A retrospective analysis of emergency department usage in rural and semi-urban indigenous Guatemalan populations

Emma L. Svenson,[1] Amber Sheth,[1] Jessica Schmidt,[2] Rafael Tun,[3] James E. Svenson[2]

[1]University of Wisconsin-Madison School of Medicine and Public Health, Madison, Wisconsin; [2]Department of Emergency Medicine, University of Wisconsin-Madison School of Medicine and Public Health, Madison, Wisconsin, USA; [3]Hospital Parroquial de San Lucas Tolimán, San Lucas Tolimán, Guatemala

Abstract

Functioning healthcare systems provide emergency medical care. Disparities exist in accessibility and availability of emergency care in low- and middle-income countries. We present a descriptive epidemiologic analysis of Emergency Department (ED) usage in a rural, indigenous Guatemalan population. San Lucas Tolimán is situated in central Guatemala. Hospital Parroquial de San Lucas offers emergency care to San Lucas Tolimán and surrounding villages. All ED visits between January 1st, 2016 and December 31st 2018 were recorded and analyzed. During the study period, 12,229 patient encounters occurred. Almost all patients identified as indigenous. Children comprised 43% of visits. Medical issues represented a majority (83%) of complaints. Respiratory (40%) and gastrointestinal disease (26%) were frequent presenting complaints. Almost all visits (83%) occurred during the day and evening hours. Trauma/surgical complaints were slightly more frequent at night. 93% of patients were discharged, while the rest were admitted or transferred. These data contribute to understanding of disease burden and emergency care needs and capacity in rural areas of low- and middle-income countries. This information may be used to inform local policy decisions, identify research priorities, and create training topics for local health care providers in Guatemala and other countries in this region.

Introduction

The provision of emergency medical care is a crucial component of successful healthcare systems.[1] Emergency care is a primary response to time-sensitive medical conditions such as trauma, obstetric complications, or ischemic cardiovascular disease, and prevents significant morbidity and mortality associated with these acute conditions. Emergency care also represents an entry point for access to additional specialized care, providing crucial preventive health services at a population level.[2–4] In nations where a significant portion of people are uninsured or underinsured, and lack access to primary care providers, emergency departments are even becoming point of care for non-urgent medical conditions.[5,6] A lack of emergency care infrastructure is thus linked to poorer health outcomes, and ensuring access to emergency medical care is being prioritized as a mechanism to improve overall population health on a global scale.[1,3,4,7]

While emergency medical systems are often robust in high-income countries, significant obstacles exist to developing, delivering and accessing emergency care in low- and middle-income countries.[8,9] Lack of transportation to medical facilities, affordability of services, poor facility infrastructure, decreased availability of medical supplies and medications, and a paucity of skilled emergency providers and emergency training programs are all frequently cited barriers to providing effective acute care in these settings.[2,10–15] Yet Lower- and Middle-Income Countries (LMIC) frequently shoulder a significant burden of critical acute illness.[13] For example, recent estimates suggest that ninety percent of trauma related deaths occur in LMIC.[13,16] In addition to the burden of infectious diseases, the acute health sequelae associated with non-communicable diseases, including diabetes and heart disease, are also on the rise in these areas.[2,13,17–20] Based on the rising burden of acute illness in LMIC, there is a growing impetus to understand emergency care needs and strengthen capacity.[20–25]

Little is known about access to, and availability of, emergency care in Central and South America.[9,11] Guatemala is the most populous nation in Central America. Since 1999, the Guatemalan Ministry of Health has undertaken initiatives to develop pre-hospital and in-hospital emergency care, and advanced disaster preparedness on a national level.[12] However, hospital emergency departments are typically staffed by rotating physicians and medical students without formal emergency medical training. It is only recently that international partnerships have led to the establishment of Guatemala's sole emergency medicine residency at the Universidad de San Carlos de Guatemala, with the first matriculated class of residents entering the program in 2019.[12,26,27] Although there is increasing access to emergency medical care in urban areas, provision of emergency services to rural areas is not widespread.[12] Strikingly, up to fifty-five percent of Guatemala's population inhabit geographically isolated rural regions, the majority of which is indigenous Mayan.[28]

