# Epidemiology of Facial Fracture Injuries

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# Epidemiology of Facial Fracture Injuries

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**Purpose:** Injuries resulting from accidents are a leading cause of mortality and morbidity. The objective of this study was to present epidemiologic estimates of hospital-based emergency department (ED) visits for facial fractures in the United States.

**Materials and Methods:** The Nationwide Emergency Department Sample for 2007 was used. All ED visits with facial fractures were selected. Demographic characteristics of these ED visits, causes of injuries, presence of concomitant injuries, and resource use in hospitals were examined. All estimates were projected to national levels and each ED visit was the unit of analysis.

**Results:** During 2007 in the United States, 407,167 ED visits concerned a facial fracture. Patients' average age for each ED visit was 37.9 years. Sixty-eight percent of all ED visits concerned male patients, and 85,759 ED visits resulted in further treatment in the same hospital. Three hundred fourteen patients died in EDs, and 2,717 died during hospitalization. Mean charge per each ED visit was $3,192. Total United States ED charges were close to $1 billion. Mean hospitalization charges (ED and inpatient charges) amounted to $62,414. Mean length of stay was 6.23 days, and total hospitalization time in the entire United States was 534,322 days. Frequently reported causes of injuries included assaults (37% of all ED visits), falls (24.6%), and motor vehicle accidents (12.1%).

**Conclusions:** The management of maxillofacial fractures in EDs across the United States uses considerable resources. The public health impact of facial fractures is highlighted in the present study.

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Injuries resulting from accidents are a leading cause of mortality and morbidity and a major public health problem in the United States.[1] Patients with facial fractures have several concomitant injuries to other body parts.[2-4] Most patients with such injuries undergo hospitalization and considerable resources are needed for treatment, thus placing an enormous burden on the health care system. Accidental falls, motor vehicle accidents, environmental factors, alcohol, and assaults have been reported to cause facial injuries.[5-8] Several prior studies have reported on facial fractures and associated hospitalization outcomes. However, a vast majority of them tend to be from single centers, hospitals drawn from a regional sample, or reports using trauma registries.[2-8] These studies present rich clinical data and have been useful to develop primary intervention programs and clinical protocols for treating patients with facial injuries. However, their results cannot be generalized to the entire population. Hospital-based emergency departments (EDs) serve as the first point of entry into the hospital system for a significant proportion of people seeking care for facial injuries.

The objective of the present study was to present epidemiologic estimates of hospital-based ED visits for facial fractures in the United States. These estimates will enable the identification of high-risk groups that are prone to facial injuries and will enable policy makers, providers, and public health personnel to tailor intervention efforts to the needs of high-risk individuals. Demographic characteristics of these ED visits, causes of injuries, and resource use in hospitals were examined in the present study.

## Materials and Methods

### DESCRIPTION OF DATABASE

The Nationwide Emergency Department Sample (NEDS) for 2007, a database of the Healthcare Cost

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and Utilization Project (HCUP), was used for the current study.[9] The HCUP is sponsored by the Agency for Healthcare Research and Quality (AHRQ). The NEDS database enables analyses of ED use patterns. The NEDS database is a 20% stratified sample of hospital-based ED visits in the United States and is the largest all-payer ED sample that is publicly available. The NEDS 2007 database draws its sample from 970 hospitals in 27 participating states. Discharge information on close to 27 million ED visits is available in the NEDS 2007 database. Sample weights are provided for each discharge, which can be used to calculate national estimates of all ED visits in the United States and which approximate 120 million visits. Stratification of the NEDS 2007 database is based on the geographic region of a hospital (Northeast, Midwest, South, and West), trauma center designation, urban or rural location of hospital, teaching status of hospitals in metropolitan areas, and hospital ownership or control.[9]

### DATA USER AGREEMENT

The present study was a secondary data analysis of the NEDS dataset made available by the AHRQ for researchers conducting health outcomes and health economics analyses. The second author (V.J.A.) obtained data from the AHRQ. The first and second authors completed the data user agreement with the HCUP regarding use and reporting of the NEDS dataset. To preserve patient confidentiality, it is mandated by the HCUP/AHRQ that researchers do not present individual cell counts less than or equal to 10. These numbers were not reported in the present study.

