The UNC Department of Emergency Medicine Carolina Center for Health Informatics Report

Overview and Analysis of NC DETECT Emergency Department Visit Data: 2009

January 1, 2009 - December 31, 2009

Published May 2011

Acknowledgements

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The following individuals from the North Carolina Division of Public Health provided valuable suggestions, insight, and ideas for the development and writing of the 2009 NC DETECT annual report:

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Suggested Citation: The UNC Department of Emergency Medicine Carolina Center for Health Informatics Report, Overview and Analysis of NC DETECT Emergency Department Data: 2009. Chapel Hill: NC. Carolina Center for Health Informatics, Department of Emergency Medicine, University of North Carolina at Chapel Hill, 2011. Available at: http://www.ncdetect.org/pubs.html

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Executive summary

The North Carolina Disease Event Tracking and Epidemiologic Collection Tool (NC DETECT) provides hospital users and public health officials with the capacity for statewide early event detection and timely public health surveillance. The 2009 annual report presents basic analyses of 4,382,051 North Carolina emergency department (ED) visits from January 1, 2009 through December 31, 2009. This report has the following three objectives: 1) to introduce the reader to the breadth and depth of ED visit data that NC DETECT collects, 2) to demonstrate the system's capacity for syndromic surveillance, and 3) to present analyses that describe North Carolina ED users in 2009 and the reasons for their visit. The authors of this report encourage the use of NC DETECT ED visit data for public health research.

Syndromic surveillance

NC DETECT uses data from the following entities to provide syndrome-based monitoring: hospital emergency departments (ED), the Carolinas Poison Center (CPC), urgent care centers, and the Emergency Medical Services (EMS, see page 14). ED Syndromes are used to conduct trend analyses and detect outbreaks. Users can review and comment on aberrations that warrant further investigation, creating a flexible, user-driven surveillance system. Influenza-like illness (ILI) trends in the ED are particularly useful for tracking statewide influenza morbidity on a near real time basis; these data are included in the North Carolina Weekly Influenza Surveillance Summary that the North Carolina Division of Public Health distributes (available at http://www.epi.state.nc.us/epi/gcdc/flu.html). During the H1N1 pandemic of 2009, regional surveillance teams used NC DETECT ILI data and reports to provide local health departments with weekly information.

Statewide ED visits, 2009

In the 2009 NC DETECT ED data, there were 2,666,704 unique patient identification numbers; 69.4% of these patients visited the same ED only once. In total, hospitals reported 4,382,051 ED visits to NC DETECT. Expected sources of payment were federal or state programs in 44%, private insurance in 26% and self-pay in 25% of visits. In 12.8% of the 2009 ED visits, the patient was admitted to the same hospital; in 1.7% of visits, the patient was transferred to another hospital.

Statewide, the two most common ED diagnoses were abdominal pain and chest pain. Dental problems were the eighth leading diagnosis. Gender specific ED visit rates for 2009 were 515.5/1,000 person-years for females and 416.5/1000 person-years for males.

Injuries due to motor vehicle crashes that involved traffic dominated transportation related injury visits; the rate of visits for injuries from traffic-related motor vehicle crashes was 11.02/1000 person-years. Rates of visits for these traffic-related motor vehicle crash injuries were higher for females compared to males, residents of the coastal plains compared to the piedmont and mountains, and drivers/passengers between the ages of 15 and 24 compared to other age groups. Visits for pedal cyclist injuries were high among the school-age population (5-14 years old).

Future goals

Timely, statewide data from EDs enables many types of public health surveillance across North Carolina; therefore, NC DETECT ED data are a valuable resource. The staff at NC DETECT will continue to make efforts to increase the reliability, validity, and completeness of the data. Other goals of NC DETECT include making these data even more accessible to public health practitioners, and revisiting the legislation under which these data are collected in order to expand the range of data elements that are included.

Introduction

The North Carolina Disease Event Tracking and Epidemiologic Collection Tool (NC DETECT) provides public health officials and hospital users with the capacity for statewide early event detection and timely public health surveillance.[1] Through NC DETECT, authorized users can access near real-time data from North Carolina Emergency Departments (EDs), the Carolinas Poison Center (CPC), and the Pre-Hospital Medical Information System (PreMIS). These data can be used for day-to-day surveillance or, per request, for conducting more detailed analyses.

NC DETECT was created in 2004 and is funded by the North Carolina Division of Public Health (NC DPH). Staff at the Carolina Center for Health Informatics (CCHI) in the Department of Emergency Medicine at the University of North Carolina at Chapel Hill, in close collaboration with staff in the Communicable Disease Branch of the NC DPH, develop and maintain the system.

Initially, NC DETECT was created to enable surveillance for potential bioterrorism events. However, the system has broader utility. NC DETECT data and reports are used across the spectrum of the divisions of public health — infectious disease, chronic disease, injury, and environmental health, among others. NC DETECT helps public health officials to detect and monitor various illnesses and outbreaks — disease outbreaks, food borne illnesses, seasonal influenza-like illness trends, gastrointestinal illness trends, and the health effects of natural and man-made disasters. Thus, NC DETECT facilitates timely and comprehensive assessment of the health of North Carolinians.

The NC DETECT annual report has the following objectives: 1) to introduce the reader to the breadth and depth of ED visit data that NC DETECT collected, 2) to demonstrate the system's capacity for syndromic surveillance, and 3) to provide descriptive analyses of North Carolina ED users and the health concerns that brought them to the ED in 2009. Similar reports from years 2007 and 2008 are available on the NC DETECT website.[2, 3]

In the first sections of this report, we outline the innovations in the NC DETECT system for the year 2009. We describe the procedures for capturing, reporting, and requesting data and explain NC DETECT's capacity for syndromic surveillance. In the final sections, which represent the majority of this report, we present descriptive analyses of ED visit data from January 1, 2009 to December 31, 2009. Interested readers can request additional analyses. Information on custom data requests is available at the following webpage: https://www.ncdetect.org/ReportsPortal/public/dataRequest.do

Innovations in NC DETECT for 2009

In 2009, NC DETECT added the following key functionalities:

- Reports that allow hospital-based public health epidemiologists to: 1) enter and track aggregated information on laboratory results for influenza, respiratory illnesses and bioterrorism agents, and 2) document communications with local health departments on public health investigations for communicable diseases.
- Additional syndromes and reporting functionalities that allow state, regional and local epidemiologists to track the nH1N1 pandemic of 2009 in the ED and poison center data:
    - CDC Influenza Like Illness (ILI) syndrome (ED)
    - American Association of Poison Control Centers (AAPC) H1N1 (Carolinas Poison Center; CPC)
    - H1N1 Vaccine Inactive (CPC)
    - H1N1 Vaccine Live (CPC)
    - Relenza® (CPC)
    - Tamiflu capsule® (CPC)
    - Tamiflu suspension® (CPC)
- ICD-9-CM diagnosis codes and keywords from ED chief complaints and triage notes are used to develop new custom event case reports. These case reports allow users to track the health effects of known events that could be of public health importance. These new reports allow events to be stratified by age group. They also provide a chart of statewide occurrences to facilitate aggregate monitoring of events outside a user's jurisdiction. The following are examples of 2009 reports:
    - Communicable Disease: H1N1 influenza
    - Communicable Disease: Bloody diarrhea
    - Communicable Disease: ILI resulting in influenza diagnosis
    - Communicable Disease: ILI admits resulting in influenza diagnosis
    - Communicable Disease: ILI with diabetes (keyword)
    - Communicable Disease: ILI with diabetes (ICD-9-CM)
    - Communicable Disease: ILI with pregnancy (keyword)
    - Communicable Disease: ILI with pregnancy (ICD-9-CM)
    - Communicable Disease: ILI with asthma/ Chronic Obstructive Pulmonary Disease (keyword)
    - Injury: Heat-related ED visits
    - Injury: Trauma (ICD-9-CM)

- Injury: Wii digital game injury
- Injury: Head injury
- Injury: Carbon Monoxide poison (keyword)
- Injury: Carbon Monoxide poison (ICD-9-CM)
- Injury: Drowning (keyword)
- Injury: Burn/electrocution (keyword)
- Injury: Burn/electrocution (ICD-9-CM)
- Medications/Prescriptions (keyword)
- Medications/Prescriptions (ICD-9-CM)
- Recall: Alfalfa
- Recall: Cookie dough
- Recall: Scrombroid
- Recall: Pistachio nuts salmonella
- Recall: Peanut butter salmonella –Brands
- Substance Abuse: Cocaine/Levamisole
- Surveillance/ Basic statistics: Pregnancy

Data capture

North Carolina legislation does not include collection of data from the EDs associated with specialty hospitals--psychiatric, prison, military, veterans, and other such hospitals.[1] Therefore, in 2009, an estimated 99.5% of all ED records from 24/7 acute care hospital-affiliated EDs in North Carolina were sent to NC DETECT. Near real-time data were extracted from 111 of 114 eligible hospitals' administrative and clinical electronic databases.