Indigenous populations often face unique challenges to accessing emergency medical care.[28–34] Although Guatemala ranks as a middle-income country based on Gross Domestic Product (GDP), extreme

Correspondence: Emma L. Svenson, University of Wisconsin-Madison School of Medicine and Public Health, Madison, Wisconsin.
Tel.: 608.216.5396
E-mail: svenson@wisc.edu

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income inequality endures, with 79% of Guatemala's indigenous population living in poverty.[28,35] Routine preventive care and medications can be obtained free of charge at government run health centers (*centros de salud*) throughout Guatemala; however, poor staffing, long wait-times and lack of medical supplies at these free, government-sponsored public hospitals drives rural residents to seek care both routine and emergency care at private hospitals, where the high out-of-pocket cost of medical care can act as a deterrent to seeking treatment. Furthermore, widespread discrimination at biomedical institutions, including both physical and mental abuse, remains a common experience for indigenous patients.[28,36–40] These barriers can be compounded by different cultural understanding of what constitutes a medical emergency, particularly in the case of obstetric emergencies.[41–43]

To our knowledge, there have been limited studies examining emergency medical services in Guatemala, with few specifically examining acute care needs and emergency medical service utilization in rural and semi-urban indigenous populations. The scope of these articles is narrowly focused on emergency training program development, pre-hospital care, and pediatric case management. [12,44–47] Therefore, the goal of this study is to provide a basic descriptive analysis of an Emergency Department (ED) located in rural Guatemala, to better define acute disease burden and emergency care needs in a representative rural Guatemalan community.

Materials and Methods

San Lucas Tolimán is located on the Southeast shores of Lake Atitlán and is considered part of the Guatemalan highlands. San Lucas Tolimán is home to a population of 17,000 people living in a semi-urban central village, with an additional 14,000 people living in 19 surrounding rural communities. A majority of its population identifies as indigenous Mayan.[48,49] The impact of recent civil war and genocide is substantial and persistent in these mountain communities, with substantial cultural and socioeconomic barriers limiting access to education, basic sanitation, and healthcare.[50,51] The average yearly income in the San Lucas Tolimán area is less than 1,000 U.S. dollars (USD), or the equivalent of $3 USD per day.[49,52,53]

Multiple healthcare practices are present in the San Lucas area. For example, government run health centers (*centros de salud*) provide free primary care services to San Lucas and surrounding communities. Residents have identified poor staffing and supply shortages as deterrents to seeking care at these institutions.[52] An IGSS (Instituto Guatemalteco de Seguridad Social) is located in the town proper, and also provides free, routine health services to certain patients and employers who pay into the IGSS system. As of 1995, only 16% of Guatemala's total population was covered through the IGSS, indicating that this service is not accessible to many Guatemalans.[54–57] Several private clinics are also present in the town proper.[53] Emergency care is available to residents of San Lucas Tolimán at hospitals in neighboring municipalities, such as the Hospitalito Atitlán or Hospital Nacional de Sololá. Emergency care is also available closer to home at the Hospital Parroquial de San Lucas Tolimán (Hospital Monseñor Gregorio Schaffer), and this hospital is the focus of this study.[35,58]

A nonprofit organization, The Friends of San Lucas, in association with the San Lucas Mission, provides social services based on community needs, and helped establish a low-cost private hospital in San Lucas Tolimán in the late 1990's, Hospital Parroquial de San Lucas Tolimán (Hospital Monseñor Gregorio Schaffer). This hospital regularly employs one physician (on call 24 hours/day), along with several nurse practitioners, who help staff the emergency department after normal business hours. The hospital partners with an established health promoter program and volunteer international healthcare providers to offer basic medical care and health education onsite to neighboring communities and within San Lucas's town proper. The hospital also coordinates with internationally based physicians to offer advanced surgical, ophthalmologic, and dental care, among other specialties. A daily clinic is offered on a first come-first serve basis by the hospital's regularly employed physician. Emergency care is also available twenty-four hours a day at the hospital, a fact that is well-known in the community, and that is advertised on the hospital's website and social media sites, among other media sources. The emergency department includes an ambulance available for emergency transport. Referrals to other hospitals are made as necessary.[48,49,59–61]