### VARIABLES EXAMINED

The NEDS provides information on more than 100 variables, including several discharge-level attributes and hospital characteristics. For the present study, the individual discharge-level attributes examined included information on age of patient at time of ED visit, gender, diagnosis documented during ED visit and subsequent hospitalization (15 diagnosis fields are available), external cause-of-injury code fields (4 fields are available), outcome of ED visit (routine discharge from ED, transfer to other facilities, discharge to home health care, discharged against medical advice, died during ED visit, admitted as inpatient into the same hospital, or unknown destination), disposition information after inpatient admission into the same hospital, insurance status (primary payer is Medicare, Medicaid, private insurance plans, uninsured, or covered by other insurance plans, including workers compensation, The Civilian Health and Medical Program of the Uniformed Services, The Civilian Health and Medical Program of the Department of Veterans Affairs, Title V, and other government programs), ED charges, hospitalization charges, and length of stay in hospital for patients admitted into the same hospital after an ED visit. The charges (including ED and inpatient charges) listed in the database refer to the actual amounts that were "charged" to patients and not the actual costs of providing treatment, the amount reimbursed to the hospitals by insurance plans, or the amount paid by patients "out of pocket."

### CASE SELECTION

All ED visits with *International Classification of Diseases, Ninth Revision, Clinical Modification* (ICD-9-CM) diagnosis codes for facial fractures in any of the 15 diagnosis fields available in the NEDS dataset were selected for analysis. The codes identifying facial fractures include nasal bones—closed (ICD-9-CM code 802.0), nasal bones—open (802.1), unspecified sites of mandible—closed (802.20), condylar process of mandible—closed (802.21), subcondylar part of mandible—closed (802.22), coronoid process of mandible—closed (802.23), ramus of mandible—closed (802.24), angle of mandible—closed (802.25), symphysis of body of mandible—closed (802.26), alveolar border of body of mandible—closed (802.27), body and other or unspecified sites of mandible—closed (802.28), multiple sites of mandible—closed (802.29), unspecified sites of mandible—open (802.30), condylar process of mandible—open (802.31), subcondylar part of mandible—open (802.32), coronoid process of mandible—open (802.33), ramus of mandible—open (802.34), angle of mandible—open (802.35), symphysis of body of mandible—open (802.36), alveolar border of body of mandible—open (802.37), body and other or unspecified sites of mandible—open (802.38), multiple sites of mandible—open (802.39), malar and maxillary bones—closed (802.4), malar and maxillary bones—open (802.5), orbital floor: blow out—open (802.6), orbital floor: blow out—closed (802.7), other facial bones—closed (802.8), and other facial bones—open (802.9).

External Cause of Injury codes (E-Codes) were used to identify causes for injuries. All possible sources of injuries using the E-Codes were identified from the dataset. The E-Codes that were of interest in the present study included those identifying cut and pierce injuries, drowning/submersion, falls, burns, machinery accidents, motor vehicle traffic accidents, pedal cyclist accidents, pedestrian accidents, transport accidents (excluding motor vehicle traffic accidents), natural/environmental causes, overexertion, poisoning, struck by, and suffocation. More than 100 individual E-Codes identify these causes of injuries.

Because patients with facial fractures visiting EDs are likely to have fractures/injuries to other body parts, the presence of other concomitant injuries that were recorded in the diagnosis fields of the dataset also were examined. All possible fractures/injuries

(trauma-related joint disorders and dislocations, fracture of neck of femur, spinal cord injury, skull fractures, fracture of upper limb, fracture of lower limb, sprain and strains, intracranial injuries, crushing injuries or internal injuries, open wounds of head, neck, and trunk, open wounds of extremities, and other fractures) were identified using ICD-9-CM codes.