Each hospital performs its own medical coding for its own operational purposes. Where appropriate, each hospital standardizes its information according to Data Elements for Emergency Department Systems (DEEDS) [4] before transmitting it to a data aggregator. Data are received securely and validated every 12 hours in HL-7-like format. Data elements that NC DETECT collects are presented in Appendix 1.

NC DETECT reports portal

State mandates govern public health investigations for conducting general surveillance and for identifying and responding to bioterrorism-related events. According to these mandates, the NC DETECT web

application provides access to near real-time data. Thus, NC DETECT allows for rapid monitoring of evolving situations of public health importance.

As a statewide system, NC DETECT serves users in multiple jurisdictions with varying responsibilities. Through the system's web application, authorized users can access reports from EDs and other data sources — aggregate syndromes and patient specific line listings, for example. Authorized users may use identifiable data to investigate public health events. NC DETECT contains specialized tools for monitoring and documenting emerging public health situations and threats, and for conducting surveillance of select chronic diseases and infections that are reported to the NC DPH.

NC DETECT uses a user-centered and iterative process to develop its web functionality; enhancements and additions are made in response to feedback from stakeholders. To ensure secure access, users are assigned pre-defined roles based on: 1) geography, 2) data source, and 3) approval from the NC DPH to access aggregate or line listing data, protected health information, and user-added textual notes. Additional roles can be defined as needed; thus, NC DETECT meets the needs of all potential users.

Custom analyses and data requests

When the available reports do not meet user needs, CCHI staff can conduct custom analyses or, pending approval from the NC DPH, respond to custom data requests. To make these custom data requests, users must provide a brief but detailed description of the proposed study, including a list of the data elements of interest. Users may submit such requests on the NC DETECT website. The data requester must also sign a Data Use Agreement with the NC DPH and receive approval from their institution's Institutional Review Board.

Topics covered in custom data requests from 2009 included but were not limited to the following:

- Dog bites
- Cycle crash/head injury
- Stroke
- Cell phone injuries
- Poisonings
- Public Health Regional Surveillance Team (PHRST) users activity log
- Heroin overdoses
- Cardiac arrests

- Chronic Obstructive Pulmonary Disease (COPD)
- Rabies post-exposure prophylaxis
- Heat-related illness

In addition to providing one-time custom data sets, NC DETECT provides daily, quarterly or annual datasets to the following groups:

- Injury and Violence Prevention Branch, Chronic Disease and Injury Section, NC DPH
- North Carolina Division of Mental Health, Developmental Disabilities and Substance Abuse Services
- BioSense (CDC)[5]
- The Distribute Project of the International Society for Disease Surveillance[6]

Syndromic surveillance

To conduct syndrome-based monitoring, NC DETECT uses data from the following sources: hospital EDs, the Carolinas Poison Center (CPC), urgent care centers, and emergency medical services (EMS). ED visits are grouped into syndromes based on analyses of three items — the chief complaint, the initial ED temperature, and, when available, the triage note. The syndromes are based on the CDC's Syndrome Definitions for Diseases Associated with Critical Bioterrorism-Associated Agents.[7] All syndromes, except "Gastrointestinal All," require the presence of constitutional symptoms.

Clinical symptoms can be "binned" into one or more of the following syndromes:

ED syndrome	Diseases the syndrome definition is designed to detect
Botulism-like	Botulism
Fever/Rash	Plague, smallpox, viral hemorrhagic fevers (Ebola, Marburg, Old World Lassa, Junin, Machupo), vaccine preventable diseases (rubella, varicella, measles)
Gastrointestinal All & Gastrointestinal Severe	Anthrax (gastrointestinal); Food borne/infectious diseases: Shigella, Salmonella, E. Coli O157:H7, Norovirus; Chemical agents: Vesicants/Blister Agents: sulfur mustard, lewisite, nitrogen mustard, mustard lewisite, phosgene-oxime, Ricin (Castor bean oil extract); T-2 mycotoxins: Fusarium, Myrotecium, Trichoderma, verticimonosporium, Stachybotrys
Influenza-like Illness & CDC Influenza-like	Influenza

Illness	
Meningoencephalitis	Meningococcal/pneumococcal meningitis, viral encephalitis (WNV, EEE, CAL); Chemical agents: Nerve: Sarin (GB), Tabun (GA), Soman (GD), Cyclohexyl Sarin (GF), VX, Novichok agents, organophosphorous compounds (carbamates & pesticides); Cyanides: hydrogen cyanide (HCN), cyanogen chloride; T-2 mycotoxins: Fusarium, Myrotecium, Trichoderma, verticimonosporium, Stachybotrys
Respiratory	Anthrax, plague, tularemia, SARS, influenza; Chemical Agents: Vesicants/Blister Agents: sulfur mustard, lewisite, nitrogen mustard, mustard lewisite, phosgene-oxime; Pulmonary/Choking Agents: phosgene, chlorine, diphosgene, chloropicrin, oxide of nitrogen, sulfur dioxide, Ricin (Castor bean oil extract); T-2 mycotoxins: Fusarium, Myrotecium, Trichoderma, verticimonosporium, Stachybotrys
Respiratory All	Category A agents: anthrax, plague, tularemia; Other diagnoses of public health priority: SARS, influenza; Chemical Agents: Vesicants/Blister Agents. Pulmonary/Choking Agents

Originally, the NC DETECT system was designed for bioterrorism surveillance; however, the flexibility of NC DETECT syndromes has enabled broader surveillance activities. Individuals can use NC DETECT syndromes to monitor seasonal trends and identify potential outbreaks of diseases — influenza, food-borne illnesses, or chemical exposures, for example. Users can review, comment on, or "annotate" signals or aberrations for the entire population, or for nine separate age groups. The aberrations are detected using the CDC's Early Aberration Reporting System (EARS) CUSUM algorithms.[8]

The Syndrome Definition Workgroup meets regularly to evaluate and refine the syndromes used in NC DETECT. Workgroup members include clinicians, epidemiologists and informaticists from the NC DPH, UNC CCHI, and the hospital-based public health epidemiologist (PHE) program.

Sample analyses of ED syndromes

ED syndromes can be used to analyze trends and detect outbreaks. Trends in ED data are particularly useful for tracking statewide influenza morbidity on a near real time basis. For example, NC DETECT ILI data are included in the North Carolina Weekly Influenza Summary, which is a report that is distributed and prepared by the NC DPH's Communicable Disease Branch. In addition, hospital-based public health epidemiologists and regional surveillance teams create weekly reports that they distribute to staff at hospitals and local health departments. Patient care at hospitals as well as EDs benefits from these weekly reports. For example, these data help hospital laboratories to prepare for increases in flu tests and allow providers to anticipate upsurges in diagnoses, anti-viral prescriptions, and the need for isolation beds.

Figures 1 and 2 graphically compare ILI for four flu seasons. Figure 1 provides information on the proportion of ED visits that were attributable to ILI during each week of the flu season. Public health officials can use this plot to monitor influenza across the state. Examining proportions rather than counts helps account for any underlying variability in total ED visits throughout the year. Figure 2 shows the percentage of ED ILI visits that resulted in a hospital admission. This graph allows public health officials to monitor ILI severity.