Over a three-year period between January 1st, 2016 and December 31st, 2018, all ED visits to Hospital Parroquial de San Lucas Tolimán were collected and entered into an Excel database by hospital staff at time of visit. The information gathered for each patient encounter included age, gender, whether or not an individual was indigenous, municipality/department/country of origin, date and time of service, chief complaint, category of chief complaint, if medical or surgical treatments were recommended, and if follow-up care was required. Categories of chief complaint were designated by hospital staff included abdominal, auditory, cardiovascular, dermatologic, diarrheal/parasitic, gynecologic, hematologic, infectious, neurologic, nutritional, ophthalmologic, dental, post-operation, surgical, renal/urinary, respiratory, rheumatic/endocrine, traumatic, premature, not diagnosed, or other.

All analyses were performed using SAS v 9.4 (SAS Corporation, Cary, NC). Groups were compared using student's t-test for continuous variables, or with Fisher's exact or Mantel Haenzel Chi Square test for categorical variables. Variations between multiple variables were carried out with logistic regression for dichotomous variables, or generalized linear models for categorical variables with multiple outcomes.

This study was determined to be exempt by the Institutional Review Board at the University of Wisconsin-Madison, as defined by the Federal Regulations for Protection of Human Research Subjects. This study was also reviewed and approved by the medical board of the Friends of San Lucas mission prior to accessing and analyzing data, which includes both local hospital staff and international partners. It was conducted with the full support of the Hospital Parroquial de San Lucas Tolimán, the Friends of San Lucas, and the San Lucas Mission.

Results

Demographic information

Between January 1st 2016 and December 31st 2018, a total of 12,229 patient encounters were recorded, 46.15 (N=5644) male and 53.85% (N=6585) female. The average age was 24.0±23.8 years for males and 29.0 ± 24.0 years for females ($p<0.01$). The age distributions of patients presenting to the ED were similar for both sexes as shown below in Figure 1, although a slightly greater proportion of patients were male in each age category below 18 years, whereas a greater proportion of patients were female in each age category over 18 years.

Children < 18 years old represented 43% of all patient visits to the ED, shown in Figure 2.

Almost all patients presenting to the ED were indigenous (92.1%, N=11248). Female patients comprised the bulk of both indigenous and non-indigenous patient vis-

its to the ED, 53.23% and 61.06% respectively. Non-indigenous patients tended to be older, with an average age of 34.61±26.18 compared to 26.0±23.71 (p=0.001).

Patient origin

Guatemala is divided into 22 departments, and further subdivided into 331 administrative districts called municipalities.[51,62] During the time period of our study, almost all patients presenting to the ED reported primary residence in Sololá (N=11,430, 93.5%), the department in which Hospital Parroquial de San Lucas Tolimán is located. The remaining patients were from 14 other departments scattered throughout Guatemala, 6.06% (N=741), or from foreign countries, 0.46% (N=58). Guatemalan departments represented at the ED included Alta Verapaz, Jutiapa, Petén, Retalhuleu, Totonicapán, Suchitepéquez, Santa Rosa, San Marcos, Quiche, Quetzaltenango, Huehuetenango, Escuintla, Chimaltenango and La Ciudad de Guatemala. Patients from foreign countries included residents of England, Germany, Belize, El Salvador, Spain and the United States.

The department of Sololá was examined at a more granular level. Within this department, the municipality of San Lucas Tolimán was the primary residence for most patients presenting to the ED, 90.09% (N=9803). Nine other municipalities in Sololá were represented, although a bulk of patients came from municipalities bordering San Lucas Tolimán, including San Antonio Palopó (5.11%, N=556) and Santiago Atitlán (4.34%, N=472). As mentioned previously, the municipality of San Lucas Tolimán includes the semi-urban town of San Lucas Tolimán, with numerous rural communities surrounding the town proper. Of the 9,803 residents residing in San Lucas Tolimán, 88.92% (N=8,717) lived in the town proper, and 11.08% (N=1,086) lived in surrounding rural communities.