Reporting all the E-Codes and ICD-9-CM codes that were used in the present study to identify external causes of injuries and different types of fractures would be beyond the scope of this report. For interested readers, the authors will provide the entire list of E-Codes and ICD-9-CM codes used to query the dataset.

### ANALYTICAL APPROACH

Because the present study is a descriptive retrospective analysis of a hospital discharge dataset, only descriptive statistics, including frequencies, proportions, mean, and standard errors, were used to summarize the data. The NEDS dataset has sample weights assigned to each discharge, and these were used to project all estimates to national levels. For all analyses and projections to national estimates, the NEDS hospital stratum was the stratification unit and each ED visit was the unit of analysis. All statistical analyses were conducted using SAS 9.2 (SAS Institute, Cary, NC).

## Results

In total 407,167 ED visits were reported to concern a facial fracture in the United States during 2007. The average age of a patient at each ED visit was 37.9 years. Close to 68% of all ED visits occurred in men and about 36% occurred during the weekends (Table 1). After an ED visit, 71% were discharged routinely, 3.5% to a short-term facility, 1.7% to another facility (including skilled nursing facility, intermediate care, and another type of facility), 0.5% to home health care, 0.5% were discharged from the ED against medical advice, and for 1.6% the destination was not known. Three hundred fourteen patients died in EDs. In total 85,759 ED visits resulted in admission to the same hospital for further treatment. Primarily, listed payers of the ED visits were Medicare (15.8% of all ED visits), Medicaid (12.9%), private insurance plans (37.5%), and other insurance plans (7.4%). About 26.4% of all ED visits were not covered by any insurance plans. Mean charge per ED visit was $3,192 (standard error, 94.3; Table 2). Information regarding ED charges was missing for 20% of all ED visits. The total ED charges for the entire United States amounted to approximately $1.04 billion.

Of ED visits that required admission into the same hospital (n = 85,759), 65.2% were discharged routinely from the hospital, 3.5% were transferred to

**Table 1. CHARACTERISTICS OF HOSPITAL-BASED EMERGENCY DEPARTMENT VISITS WITH FACIAL FRACTURES**

| Characteristic | Response | n (%) |
|---|---|---|
| Admission timing | Admission Monday through Friday | 262,147 (64.4) |
| | Admission Saturday through Sunday | 144,987 (35.6) |
| Disposition of patient from ED | Routine discharge | 289,079 (71) |
| | Transfer to short-term facility | 14,157 (3.5) |
| | Other transfers, including skilled nursing facility, intermediate care, and another type of facility | 7,001 (1.7) |
| | Home health care | 2,090 (0.5) |
| | Against medical advice | 2,146 (0.5) |
| | Admitted as an inpatient to this hospital | 85,759 (21.1) |
| | Died in ED | 314 (0.1) |
| | Not admitted, destination unknown | 6,577 (1.6) |
| | Not admitted to this hospital, discharged alive, destination unknown | 44 (0.01) |
| Gender | Male | 277,086 (68.1) |
| | Female | 129,932 (31.9) |
| Insurance status | Medicare | 63,810 (15.8) |
| | Medicaid | 52,047 (12.9) |
| | Private insurance plans, including HMO | 151,808 (37.5) |
| | Uninsured | 106,960 (26.4) |
| | Other plans (including workers compensation, CHAMPUS, CHAMPVA, title V, and other government programs) | 29,978 (7.4) |

NOTE. Individual cell counts will not sum to the global total of 407,167 discharges because of missing values for some variables.

Abbreviations: CHAMPUS, The Civilian Health and Medical Program of the Uniformed Services; CHAMPVA, The Civilian Health and Medical Program of the Department of Veterans Affairs; ED, emergency department; HMO, health maintenance organization.