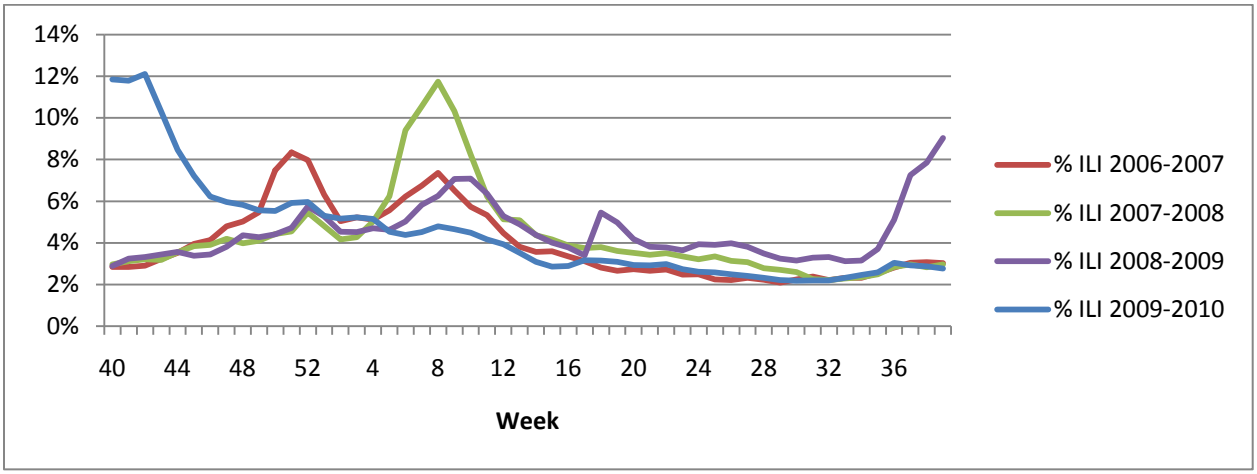


Figure 1. Percentages of North Carolina ED visits from 2006 to 2010 with influenza-like illness, by week[1]
[1] Week 40 begins in the first week of October

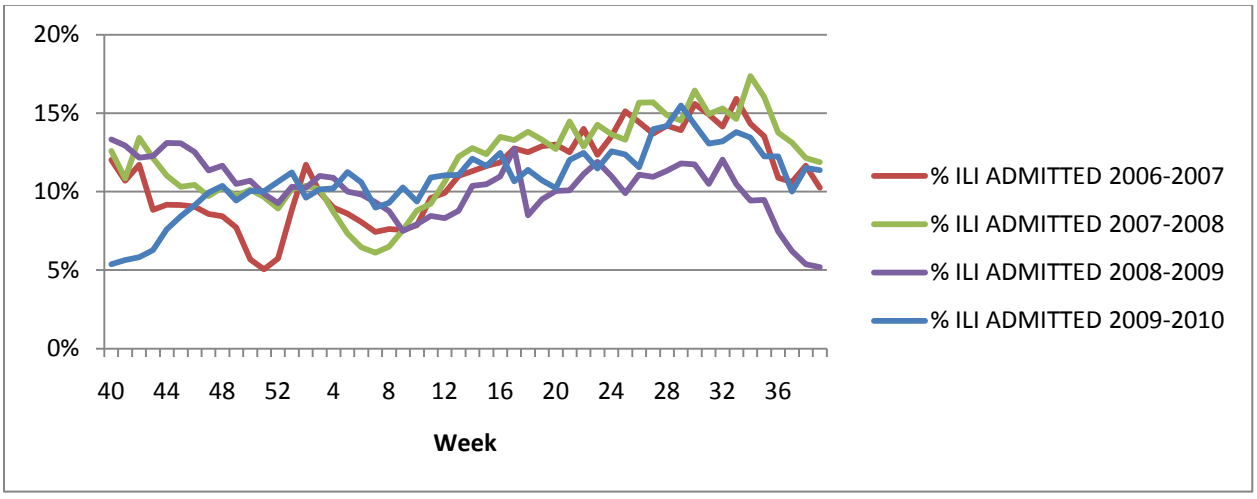


Figure 2. Percentages of North Carolina ED visits from 2006 to 2010 with influenza-like illness that were admitted to the hospital[1]
[1]Week 40 begin in the first week of October

Annotation Analysis

With NC DETECT's annotation functionality, authorized users can view the EARS signals for each syndrome, access patient-specific information, add comments to signals, and view comments made by other users who have access to the same signals. Users may also assign an investigation status to the signals - *active investigation, monitoring, no action needed, or investigation complete*.

If NC DETECT does not generate a signal for a known or suspected public health situation, users can add an event with their own parameters to the annotation reports. They can then comment on and monitor the newly added event. Authorized users created the following events in 2009: clusters of food borne illness, salmonella, norovirus and brucellosis, as well as single, unrelated cases of LaCrosse encephalitis, nH1N1 and pertussis.

In 2009, NC DETECT generated 12,140 signals based on patient's county of residence (an average of 33.3 signals per day across 100 counties and nine syndromes) and 14,874 signals based on the hospital visited (an average of 42.0 signals per day across 120 hospitals). These annotation counts include data from eight Veteran's Administration (VA) hospitals. VA hospital data are not included in any other analyses in this report.

A review of the annotation data indicates that, in 2009,114 county-based signals were investigated, 1,657 signals were immediately ruled out and 10,369 were not documented. Of the hospital-based signals, 600 were investigated, 3,121 were immediately ruled out and 11,153 were not documented. Undocumented signals do not necessarily indicate a lack of review of the data: not all users are required to use NC DETECT's annotation functionality when viewing the data.

At ten hospital systems in North Carolina, state-funded hospital-based public health epidemiologists (PHE) are expected to use the annotation reports and to document any signals that their respective hospitals generate. Limited to the hospitals that the PHEs monitored in 2009, there were 4,254 total signals. Of these, 593 were investigated, 2,876 were immediately ruled out and 785 were not documented within the Annotation Report. In both county and hospital ED data, the following three syndromes generated the most signals: respiratory all (~ 18% of all signals), influenza-like-illness (ILI) (~ 18%), and gastrointestinal (GI) all (~ 14%). Botulism-like and fever/rash syndromes generated the fewest signals; each represented approximately 2% of all signals.

There is ongoing work to improve syndrome definitions and algorithms, and to determine new methods for improving the positive predictive value of NC DETECT for early event detection.

NC DETECT ED data characteristics

ED data provide valuable information on acute illness and injury across the state and by region; these data help identify populations that are vulnerable to specific disorders. NC DETECT data include 4,382,051 ED visits from 2009 alone and 15,522,331 visits from 2006 to 2009.

Compared to hospital discharge data or specialized registries, ED data represent a more comprehensive source for identifying trends in acute illness and injury. For example, hospital discharge databases represent only those patients who have been admitted to hospitals. These patients typically represent only about 12% of the ED visits in the United States[9] and 13.6% of the ED visits in North Carolina (Table 3). Thus, an examination of only hospital discharge databases would exclude approximately 86.4% of the North Carolina ED visits from 2009. Similarly, specialized registries - trauma registries, for example - often capture data from a limited number of hospitals and/or for a defined subset of individuals.[10,11] For instance, in 2009, NC DETECT identified more than 8 times more bicycle crash related injuries than did the North Carolina Division of Bicycle and Pedestrian Transportation.[12]

NC DETECT ED data represent only those disorders or situations that result in a visit to the ED. According to national data, approximately 89% of ambulatory care visits are made to physician offices or clinics and 11% are made to EDs.[13] Since statewide information on physician clinic or office visits is currently unavailable, NC DETECT is the best source for population-based acute care data in North Carolina.

Patients might visit multiple EDs for the same problem.[14] Currently, NC DETECT data can be used to identify visits only to the same ED, and it is not possible to utilize linkages to identify a patient's visits to all North Carolina EDs. NC DETECT's utility would be enhanced by the ability to track all serial ED visits.

The statewide North Carolina ED visit rate for 2009 was 467 visits/1,000 person-years (Table 2). This represents a small increase from the 2008 rate of 454 visits/1,000 person-years. The rate estimates published in this report are conservative because the numerators and denominators reflect slightly different North Carolina demographics. For example, military and prison hospital EDs do not submit visit data to

NC DETECT. Therefore, many ED visits made by military and imprisoned populations are probably not represented in the rate numerators, even though members of these subpopulations are included in the population-based denominators.