Temporal and seasonal variability

Over a three-year span, a slight increasing trend in annual presentations was observed. Of the 12,229 total patient encounters recorded, 29.98% (N=3,666) occurred in 2016, 32.43% (N=3,966) occurred in 2017, and 37.59% (N=4,597) occurred in 2018. This trend was significant (p<0.001). In Guatemala, the rainy season lasts from May through October, while the dry season lasts from November to April. A total of 6,070 patient encounters (49.64%) occurred during the rainy season. A total of 6,159 patient encounters (50.36%) occurred during the dry season. There was no statistically significant change in number of ED visits across seasons (p=0.42). Visits were also evenly distributed across individual months, shown in Figure 3.

The bulk of ED visits (N=10,453, 85.3%) occurred during the day (7 am – 3 pm) and evening (3 pm – 11 pm) hours. Relatively fewer visits occurred during night hours from 11 pm – 7 am (N=1,796, 14.69%). This trend was significant (p <0.0001).

Chief complaint and disposition

Presenting complaint was recorded for all patients, and these were categorized into one of 21 categories by the hospital. These were further stratified as medical or surgical complaints. Medical complaints accounted for most of the visits to the ED (83.1%). There was a statistically significant difference in the proportion of males presenting with a surgical complaint (12.59%) compared to females (21.90%). A slight temporal variability was also observed, with a greater proportion of surgical complaints occurring during day and evening hours (19.50% and 16.73% respectively). Within the municipality of San Lucas Tolimán, rural residents presented more frequently with surgical complaints (19.98%) than did their semi-urban counterparts (16.28%). Type of complaint did not appear to be significantly correlated with season, ethnicity or outcome. These results are shown in Table 1. Overall, a majority of patients were discharged to home from the ED 93.02% (N=11,298). 814 patients (6.7%) were either admitted to the hospital or referred to another hospital for care, such as the Hospital Universidad del Valle de Guatemala or the Hospital Nacional de Sololá. Thirty patients, 0.25%, did not survive to discharge.

Medical visits were categorized into respiratory illnesses, Cardiovascular Disease (CV), Gastrointestinal (GI) disease, neurological disease (neuro), and other. The majority of these medical visits were either respiratory (N=4,110, 40.4%) or GI

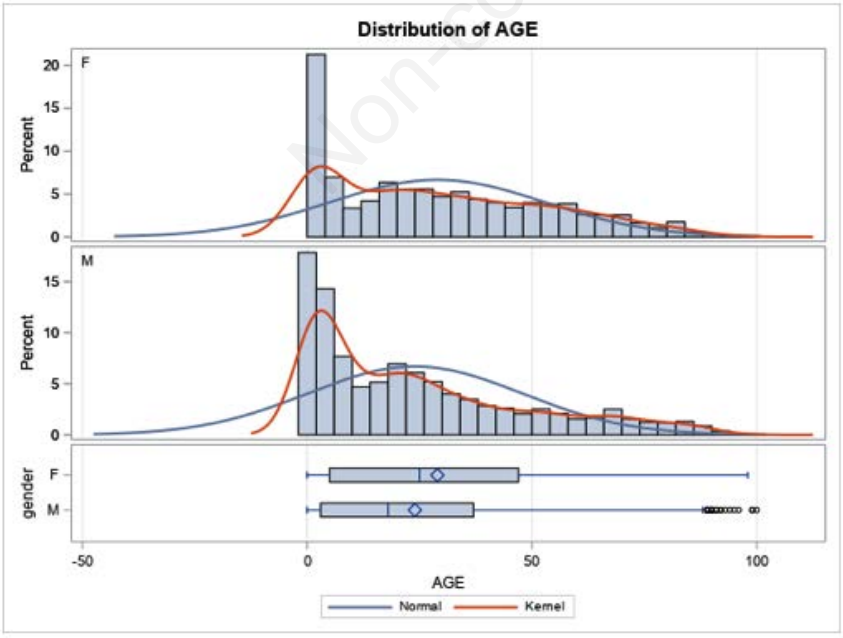

Figure 1. Distribution of patient age based on sex over a three-year period.