**Table 2. OUTCOMES OF EMERGENCY DEPARTMENT VISITS WITH FACIAL FRACTURES**

| Characteristic | Mean | SE | Total U.S. Charges/LOS |
|---|---|---|---|
| ED + inpatient hospital charges ($) | 62,414 | 3,130.3 | 5,335,375,267 |
| Inpatient LOS (days) | 6.23 | 0.18 | 534,322 |
| ED charges ($) | 3,192.5 | 94.3 | 1,043,596,268 |

Abbreviations: ED, emergency department; LOS, length of stay; SE, standard error.

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another short-term facility, 18.6% were transferred to other facilities (including skilled nursing facility, intermediate care, and another type of facility), 7.8% to home health care, 1.6% were discharged from the hospital against medical advice, and for 0.1% the destination was unknown (Table 3). In total 2,717 patients died in hospitals. Average hospitalization charges (including ED charges and inpatient charges) amounted to $62,414 (standard error, 3,130; Table 2). Mean length of stay in the hospital was 6.23 days, and the total hospitalization period in the entire United States was 534,322 days.

The prevalence estimates of different types of facial fractures are presented in Table 4. In summary, closed fractures of different facial bones were more common compared with open fractures. The most frequently occurring facial fractures included fractures of nasal bones—closed (55.8% of all ED visits), other facial bones—closed (17.2%), malar and maxillary bones—closed (13.4%), orbital floor (blow out)—closed (13%), and mandible (unspecified site)—closed (5.3%).

As mentioned in Materials and Methods, E-Codes were used to identify possible causes of injuries leading to the ED visit. Reported causes are presented in Table 5. The frequently reported causes of injuries included assaults (37% of all ED visits), falls (24.6%), motor vehicle accidents (12.1%), transport accidents (2%), and pedal cyclist accidents (1.6%).

**Table 3. DISPOSITION OF PATIENTS ADMITTED INTO THE SAME HOSPITAL AFTER EMERGENCY DEPARTMENT VISIT (N = 85,759)**

| Disposition | n (%) |
|---|---|
| Routine | 55,903 (65.2) |
| Transfer to short-term hospital | 3,029 (3.5) |
| Other transfer, eg, skilled nursing facility, intermediate-care facility, and other type of facility | 15,942 (18.6) |
| Home health care | 6,667 (7.8) |
| Against medical advice | 1,401 (1.6) |
| Died in hospital | 2,717 (3.2) |
| Discharged alive, destination unknown | 73 (0.1) |

NOTE. For 27 inpatient admissions, the disposition information was missing.

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**Table 4. TYPE OF FACIAL FRACTURE**

| Type of Facial Fracture | n (%) |
|---|---|
| Nasal bones, closed | 227,024 (55.8) |
| Nasal bones, open | 11,241 (2.8) |
| Mandible (closed)—unspecified site | 21,733 (5.3) |
| Mandible (closed)—condylar process | 5,899 (1.4) |
| Mandible (closed)—subcondylar | 4,006 (1) |
| Mandible (closed)—coronoid process | 685 (0.2) |
| Mandible (closed)—ramus, unspecified | 5,024 (1.2) |
| Mandible (closed)—angle of jaw | 8,418 (2.1) |
| Mandible (closed)—symphysis of body | 4,710 (1.2) |
| Mandible (closed)—alveolar border of body | 1,344 (0.3) |
| Mandible (closed)—body and other or unspecified sites | 5,239 (1.3) |
| Mandible (closed)—multiple sites | 3,393 (0.8) |
| Mandible (open)—unspecified site | 1,386 (0.3) |
| Mandible (open)—condylar process | 446 (0.1) |
| Mandible (open)—subcondylar | 447 (0.1) |
| Mandible (open)—coronoid process | 51 (0.01) |
| Mandible (open)—ramus, unspecified | 529 (0.1) |
| Mandible (open)—angle of jaw | 1,647 (0.4) |
| Mandible (open)—symphysis of body | 1,925 (0.5) |
| Mandible (open)—alveolar border of body | 296 (0.1) |
| Mandible (open)—body and other or unspecified sites | 1,465 (0.36) |
| Mandible (open)—multiple sites | 843 (0.2) |
| Malar and maxillary bones, closed | 54,760 (13.4) |
| Malar and maxillary bones, open | 2,188 (0.5) |
| Orbital floor (blow-out), closed | 52,799 (13) |
| Orbital floor (blow-out), open | 1,231 (0.3) |
| Other facial bones, closed | 69,982 (17.2) |
| Other facial bones, open | 2,048 (0.5) |