ED visits in North Carolina: An overview

In this report, we analyzed 2009 North Carolina ED visit data according to the following variables: sex, age, geographic residence, method of arrival to the ED, return and repeat ED visits, expected source of payment, and ED disposition. Data tables include counts of visits, percentages, and/or rates. Since data are from one complete year, rates are reported as the number of visits per 1,000 person-years. Rates were calculated by dividing counts of ED visits for subgroups of interest by the 2009 certified North Carolina population estimates.[15] As discussed above, these rates are conservative since the denominators consist of counts for the entire population, but the numerators exclude visits to military, veterans, psychiatric, specialty, and prison hospital EDs.

For analyses of region in the 2007 NC DETECT annual report,[3] data were stratified by the seven Public Health Regional Surveillance Team (PHRST) regions. This method for reporting of PHRST regions is comparable to that which the funder, the NC DPH, uses. However, in NC DETECT's 2008 and 2009 annual reports, data are stratified by three geographic areas - coastal plains, piedmont, or mountains (Appendix 3).[16] The Secretary of State's office uses these three geographic regions. Compared to the PHRST regions, the three geographic regions are more readily intuitive to the general user.

More detailed analyses are presented for the following:

First-listed diagnoses: NC DETECT records up to 11 diagnoses per visit. According to coding guidelines, the first-listed diagnosis code should be "the diagnosis, condition, problem, or other reason for the encounter/visit shown in the medical record to be chiefly responsible for the services provided."[17] For all visits and for visits by repeat patients, we examined the most frequently appearing first-listed diagnoses, with minimal grouping of codes for medical clarity (Table 4 and 5). We also examined the top ten first-listed diagnoses in the ED records for members of the following groups: children, women of childbearing age, and pregnant women (Table 23).

Disease groups: In addition to the first-listed diagnosis code, coders are instructed to record all coexisting conditions that affected patient care at the time of the visit.[17] For each visit, hospitals report up to 11 ICD-

9-CM diagnosis codes to NC DETECT (including the first-listed code). We used sets of first-listed as well as comorbid ICD- 9-CM codes to identify epidemiologically important disease groups (Appendix 2).[18] The following are the disease groups that we selected and reviewed: 1) chest pain and ischemic heart disease, 2) psychiatric disorders, 3) lower respiratory tract disorders, 4) substance abuse/dependency (SAD) and acute intoxication or withdrawal (AIW), 5) diabetes mellitus, 6) neoplasm, 7) heart failure, 8) dental conditions, 9) stroke and transient ischemic attacks (TIA), 10) traumatic head injuries, 11) cardiac arrest, and 12) sickle cell disease and other hemoglobinapothies (Tables 6-22 and 26).

Injuries: We created injury groups according to the classification system that the National Hospital Ambulatory Medical Care System (NHAMCS) used in its 2006 report; this includes both unintentional and intentional injuries (Table 27). To capture the maximum number of reported visits with a type of injury, we used two types of codes: 1) ICD-9-CM injury and poisoning codes (800-999) and 2) cause of injury codes (E-codes). We only used E-codes to categorize the injury-related visits. We conducted in-depth analyses for unintentional falls (Table 28) and specific transportation-related ED visits (Tables 29-30). Tables 29 and 30 cover ED visits that resulted from the following: 1) motor vehicle traffic crash injuries, 2) motor vehicle non-traffic crash injuries, 3) pedal cyclist injuries, and 4) pedestrian injuries.

Missing data

Visits that were missing one data field were likely to be missing other fields, as well. For example, approximately 19% of the visits that were missing information on region were also missing data on the expected source of payment. In the tables that we show in this report, we include a row that describes the number of observations with missing information for each variable (i.e. sex, age, geographic region, disposition, etc.).

Total North Carolina ED visits and repeat visits

In 2009, hospitals reported 4,382,051 ED visits to NC DETECT; 2,666,704 individually identified patients made these visits (Table 1). This single patient count could be inflated. NC DETECT is only able to track repeat visits to the same ED, and if the same patient visited two or more different EDs in 2009, he or she would be counted as 2 or more different people.

In the 2009 NC DETECT data, the majority of the patients (69.4%) made only one visit to the same ED; the remaining 30.6% of patients (N=817,328) made two or more visits to the same ED (Table 1). Of the 4,382,051 total North Carolina ED visits in 2009, 5.3% were return visits that the patient made within 72 hours of the initial visit; this is larger than the 3.8% of national ED visits that were returns within 72 hours

of the first visit.[9] While these proportions are important quality control measures, they also represent patients who were instructed to return to the ED for follow-up treatments.

In 2009, approximately 28.4% of North Carolina's total population, which the North Carolina Office of State Budget and Management estimates as having been 9,382,609 people, visited a North Carolina ED at least once (Table 1). This is a higher proportion compared to the 27.7% in 2008 and 26.3% in 2007 (data not shown). These proportions are estimates, since residents of Virginia, South Carolina, and Tennessee might use North Carolina EDs located near the borders of these states. Indeed, NC DETECT data show that in 2009, 156,710 ED visits were made by patients from outside of North Carolina. Similarly, North Carolina residents might have visited EDs in neighboring states.

In total, 9,333 patients visited the same ED 12 or more times. Approximately 47% of these patients were ages 24 to 44, 29% were ages 45 to 64, and 9% were ages 65 and older. Fewer than 1% of the 9,333 visitors were ages 0 to 1 or ages 2 to 14. Approximately 61% of the patients who visited the ED 12 or more times in 2009 were female and 39% were male (data not shown).

Table 1. Number of visits that each unique patient made to the same North Carolina ED in 2009

	ED Patients	
Number of Visits	**No.**	**%[1]**
One ED visit	1,849,376	69.4
Two ED visits	458,894	17.2
Three ED visits	172,272	6.5
More than three ED visits	186,162	6.9

[1]Denominator for the percent is the total number of individually identified patients who made a visit the a NC ED in 2009, N= 2,666,704

In 2009, there were 467 visits to the ED per 1,000 person-years; this represents an increase from the North Carolina ED visit rates in 2008 and 2007— 454/1,000 and 425/1,000 person-years, respectively. The 2009 North Carolina ED visit rate is higher than the estimated rates for the nation (390.4/ 1,000 person-years), and for the southern region of the United States from 2007 (450/1,000 person-years).[9]

Women made over half (56.3%) of North Carolina ED visits (Table 2). Similarly, individuals between the ages of 25 and 64 accounted for slightly over 50% of ED visits. However, infants had the highest rate of ED visits, followed by individuals ages 19 to 24, and 65 and older. Between 2008 and 2009, the rate of ED visits among infants increased from 782.1/1,000 person-years to 809.9/1,000 person-years. Similarly, the rate of visits made by young adults ages 19 to 24 years increased, from 560.3/1,000 in 2008 to 598.7/1,000 person-years in 2009. However, the visit rate for individuals ages 65 and older decreased from

570.2/1,000 person-years in 2008 to 556.5/1,000 person-years in 2009. This is at least partially attributable to a larger proportional increase in the total number of North Carolina residents ages 65 and older than in the number of ED visits made by this demographic: from 2008 to 2009, there was an approximately 4% increase in the population of individuals ages 65 and older compared to a 2% increase in number of visits.