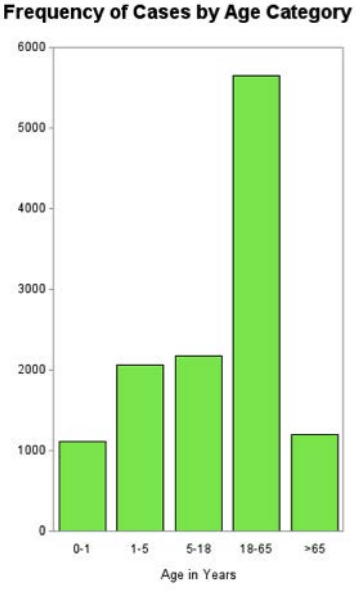

Figure 2. Age distribution of all patients presenting to the ED over a three-year period by age group <1, 1-5, 5-18, 18-65 and > 65 years old.

(N=2694, 26.5%). While the pattern of medical complaints was similar between indigenous and non-indigenous patients, indigenous patients presented more frequently with respiratory complaints and non-indigenous patients present more frequently with cardiovascular issues. During the dry season, presentation for GI complaints was slightly more common, but there was no significant difference in complaint distribution between the two seasons. These results are shown in Table 2.

Presenting complaint for medical cases varied significantly by age (Figure 4). While respiratory complaints were the most frequent in most age groups, for adults aged 18-65 years, GI complaints were the most frequent complaint. For older adults >65 years, cardiovascular problems were almost as common as respiratory complaints.

Traumatic complaints made up 43.2% of all surgical presentations to the ED. The average age of patients presenting with trauma was 31.9 years. Most trauma cases occurred during day or evening hours, and only 39.33% of surgical cases presenting to the ED during late-night hours were traumas. There were no significant seasonal trends in the distribution of surgical complaints. Female patients presented more frequently with trauma compared to male patients. In general, a greater proportion of trauma cases were admitted to the hospital or referred to another institution for follow up care (54.48%), compared to other surgical complaints. These results are shown in Table 3. A greater proportion of patients presenting to the ED with a traumatic surgical complaint were referred (8%) compared to admitted (1.03%), whereas an equal proportion of patients presenting to the ED with nontraumatic surgical complaints were

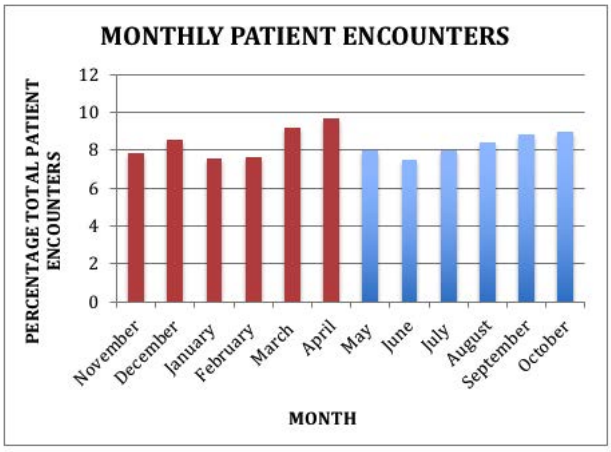

Figure 3. Distribution of monthly patient encounters from January 1st, 2016 to December 31st, 2018. Rainy season is depicted in blue, and dry season is depicted in red.