NOTE. Individual cell counts will not sum to the global total of 407,167 discharges because 1 discharge may concern more than 1 type of fracture.

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Apart from facial fractures, most ED visits concerned other concomitant injuries that were reported during the ED visit or hospitalization (Table 6). Commonly presented concomitant injuries included open wounds of the head, neck, and trunk (30.8% of all ED visits), intracranial injuries (12.3%), skull fractures (7.4%), fractures of upper limbs (5.7%), other reported fractures (5.6%), and crushing or internal injuries (3.7%).

## Discussion

The present study used the largest all-payer, nationally representative, hospital-based ED database in the

**Table 5. CAUSES OF FACIAL FRACTURES**

| Causes of Injuries | n (%) |
|---|---|
| Cut and pierce injuries | 2,834 (0.7) |
| Drowning/submersion | 146 (0.04) |
| Fall | 100,230 (24.6) |
| Burns | 171 (0.04) |
| Firearm | 2,163 (0.5) |
| Machinery | 639 (0.2) |
| Motor vehicle traffic accidents | 49,121 (12.1) |
| Pedal cyclist accidents | 6,626 (1.6) |
| Pedestrian accidents | 366 (0.1) |
| Transport accidents (not motor vehicle traffic accidents) | 8,101 (2) |
| Natural/environmental causes | 2,048 (0.5) |
| Overexertion | 348 (0.1) |
| Poisoning | 496 (0.1) |
| Struck by | 150,727 (37) |
| Suffocation | 121 (0.03) |

NOTE. Individual cell counts may not sum to the global total of 407,167 discharges because 1 discharge may have more than 1 External Cause of Injury code in the dataset, or in some instances some emergency department visits with facial fractures may not have an External Cause of Injury code that identifies the external cause of injury listed in the dataset.

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United States to describe the epidemiology of facial fractures in the United States. The present study showed that 26.4% of those who presented to an ED with facial fracture were uninsured and a further 28.7% had Medicaid or Medicare listed as their primary insurance. In fact, only 37.5% of those who presented with facial fractures had private health insurance. A 2009 U.S. Census Bureau survey of 304,280 people found that 194,545 individuals were covered by private health insurance, which represents almost 64%.[10] Subsequently, those with private insurance seemed to present less frequently to an ED with facial fracture than expected, based on population estimates of those with private health insurance. Research that identifies factors that make individuals likely to present to an ED with facial fracture may lead to the development of programs that decrease the hospital costs associated with facial fractures.

Many previous studies have shown that men tend to be the victims of facial fractures more often than women,[8,11-19] and the present study results also suggest that a larger proportion of patients visiting hospital-based EDs for facial fractures tend to be male. Prior studies have shown that assault, motor vehicle accidents, and falls are the 3 most common causes of facial fracture, but the order of importance varies among the different studies.[1,8,17,18,20] Existing research has also shown that being struck tends to be the most likely cause of facial fracture in North America[11,12] and the present study results concur with previous findings.