Table 2. North Carolina ED visits from 2008 and 2009, stratified by sex, age, and region of residence

	2008			2009		
	No.	%[1]	Rate[2]	No.	%[3]	Rate[1]
Total	4,190,911	100	454.2	4,382,051	100	467.0
Sex						
Female	2,347,183	56.0	502.4	2,466,016	56.3	515.5
Male	1,842,506	44.0	404.5	1,915,628	43.7	416.5
Missing	1,222	---	---	407	---	---
Age Group						
0-1	201,948	4.8	782.1	209,637	4.8	809.9
2-4	159,377	3.8	436.8	182,085	4.3	482.3
5-9	164,021	3.9	271.9	189,435	4.3	310.1
10-14	148,241	3.5	245.8	164,126	3.8	274.7
15-18	209,990	5.0	397.5	216,889	5.0	426.5
19-24	464,933	11.1	560.3	495,846	11.3	598.7
25-44	1,284,940	30.7	511.9	1,316,025	30.0	502.9
45-64	906,209	21.6	379.2	945,952	21.6	394.9
65 and over	649,674	15.5	570.2	661,693	15.1	556.5
Missing	1,578	---	---	363	---	---
Region						
Coastal Plains	1,241,740	29.7	468.4	1,316,731	30.1	489.5
Piedmont	2,256,493	54.0	415.4	2,351,073	53.8	424.4
Mountains	535,020	12.8	467.5	549,676	12.6	476.8
Out of State	148,984	3.6	---	156,710	3.6	---
Missing	8,674	---	---	7,861	---	---

[1]Denominator is the total number of NC ED visits in 2008
[2]Rate is reported per 1,000 person-years
[3]Denominator is the total number of NC ED visits in 2009

Residents of the piedmont, which is the most populous region in North Carolina, accounted for the largest proportion of visits to the ED (53.8%). However, residents of the piedmont had a lower ED visit rate compared to residents of the coastal plains and mountains. From 2008 to 2009, there were increases in the rate of ED visits in all regions. The distributions of ED visits by gender and age were fairly consistent when stratified across geographic regions, although a slightly higher proportion of visits from the mountains were made by people ages 65 and older (data not shown).

Payment

Since 2007, the proportion of North Carolina ED visits expected to be paid by insurance companies decreased, while the proportion expected to be self-paid or paid by Medicaid increased. In 2009, state and federal government programs were the expected sources of payment in 45% of North Carolina ED visits (Figure 3). These government payment programs include the following: Medicare (18.2%), Medicaid (23.5%), worker's compensation (0.9%) and other government programs (2.3%). Private insurance and self-pay combined made up a large proportion of the remaining visits (25.6% and 24.7% of visits, respectively). Less than one percent of the ED visits were reported as having "no charge."

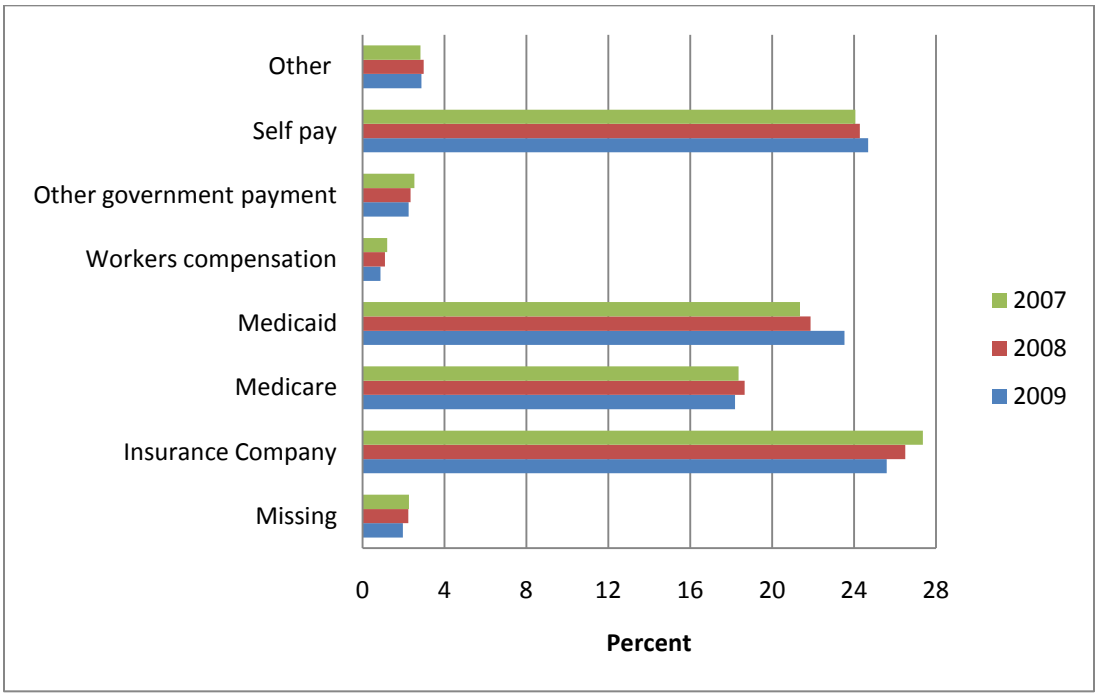


Figure 3. Expected source of payment for North Carolina ED visits by year, 2007-2009[1]

[1]Similar to years 2007 and 2008, only 0.02% of visits had a no charge payment in 2009. Therefore, these visits are not represented in the figure.

Compared to these NC data, in the United States, private insurance was expected to pay for a much higher proportion of ED visits (39%); a lower proportion was expected to be self-paid (only 15.3% of ED visits).[9] However, government programs were expected to pay for approximately the same proportion of United States ED visits in 2007 (42.4%) as for North Carolina ED visits in 2009.[9]

In 2009 NC DETECT data, the expected payment source varied according to age group. The youngest and oldest populations relied more heavily on government payments (Figure 4); this corresponds to expectations, since federal insurance programs target members of these age groups. Also, since the United

States health insurance system is based on employer paid insurance, one would expect private insurance to represent the major source of payment for working ages.

Compared to other age groups, a higher proportion of visits by patients between the ages of 19 and 24 were self-paid. This corresponds to national data on the uninsured population in the United States. The United States Census Bureau estimates that in 2009, 18 to 24 year olds represented the highest proportion, about 30%, of the United States' uninsured population. People ages 25 to 34 followed closely behind; they represented 29.1% of the nation's uninsured.[19]

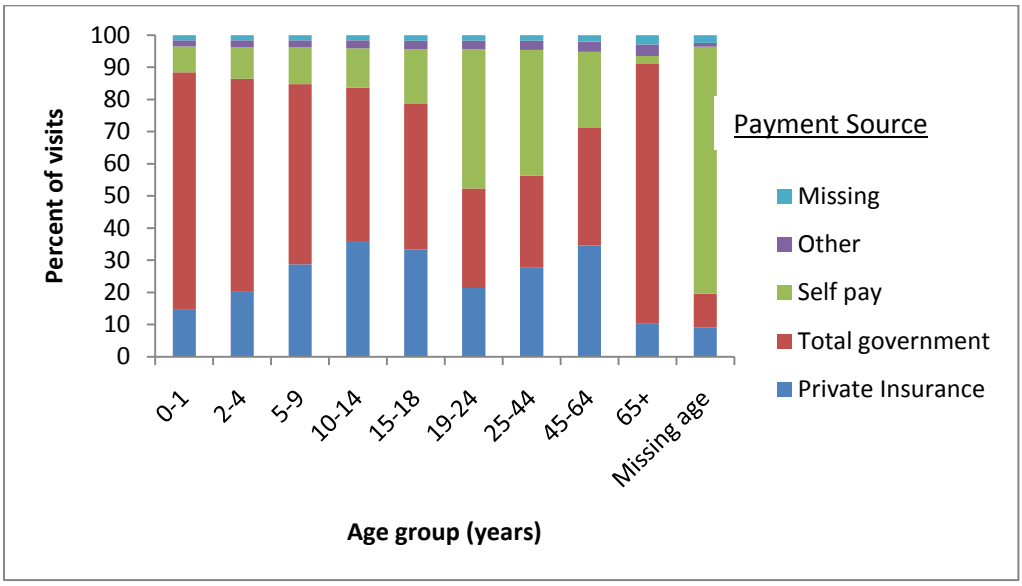


Figure 4. Expected source of payment for North Carolina ED visits from 2009, by age group

ED visits in the coastal plains region accounted for the largest proportion of federal or state payments (50.9%) — mostly from Medicare and Medicaid (Figure 5). Of all the geographic regions in North Carolina, the piedmont reported the highest proportion of visits expected to be covered by private insurance (29.7%).