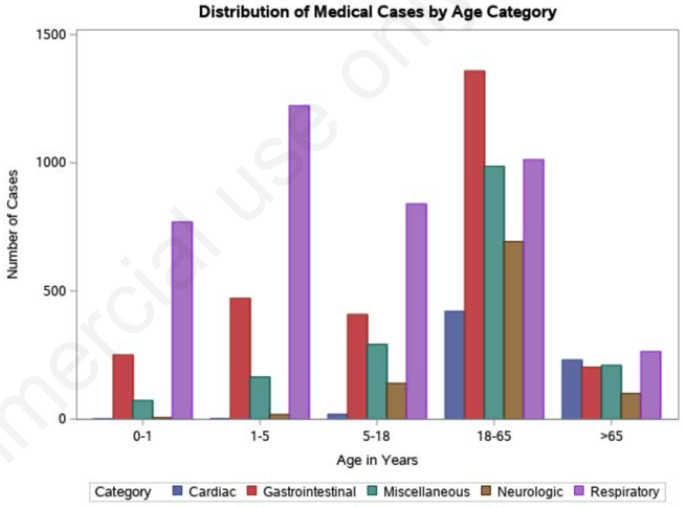

Figure 4. Frequency of medical complaints across age categories, <1, 1 – 5, 5 – 18, 18-65, and >65 years old.

Table 1. Demographic characteristics, seasonal/ temporal characteristics, and disposition associated with patients presenting for medical or surgical complaints over a three-year period.

		Medical complaint (%, N=10,164)	Surgical complaint (%, N=2,065)	p*
Average age (years)		25.9	30.28	<0.0001
Location	Rural	80.02	19.98	0.001
	Semi-urban	83.72	16.28	
Season	Rainy	83.05	16.95	0.4914
	Dry	83.18	16.82	
Time	7 am – 3 pm	80.50	19.50	<0.0001
	3 pm – 11 pm	83.27	16.73	
	11 pm – 7 am	90.09	9.91	
Indigenous	Yes	83.21	16.79	0.5743
	No	82.04	17.96	
Sex	Male	78.10	21.90	<0.0001
	Female	87.41	12.59	
Outcome	Discharge	83.31	16.69	0.4248
	Admit/ refer	82.19	17.81	

* p-value of regression model containing all variables.

referred (2.84%) compared to admitted (2.84%).

Discussion

Emergency medical care has a demonstrable impact on healthcare system functions, yet scant data exist to describe emergency department availability, access and utilization in low- and middle-income countries.[9,20,63] Data from South and Central America are especially scarce.[9,11,63] This study represents the first attempt to describe the functioning of an emergency department in a rural and semi-urban setting in Guatemala. Although a vast majority of emergency departments worldwide still rely on paper-based records, electronic documentation of patient presentation to Hospital Parroquial de San Lucas Tolimán allowed for nearly full capture of acute care during the time period studied.[64]

While presentations to the ED were fairly consistent between months and seasons, time of patient presentation over the course of a day followed a clear distribution. A majority of patient encounters occurred during day and evening hours (7 am – 11 pm). Relatively fewer patients presented to the ED during late evening or early morning hours (11 pm – 7 am). This finding is consistent with other studies of emergency department utilization in LMIC.[65–67] For example, a tertiary care institution in Northern India found that peak patient encounters occurred during day and evening hours and concluded that a lack of readily available transportation may be responsible for this temporal distribution, given that an ambulance was not available, public transportation shuts down at 21:00, and personal vehicles are difficult to arrange.[66] Another study of trauma systems in Kenya also found that transportation at night was a barrier to accessing care, given the risk of being hijacked or shot.[67] In remote rural areas of Guatemala, many families live without access to motor vehicles, and there is poor public transportation infrastructure.[68] For people living in mountain hamlets and rural areas, traversing roads on foot may take several hours, and may be impassable depending on weather conditions, or generally unsafe at night.[69] Thus, the temporal distribution of patient presentation at this hospital underscores that transportation, distance and road infrastructure may still be significant barriers to accessing acute care in the predominantly indigenous

Table 2. Demographic characteristics, seasonal/ temporal characteristics, and disposition associated with patients presenting for medical complaints over a three-year period.