An interesting finding in the present study is that 23.3% of fractures were open or closed fractures of the mandible. Previous studies have shown that the mandible is the most common site for maxillofacial fracture.[8,15-18] However, the present study produced a contrasting finding of more than 50% of ED visits owing to facial fracture associated with fractures of the nasal bone. A Korean study[19] and a study of Finnish children[21] found that the nasal bone was the most common site of maxillofacial fracture. However, most previous studies have found the most common site to be the mandible. The cause of this surprising difference is unclear, but 1 possibility could be related to the inclusion criteria of the present study. Although previous studies have included patients after admission to a hospital, the present study included patients who presented to hospital-based EDs. Routine discharge after presenting to the ED with a maxillofacial fracture represented 71% of visits in the present study. In addition, nasal fractures only need to be corrected when there is a functional or esthetic defect, and it may be that many of the nasal fractures presenting to an ED did not require inpatient hospitalization. However, there are no epidemiologic studies considering nasal bone fractures presenting to an ED with which the present findings could be compared, and more research is needed to further explore this area.

The total ED charges because of facial fractures was higher than $1 billion and the sum of hospitalization and ED charges was higher than $5 billion. However, these estimates are not likely to be accurate. Close to 20% of ED visits in the present study had missing

**Table 6. TYPES OF CONCOMITANT INJURIES**

| Type of Injury | n (%) |
|---|---|
| Joint disorders and dislocations; trauma-related | 3,842 (0.9) |
| Fracture of neck of femur (hip) | 1,595 (0.4) |
| Spinal cord injury | 1,000 (0.2) |
| Skull fractures | 30,116 (7.4) |
| Fracture of upper limb | 23,145 (5.7) |
| Fracture of lower limb | 9,896 (2.4) |
| Other fractures | 22,965 (5.6) |
| Sprains and strains | 13,796 (3.4) |
| Intracranial injury | 50,147 (12.3) |
| Crushing injury or internal injury | 15,188 (3.7) |
| Open wounds of head, neck, and trunk | 125,240 (30.8) |
| Open wounds of extremities | 12,124 (3) |

NOTE. A single emergency department visit may have more than 1 type of concomitant injury apart from the facial fractures.

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information on ED charges. Also, all charges (ED or hospitalization) obtained from the present dataset cannot be attributed exclusively to treatment of facial fractures. As evident from the present study findings, a large proportion of discharges had several concomitant injuries and a portion of the hospital charges is likely to result from treating these concomitant injuries. What the present study does indicate is that significant hospital resources are needed for treating individuals with facial fractures in an ED or inpatient setting. It should also be noted that the present dataset does not provide any indication of prescription medication, postdischarge care, outpatient costs, or other costs involved with the management of facial fractures. Subsequently, a limitation of the present study is that total associated costs could be much greater than what the present dataset was able to provide. A study published in 2010 found that 37.9% of costs associated with maxillofacial fracture were due to prescription medication.[22] Subsequently, the present study may have underestimated the actual costs of facial injuries. However, it is clear that a large amount of resources is used to manage facial fractures in hospitals across the United States and any decrease in costs through preventive interventions could decrease the financial burden on the health care system.

The most common concomitant injury was open wounds of the head, neck, and trunk (30.8% of all ED visits). Concomitant fractures of the skull, upper limbs, or other fractures were present in 25.4% cases of facial fracture. The high incidence of concomitant fractures of the skull, upper limbs, and other fractures with maxillofacial fracture suggests that maxillofacial departments should train and work effectively with the general surgeon for the best outcomes and most efficient management of patients.

Intracranial injuries were associated with 12.3% of facial fractures. One previous study found intracranial injuries constituted the most frequent concomitant injury associated with facial fracture.[11] As mentioned earlier, the inclusion criteria of the present study, which includes patients who were routinely presented to an ED because of facial fracture, may be partly responsible for the differences in estimates from the previous study.

The present study used the largest all-payer, hospital-based ED dataset in the United States to estimate ED visits with facial fractures. The management of maxillofacial fractures in EDs across the United States uses considerable resources. In total $1 billion dollars of ED charges was incurred during 2007. Close to 70% of hospital-based ED visits were made by men and 26% by the uninsured. The most common causes of injury were assaults, falls, and motor vehicle accidents.

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