Transportation

A common misconception is that most ED patients are transported by ambulance. In fact, in the majority of visits in the 2009 ED data, the patient used their own transportation to arrive at the ED; this is known as being a 'walk-in' (Figure 6). In 2009, 11% of visits arrived with EMS by ambulance, less than 1% arrived by air ambulance, and approximately 2% were transported by an 'other' mode of transport. Despite continued efforts to acquire more complete data, information on patients' mode of transportation was

reported in only about 75% of records. While this percentage is similar to the proportion of records that reported a transport mode in 2008, it is lower than the 79% of 2007 NC DETECT records with complete information on transport mode.

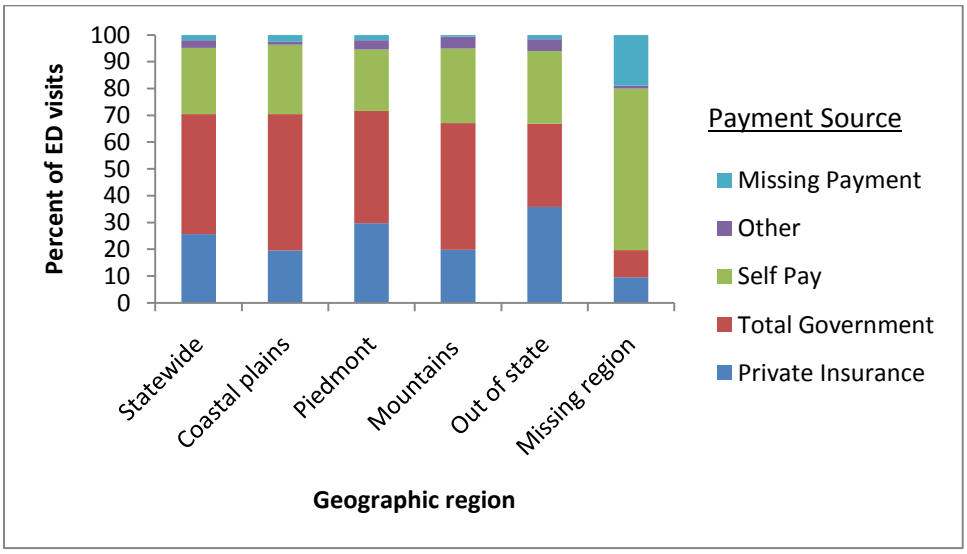


Figure 5. Expected source of payment for North Carolina ED visits from 2009, by region of residence

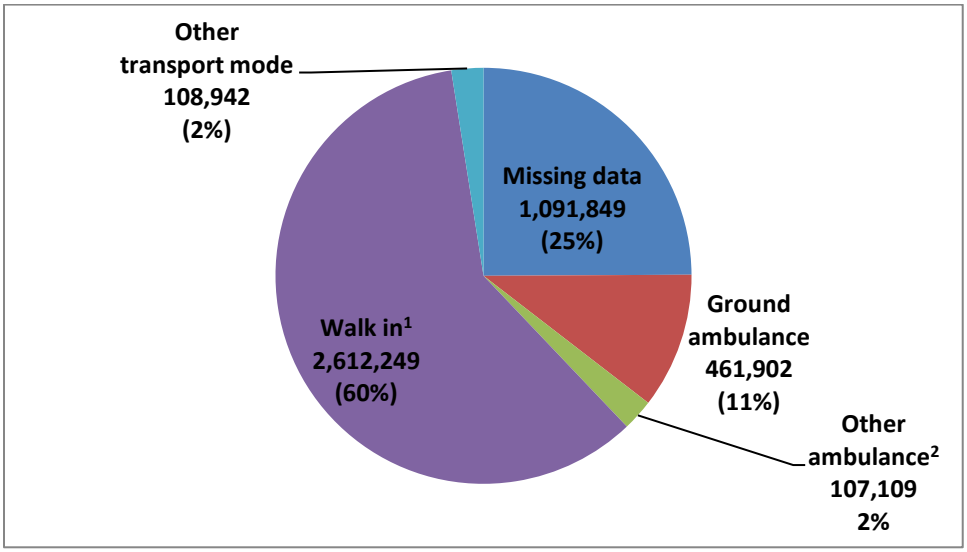


Figure 6. North Carolina ED visits from 2009, by method of transportation

[1]Walk-in: private transportation, public transportation, non-ambulance law enforcement, and type of walk-in not otherwise specified
[2]Other ambulance: helicopter ambulance, fixed-wing ambulance and ambulance not specified.

Disposition

In 77.2% of ED visits, the patient received care at the hospital where they initially presented and was subsequently discharged. In 1.7% of visits, the patient was transferred to another facility (Table 3). In

12.8% of ED visits, the patient was admitted to an inpatient unit in the same hospital; this proportion is consistent with the national estimate of 12.5% in 2007. Proportions of North Carolina ED visits that left 'against medical advice' (1.3%) and 'left without being seen' (2.1%) are also consistent with 2007 national estimates.[9]

Disposition varied only slightly by region: the patient was discharged in 76.5% of visits from the mountains, 78.2% from the piedmont, and 75.8% from the coastal plains. Also, lower percentages of visitors from the mountains "left without being seen" (1.0%) compared to the piedmont (2.2%) and coastal plains (2.6%; data not shown).

Average patient age varied by disposition. Patients who left without being seen were the youngest, with an average age of 29. Patients who left against medical advice were relatively young, also; their average age was 34. With a mean age of 57, patients who were admitted to the hospital were older. Similarly, patients who died tended to be older; their average age was 60 (Table 3).

Table 3. North Carolina ED visits from 2009, by disposition and mean age

	ED Visits		
	Number	Percent	Mean age (Standard deviation)
Total Visits	4,382,051	100	37.5 (24.2)
Disposition			
Discharged from ED	3,383,244	77.2	33.9 (22.3)
Admitted to hospital[1]	562,243	12.8	57.4 (22.6)
Transferred to general hospital[2]	35,385	0.8	48.8 (26.0)
Transferred to specialty care[3]	38,991	0.9	53.6 (25.9)
Left against medical advice	56,028	1.3	33.8 (21.5)
Left without being seen	89,943	2.1	29.4 (19.2)
Died	8,117	0.2	60.0 (32.8)
Other/Unknown	54,842	1.3	44.3 (25.8)
Missing	137,802	3.1	38.1 (31.9)

1 Admissions to general hospital includes placed in observation unit; excludes observation and death in ED
2 Transfers to another short-term general hospital
3 Transfers to psychiatric, substance abuse rehabilitation, rehabilitation or veterans' hospitals, prisons or prison hospitals

ED visit diagnosis codes

For each visit that they report, hospitals send up to11 diagnosis codes to NC DETECT. According to ICD-9-CM diagnosis coding and reporting guidelines, the first-listed diagnosis should describe the diagnosis, condition, or problem that was the principal reason for the visit.[17] Secondary to the first-listed diagnosis, coders should list all conditions that coexist at the time of the visit.

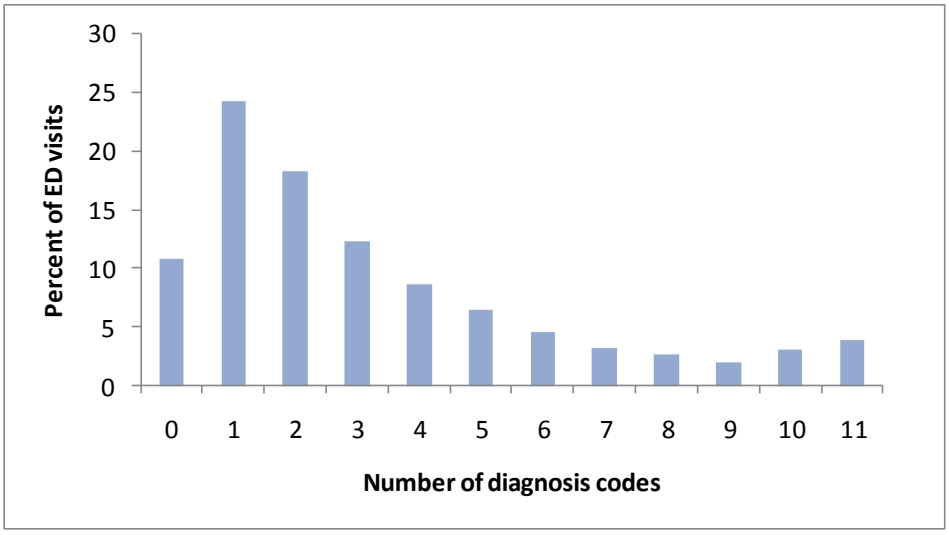


Figure 7. Number of diagnosis codes in NC DETECT visit records, reported as a percentage of the total number of ED visits, 2009[1]

[1] Of the 4,382,051 total records in 2009, 7.6% were missing an ICD-9-CM code in first position, and approximately 83% of these were missing diagnosis codes in all other positions, as well.