		Respiratory (%, N=4,110)	Cardiovascular (%, N=676)	Gastrointestinal (%, N=2,694)	Neurological (%, N=957)	Other (%, N=1,727)	p*
Average age (years)		55.2	25.9	35.9	32.4	16.0	<0.0001
Location	Rural	33.26	4.14	30.49	11.85	20.25	0.0001
	Semi-urban	42.89	7.07	25.61	8.77	15.66	
Season	Rainy	40.71	6.41	25.03	9.92	17.93	0.4797
	Dry	40.17	6.89	27.95	8.92	16.06	
Time	7 am – 3 pm	39.94	5.86	25.70	8.84	19.66	<0.0001
	3 pm – 11 pm	41.58	7.58	24.79	10.02	16.03	
	11 pm – 7 am	38.57	6.12	33.25	9.21	12.86	
Indigenous	Yes	41.18	6.06	26.48	9.53	16.75	<0.0001
	No	31.52	13.54	26.84	8.23	19.87	
Sex	Male	44.90	5.24	25.25	6.74	17.88	<0.0001
	Female	37.02	7.73	27.47	11.47	16.31	
Outcome	Discharge	41.25	6.65	25.86	9.75	16.49	0.6091
	Admit/ refer	31.24	5.23	33.93	4.78	24.81	

* p-value of regression model containing all variables

Table 3. Demographic characteristics, seasonal/ temporal characteristics, and disposition associated with patients presenting for surgical complaints over a three-year period.

		Trauma (%, N=892)	Other (%, N=1,173)	p*
Average age (years)		31.9	29.0	
Location	Rural	43.78	56.22	0.6025
	Semi-urban	42	58	
Season	Rainy	41.21	58.79	0.227
	Dry	45.17	54.83	
Time	7 am – 3 pm	45.84	54.16	0.2761
	3 pm – 11 pm	41.01	58.99	0.5640
	11 pm – 7 am	39.33	60.67	
Indigenous	Yes	42.20	57.60	0.0566
	No	52.60	47.40	
Sex	Male	39.97	60.03	0.010
	Female	51.99	48.01	
Outcome	Discharge	41.99	58.01	0.0005
	Admit/ refer	54.48	45.52	

* p-value of regression model containing all variables.

population studied. Interestingly, children and adolescents represented nearly half of all ED visits (43.2%). Elderly patients over 65 years old were seen less frequently. Presumably younger patients are free of the chronic conditions that typically burden the increasing volume of elderly patients seen in high-income country emergency departments.[9] However, other studies have identified higher mortality for younger patients in low- and middle-income countries. Thus, timely access to quality emergency care with relatively simple interventions may significantly reduce morbidity and mortality for younger subsets of patients.[9,70–73] For example, implementing Emergency Triage And Treatment (ETAT) guidelines may improve pediatric care. At a hospital in Malawi, ETAT was responsible for halving mortality rate for pediatric inpatients.[73–75] This system has already been used in select referral hospitals and primary health centers in Guatemala to successfully train health providers in acute pediatric care, and could be implemented at other rural health centers across the country, including the Hospital Parroquial de San Lucas Tolimán.[46,76]

Respiratory infections remain a top global cause of morbidity and mortality.[63] Our study corroborated this finding, with 40.4% of all medical complaints to the ED attributable to respiratory illness. This is particularly concerning in the era of COVID-19. Although COVID-19 patients are unlikely to have co-existent viral and bacterial respiratory infections, there may be significant overlap in patient presentation and comorbidities.[77] A surge in patients needing diagnosis and treatment of respiratory illness may overwhelm already overburdened health systems, and result in delays in diagnosis and treatment of respiratory cases requiring timely intervention, such as tuberculosis, which remains a major burden of infectious disease in Guatemala.[78–80] There is evidence that there may be dual risk posed by co-infection with tuberculosis and COVID-19, advancing disease severity and progression for both diseases, and leading to dramatic differences in health services utilization that can affect tuberculosis disease management.[81–84] It is difficult to quantify the true impact of COVID-19 on this particular hospital and emergency department at this time; however, given the aforementioned issues, it is unlikely that hospital functions will remain unaffected by this evolving pandemic. Indeed, excess mortality due to the pandemic has been documented in Guatemala on a nation-wide level.[85]

Traumatic complaints made up 43.2% of all surgical presentations to the ED. Notably, 51.99% of all females presenting with a surgical complaint were classified as having a traumatic injury. Only 39.97% of males presenting with a surgical complaint, on the other hand, were classified as having a traumatic injury. This is in contrast to a body of existing literature that demonstrates males are generally more likely than females to present to emergency departments for traumatic injury.[86–95] Detailed etiologies of traumatic surgical complaints were not available in hospital records; however, understanding the nature of trauma may represent a potential future area of study, and an important point of intervention for female patients presenting to the ED with trauma. While we are unable to conclude what is causing the observed phenomena in our study population, we are concerned that previous studies have demonstrated that women may suffer a greater proportion of sexual violence and assault injuries compared to male counterparts.[93,96] Domestic violence against women is well documented in Guatemala, and may be one factor that has contributed to the trend observed in our study.[97–99] Future research should explore this potential in a culturally sensitive manner.

