.8	27.5	28.9	<0.001***
Dehydration	6.5	6.3	7.2	<0.001***
Bacterial Pneumonia	13	13.1	12.8	<0.001***
Urinary Tract Infection	8.3	8.1	9	<0.001***
Chronic ACS Condition Discharge	50.2	50.8	48	<0.001***
Diabetes Short Term Complication	6.2	6.2	6.3	0.004**
Diabetes Long Term Complication	9.8	9.6	10.6	<0.001***
COPD or Asthma in Older Adults	12.4	12.7	11.1	<0.001***
Hypertension	3.5	3.5	3.4	0.06
Congestive Heart Failure	12.4	12.9	10.5	<0.001***
Angina	1.9	2	1.7	<0.001***
Uncontrolled Diabetes	1.4	1.4	1.6	<0.001***
Asthma in Younger Adults	2.1	2.1	2.3	<0.001***
Lower Extremity Amputation in Diabetic	1.2	1.2	1.1	<0.001***
Any Marker Condition	22	21.7	23.1	<0.001***
Appendicitis with Appendectomy	11	10.8	12	<0.001***
Acute Myocardial Infarction	2.8	2.8	2.9	<0.001***
Intestinal Obstruction	6.8	6.8	6.7	0.17
Hip Fracture	1.4	1.4	1.5	<0.001***

P-values by t-test for continuous variables and chi2 test for binary / categorical variables

* p<0.05, ** p<0.01, *** p<0.001

Table 2: Regression estimation results

Panel A: Marginal effects

	Marginal Effect	95% Confidence Interval §
Patient residence in border county	-0.01306*	[-0.01494, -0.01117]
Combined effect of lagged homicide rates in border county	1.003623*	[1.00249, 1.00512]
Combined effect of lagged homicide rates in non-border county	1.00061	[0.9997, 1.0015]

Panel B: Full regression results for primary sample

Variable◆	Odds Ratio	Robust Standard Error
Patient residence in border county	0.9134*	(0.0060)
1-month lag of homicide rate	1.0005	(0.0004)
1-month lag of homicide rate * border county	1.0009	(0.0007)
2-month lag of homicide rate	1.0003	(0.0005)
2-month lag of homicide rate * border county	1.0002	(0.0007)
3-month lag of homicide rate	0.9998	(0.0005)
3-month lag of homicide rate * border county	1.0019*	(0.0007)
Age Category (18-39 years)	0.4808*	(0.0019)
State		
Arizona	1.0037	(0.0080)
Texas	1.2187*	(0.0061)
Unemployment Rate	0.9942*	(0.0010)
Income Quartile (reference group = 1st – lowest quartile [less than $48,850])		
2nd [$48,850-$63,953]	0.9148*	(0.0049)
3rd [$63,954-$88,000]	0.7831*	(0.0042)
4th – highest quartile [$88,001 and greater]	0.5885*	(0.0034)
Metropolitan Area	0.9745*	(0.0082)
Physician Supply (MDs per 1,000 population)	0.9643*	(0.0020)
Male	0.7670*	(0.0028)
Primary Payer (reference group = private insurance)		
Medicare	2.9591*	(0.0177)
Medicaid	2.8101*	(0.0150)
Self-Pay/Uninsured	1.5884*	(0.0096)
No Charge	1.7373*	(0.0146)
Other	1.3526*	(0.0151)
Government	1.2378*	(0.0156)
Number of Observations	1,873,407	
Psuedo-R^2	0.071	

* indicates significance at a 95% confidence level.

§ Confidence interval for marginal effect of patient residence in border county is calculated using the delta method. Confidence intervals for combined marginal effects of lagged homicide rates are calculated using bias corrected bootstrapping methods with 100 repetitions.

◆Controls for month and year of admission/discharge were also included. Omitted categories are Patient Residence - California, 18-39 years, Lowest Income Quartile, and Primary Payer - Private Insurance. Robust standard errors were used.

Table 3: Subgroup Analyses

Panel A: Uninsured and underinsured subgroup		
	Marginal Effect	**95% Confidence Interval §**
Patient residence in border county	-0.01306*	[-0.01494, -0.01117]
Combined effect of lagged homicide rates in border county	1.00362*	[1.00249, 1.00512]
Combined effect of lagged homicide rates in non-	1.00061	[0.9997, 1.0015]

Panel B: Lowest income quartile subgroup		
	Marginal Effect	**95% Confidence Interval §**
Patient residence in border county	-0.0175	[-0.0202,-0.0148]
Combined effect of lagged homicide rates in border county	1.0048*	[1.0022,1.0069]
Combined effect of lagged homicide rates in non-border county	0.9994	[0.9979,1.0015]

* indicates significance at a 95% confidence level.

§ Confidence interval for marginal effect of patient residence in border county is calculated using the delta method. Confidence intervals for combined marginal effects of lagged homicide rates are calculated using bias corrected bootstrapping methods with 100 repetitions.

Table 4: Sensitivity Analyses

Panel A: One-month lag of homicides

	Marginal Effect	**95% Confidence Interval §**
Patient residence in border county	-0.0129*	[-0.0148, -0.0110]
Effect of lagged homicide rates in border county	1.0019*	[1.0010, 1.0028]
Effect of lagged homicide rates in non-border county	1.0005	[0.9997, 1.001]

Panel B: Arizona and Texas with five-year age categories

	Marginal Effect	**95% Confidence Interval §**
Patient residence in border county	-.01590*	[-0.0189, -0.0129]
Combined effect of lagged homicide rates in border county	1.0034*	[1.0019, 1.0051]
Combined effect of lagged homicide rates in non-border county	1.0028	[1.0014, 1.0037]

Panel C: Inclusion of categorical race indicators

	Marginal Effect	**95% Confidence Interval §**
Patient residence in border county	-.0023*	[-.0041339 -.0004547]
Combined effect of lagged homicide rates in border county	1.0033*	[1.0022, 1.0048]
Combined effect of lagged homicide rates in non-border county	1.00179*	[1.00078,1.00281]

* indicates significance at a 95% confidence level.

§ Confidence interval for marginal effect of patient residence in border county is calculated using the delta method. Confidence intervals for combined marginal effects of lagged homicide rates are calculated using bias corrected bootstrapping methods with 100 repetitions.