Of the 4,382,051 ED visits from 2009, nearly 11% were missing an ICD-9-CM diagnosis code in any of 11 possible fields, 24% reported one diagnosis code, 18% reported two diagnosis codes, and approximately 47% reported three or more codes (Figure 7). About 2% of ED visit records were missing a diagnosis code in the first position but had an ICD-9-CM diagnosis code at another position. In this report, the first appearing code is defined as the first-listed diagnosis.

We examined the 100 most common first-listed diagnoses, considering all possible ICD-9-CM codes. Working from this list, we collapsed the codes that were clinically similar within the context of a visit to the ED. The individual diagnosis codes that appeared most frequently in the first position are shown, with minimal grouping, in Table 4. The most frequently reported first-listed diagnoses were abdominal and chest pain: over 3% of all ED visits had a first-listed diagnosis of abdominal pain, and over 3% had first-listed diagnosis of chest pain. Rates of visits with these diagnoses exceeded 14.0/1000 person-years.

Table 4. The most common first-listed diagnosis codes in North Carolina ED visit data from 2009

Diagnosis group	Diagnosis codes	ED visits	%[1]	Rate[2]
Abdominal Pain	789.0, 789.00, 789.03, 789.09	141,704	3.6	15.1
Chest Pain	786.5, 786.50,786.59	134,647	3.4	14.4
Acute URI/Pharyngitis, Streptococcal sore throat	034.0, 465.9, 462	131,133	3.4	14.0
Back Pain, Strains/Sprains of Lumbar spine, Sciatica	724.2, 724.3, 724.5, 847.2	123,361	3.2	13.1
Headache, Migraine Unspecified	784.0, 346.9	101,878	2.6	10.9
Cough, Bronchitis	786.2, 466.0, 490	101,803	2.6	10.9
Fever, Unknown origin	780.6, 780.60	83,324	2.1	8.9
Nausea with vomiting, or vomiting alone	787.01, 787.03	70,192	1.8	7.5
Dental caries, Periapical abscess, Tooth/ structure disorders	521.00, 522.5, 525.9	61,767	1.6	6.6
Urinary Tract Infection	599.0	59,063	1.5	6.3
Essential Hypertension	401.9	54,261	1.4	5.8
Neck sprains/strains	723.1, 847.0	49,468	1.3	5.3
Pain in Limb	729.5	51,105	1.3	5.4
Asthma, unspecified	493.90, 439.92	43,951	1.1	4.7
Pain in Joint	719.41, 719.45, 719.46	43,060	1.1	4.6
Pneumonia	486	37,140	1.0	4.0
Open wound of hand or finger without complication	882.0, 883.0	30,474	0.8	3.2
Otitis Media	382.9	35,875	0.9	3.8
Syncope and Collapse	780.2	29,914	0.8	3.2
Contusion of face, scalp, and neck except eyes	920	26,445	0.7	2.8
All other diagnoses		2,521,653	64.5	266.2
Missing primary diagnosis code		474,179	--	--

[1]Denominator is the total number of NC ED visits in 2009 (N=4,382,051)
[2]Rate is reported per 1,000 person-years

In 2009, 9,333 patients visited the same ED twelve or more times. The three most common first-listed diagnosis codes in the records of these frequent ED users were similar to those for the general ED population (Table 5). For males who visited the ED 12 or more times, the three most common first-listed diagnoses were abdominal pain, chest pain, and backache. For females who visited the ED 12 or more times, the three most common first-listed diagnoses were headache, abdominal pain, and chest pain. For patients ages 0 to 1 who visited the ED twelve or more times, common first-listed diagnoses were acute upper respiratory infection (URI), fever, and otitis media. Because so few patients who visited an ED 12 or more times were between the ages of 2 and 14, we collapsed these ages into a single category. Among patients ages 2 to 14 who visited the ED 12 or more times, the most frequently appearing first-listed diagnoses were fever, acute URI, and otitis media. For frequent users of the ED who belonged to other age categories, commonly appearing first-listed diagnoses included headache, abdominal pain, disorders of teeth and supporting structures, chest pain, shortness of breath, and essential hypertension.

Table 5. The three most common first-listed diagnosis codes for patients who visited a North Carolina ED 12 or more times in 2009

Sex	
Female	Headache (784.0), Abdominal pain (789.00), Migraine (346.90)
Male	Abdominal pain (789.00), Chest pain (786.50), Headache (784.0)
Age group	
0-1	Fever (780.6), Acute URI (465.9), Otitis Media (382.9)
2-14	Fever (780.60), Acute URI (465.9), Otitis Media (382.9)
15-18	Headache (784.0), Disorder of teeth and supporting structures (525.9), Abdominal pain (789.00)
19-24	Abdominal pain (789.00), Headache (784.0), Disorder of teeth and supporting structures (525.9)
25-44	Headache (784.0), Abdominal pain (789.00), Migraine (346.90)
45-64	Chest pain (786.50), Headache (784.0), Essential hypertension (401.9)
65 and over	Chest pain (786.50), Shortness of breath (786.05), Essential hypertension (401.9)

ED visits by select disease groups

Based on clinical experience and/or the belief that the items could be of public health importance, we conducted further analyses of select disease groups. Table 6 shows the numbers of ED visits with diagnoses for selected disease groups; these are the total ED visits with one or more codes that define a disease group (Appendix 2). The percentages reported in Table 6 do not add to 100 because one ED visit could include ICD-9-CM diagnosis codes in multiple categories. For example, one patient visit to the ED might have been assigned diagnosis codes for both chest pain and diabetes.

Using diagnosis codes in any of the 11 possible positions, the following were the five most common-disease groups: 1) chest pain/ischemic heart disease, 2) lower respiratory tract disorders, 3) psychiatric disorders, 4) diabetes, and 5) substance abuse, intoxication, and withdrawal.

Table 7 shows the proportion of these visits for which the diagnosis was first-listed. Of the 516,972 visits with a code for chest pain, the diagnosis was first-listed in 210,018, or 40.6%, of these visits. Over 50% of the visits with a diagnosis for traumatic head injuries, cardiac arrest, and dental problems were diagnosed in the first position. However, only 11.9% of the 344,690 visits with a diabetes diagnosis had the code listed in the first position.

Table 6. North Carolina ED visits from 2009 with select disease group diagnoses coded in any of 11 possible positions

Disease groups	ED Visits		
	No.	%[1]	Rate[2]
Chest Pain/Ischemic Heart Disease	516,972	11.8	55.1
Lower Respiratory Tract Disorders	481,177	11.0	51.3
Psychiatric Disorders	382,005	8.7	40.7
Diabetes	344,690	7.9	36.7
Substance Abuse	121,386	2.8	12.9
Heart Failure	110,352	2.5	11.8
Neoplasms	82,215	1.9	8.8
Dental Problems	47,029	1.1	5.0
Stroke / TIA	37,668	0.9	4.0
Traumatic Head Injuries	20,741	0.5	2.2
Cardiac Arrest	7,035	0.2	0.7

[1]Denominator is the total number of NC ED visits in 2009 (N=4,382,051).
[2]Rate is reported per 1,000 person-years

Table 7. North Carolina ED visits from 2009 with select disease group diagnoses coded in the first-listed position

Disease groups	ED Visit	
	No.	%[1]
Chest Pain/Ischemic Heart Disease	210,018	40.6
Lower Respiratory Tract Disorders	175,461	36.5
Psychiatric Disorders	89,668	23.5
Diabetes	40,924	11.9
Substance Abuse	34,791	28.7
Heart Failure	22,004	19.9
Neoplasms	11,886	14.5
Dental Problems	26,756	56.9
Stroke / TIA	17,136	45.5
Traumatic Head Injuries	12,104	58.4
Cardiac Arrest	3,752	53.3

[1]The denominators for the percentages were based on the counts of disease groups using first-listed or comorbid diagnosis codes, as reported in Table 6.