Furthermore, the substantial burden of traumatic surgical complaints that were identified on presentation to this ED, and the higher percentage of those referred to another institution compared to admitted to the hospital may underscore the need for improved organization and planning for trauma care services regardless of gender-based differences. Low cost initiatives to streamline trauma care have been evaluated in Mexico, and include the design of specific trauma registries, uniform training for hospital staff involved in the management of trauma cases, and strengthening prehospital services, among others.[100–102] Similar low-cost efforts could be developed in this setting depending on local interest and resources. For example, an effective prehospital emergency trauma care curriculum was recently developed for lay first responders in the departments of Chimaltenango, Escuintla and Sacatepéquez, and could be modified for use in the San Lucas Tolimán setting.[44] Long-term capacity building could also include more in-depth analyses of the types of surgical traumas presenting to the ED, and staff concerns regarding the hospital's ability to manage these cases on-site. Identifying any deficits that exist at this hospital could suggest site-specific interventions.

Limitations

Our descriptive epidemiologic study may have been subject to a few different sources of bias, limiting the interpretation of our results. First, there may be cross-level confounding by individual level covariates, including individual income.[103] Presentation to the ED may have been influenced by socioeconomic status and/or educational attainment, leading to significant selection bias. More financially stable individuals, with easy access to transportation, may choose to seek care at larger urban centers rather than at a local rural hospital. Given that a higher proportion of indigenous individuals are socioeconomically disadvantaged, this could have led to an overrepresentation of the indigenous population at Hospital Parroquial de San Lucas Tolimán, and not accurately reflected emergency department usage in non-indigenous populations. For this reason, patient outcome may also be somewhat misleading. Individuals may choose to recover at home given the high cost of referred medical care and hospitalization, despite advice to seek additional treatment. Thus, socioeconomic status could be a confounding variable not readily apparent based on the information contained in this dataset.

Migration across groups may also be a problem.[103,104] In Guatemala, seasonal labor on agricultural plantations (*fincas*), including coffee and sugarcane plantations, is a primary source of employment for many individuals.[105,106] The availability of temporary labor on plantations may cause substantial migration into, and out of, our study population based on season. There may be differences in health risks for temporary workers on plantations compared to permanent residents, given extant labor conditions.[106,107] For example, labor exploitation and abuses that occur on Guatemalan coffee farms include child labor, the utilization of dangerous forms of transportation, exposure to pesticides/chemicals without adequate personal protective equipment, food and shelter deprivation, and poor living conditions.[107] This in turn may lead to an increase in ED encounters among groups of seasonal laborers. We may therefore have observed an overrepresentation of laborers whose primary residence is not San Lucas Tolimán or the immediate surrounding rural area.

Finally, non-differential misclassification/measurement error may be a problem.[108,109] Although hospital staff coded presenting complaint according to a specified system, individuals may have been misclassified if there were multiple presenting complaints or an ambiguous presenting complaint, or if untrained hospital staff filled out the electronic medical record. While we do not expect that this was a significant source of error in this study, in many ecological studies, this type of mis-

classification can bias results away from null hypotheses.[109]

Conclusions

Despite limitations, this study generates epidemiologic data that will contribute to the understanding of acute care disease burden and emergency care needs and capacity in a middle-income country, with specific focus on an underserved indigenous population. This information adds to general knowledge of emergency care in this region, and may be used to inform local policy decisions, identify research priorities, create training topics for local health care providers, and perhaps introduce new protocols at rural ED's in Guatemala.

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