Cardiac disease and stroke diagnosis groups

Tables 8-10 show the statewide proportions and rates of visits with select cardiac diseases and stroke syndromes by first-listed and comorbid conditions, and according to demographic characteristics. We discuss these tables in the sections below.

Chest pain and ischemic heart disease

In 4.8% of the 2009 ED visit records, chest pain/ischemic heart disease was recorded in the first position (Table 8). In 11.8% of ED visits, chest pain/ischemic heart disease was reported in the first position, or as a comorbid condition. There were 55.1 visits for chest pain/ischemic heart disease per 1,000 person-years. Approximately 2.4% of ED visits with a first-listed or comorbid diagnosis for chest pain/ischemic heart

disease had an acute myocardial infarction (MI) diagnosis. ST elevation (STEMI) was reported in approximately one quarter of these acute MI visits.

Females had a higher rate of visits for chest pain/ischemic heart disease than males (58.3 visits per 1,000 person-years, compared to 51.8 visits per 1,000 person-years; Table 9). Patients from the coastal plains and mountains had similar rates of visits for chest pain and ischemic heart disease, while patients from the piedmont had a lower rate — by approximately 10 visits per 1,000 person-years (Table 9). Individuals ages 65 and older experienced the highest rate of ED visits with a chest pain/ischemic heart disease diagnosis in any of 11 possible positions (176.1/1,000 person-years; Table 9).

Age-specific rates of visits for chest pain/ischemic heart disease were approximately the same for males younger than 18 as for females younger than 18. However, women ages 18 to 44 had a higher age-specific rate compared to men ages 18 to 44 (data not shown). Meanwhile, rates for men ages 45 to 64, and for men ages 65 and older, were higher compared to females in these respective age categories (72.7/1,000 for 45-64 year old men vs. 66.0/1,000 for 45-64 year old women, and 184.3/1,000 for 65 and older men vs. 170.0/1,000 for 65 and older women).

Table 8. North Carolina ED visits from 2009 with cardiac or stroke/TIA diagnosis codes in the first-listed position or in any of 11 possible positions

Condition	ED Visits with first-listed diagnosis			ED Visits with first-listed or comorbid diagnosis		
	No.	%[1]	Rate[2]	No.	%[1]	Rate[2]
Chest Pain/Ischemic Heart Disease	210,008	4.8	22.4	516,972	11.8	55.1
Acute Myocardial Infarction – STEMI	2,375	0.1	0.3	3,210	0.1	0.3
Acute Myocardial Infarction - non-STEMI	4,574	0.1	0.5	9,133	0.2	1.0
Heart Failure	22,004	0.5	2.3	110,352	2.5	11.8
Strokes and TIA	17,136	0.4	1.8	37,668	0.9	4.0

[1]Denominator is the total number of NC ED visits in 2009 (N=4,382,051).
[2]Rate is reported per 1,000 person-years

Heart failure

The rate of visits with a first-listed or comorbid diagnosis for heart failure was much lower than the rate of visits with a diagnosis for chest pain/ischemic heart disease (11.8/1,000 person-years compared to 55.1/1,000 person-years; Table 8). The rate of visits with heart failure recorded in the first position was only 2.3 visits/1000 person-years.

Stratified by age, patients ages 65 and older had the highest rate of visits with heart failure coded in any of 11 positions (61.8 visits/1000 person-years; Table 8). This 2009 age-specific rate of heart failure visits

represents a slight increase from 2008, when it was 61.6 visits/1000 person-years. For the most part, age-specific rates of visits with a heart failure diagnosis in any position were similar for men and women. However, the rate of visits for women ages 65 and older was 1.11 times that for men in this age group (64.3/1,000 female person-years vs. 58.2/1,000 male person-years).

Strokes and transient ischemic attacks (TIA)

Of the 4,382,051 ED visits, 0.4% had a stroke/transient ischemic attack (TIA) diagnosis in the first position, and 0.9% had a stroke/TIA diagnosis in any of the 11 possible coding positions (Table 8). Rates of visits for stroke/ TIA were lower than the rates of visits for other cardiac diseases (Table 9). For example, whereas rates of ED visits for chest pain/ischemic stroke and cardiac disease were 55.1/1,000 person years and 11.8/1,000 person-years, respectively, the rate of visits for stroke/TIA was only 4.0/1,000 person-years.

The rate of visits for ischemic stroke were higher than the rate of visits for TIA or hemorrhagic stroke (2.1/1,000 person-years compared to 1.1/1,000 and 0.5/1,000, respectively). For all categories of stroke, rates increased with age and were lowest for patients from the mountains (Table 10). Compared with other diagnoses, high proportions of visits with stroke diagnoses were admitted to the hospital. Of the 37,668 ED visits with a stroke diagnosis, 71% were admitted to the hospital. Approximately 58% and 82% of visits with a hemorrhagic and ischemic stroke diagnosis were admitted, respectively (data not shown).

In 2007, 29,063 ED visits had a diagnosis for ischemic stroke or TIA in any position, compared to 28,643 in 2008 (data not shown) and 29,966 in 2009 (Table 10). These values reflect the total number of diagnosis codes for ischemic stroke (N=19,612 in 2009) and TIA (N=10,354 in 2009) and not the total number of distinct visits with these codes since 1,129 visits had multiple stroke related diagnoses (Table 10).

Fifty-three North Carolina hospitals report to the North Carolina Collaborative Stroke Registry (NCCSR), which is a voluntary registry that provides information on stroke-related hospitalizations across the state. According to NCCSR, North Carolina belongs to the "Stroke Belt," which is a group of southeastern US states that have higher rates of stroke mortality compared to the national average. With 4,335 stroke-related deaths reported in 2007, North Carolina has the sixth highest rate of stroke mortality in the nation.[20]

Table 9. North Carolina ED visits from 2009 with chest pain/ischemic heart disease, heart failure, or stroke/TIA diagnosis codes in any of 11 positions

	Chest Pain / Ischemic Heart Disease			Heart Failure			Strokes and TIA		
	No.	%[1]	Rate[2]	No.	%[1]	Rate[2]	No.	%[1]	Rate[2]
Total	516,972	100	55.1	110,356	100	11.8	37,668	100	4.0
Gender									
Female	278,844	53.9	58.3	62606	56.7	13.1	20,772	55.2	4.3
Male	238,111	46.1	51.8	47746	43.3	10.4	16,894	44.9	3.7
Missing	17	---	---	<10	---	---	<10	---	---
Age Group									
0-1	544	0.1	2.1	73	0.1	0.3	50	0.1	0.2
2-4	635	0.1	1.7	27	0.0	0.1	17	0.1	0.1
5-9	2,639	0.5	4.3	32	0.0	0.1	26	0.1	0.0
10-14	4,573	0.9	7.7	37	0.0	0.1	27	0.1	0.1
15-18	9,079	1.8	17.9	69	0.1	0.1	58	0.2	0.1
19-24	21,900	4.2	26.4	317	0.3	0.4	161	0.4	0.2
25-44	102,439	19.8	39.1	6,445	5.8	2.5	2,011	5.3	0.8
45-64	165,764	32.1	69.2	29,934	27.1	12.5	10,586	28.1	4.4
65 and over	209,364	40.5	176.1	73,416	66.5	61.8	24,731	65.7	20.8
Missing	35	---	---	<10	---	---	<10	---	---
Region									
Coastal Plains	160,228	31.0	59.6	37,058	33.6	13.8	11,588	30.8	4.3
Piedmont	272,125	52.7	49.1	55,858	50.6	10.1	20874	55.4	3.8
Mountains	66,583	12.9	57.8	14,372	13.0	12.5	3796	10.1	3.3
Out of State	17,644	3.4	---	3,019	2.7	---	1392	---	---
Missing	392	---	---	45	---	---	18	---	---

[1]Denominator is the total number of NC ED visits in 2009 for the disease grouping.
[2]Rate is reported per 1,000 person-years

Combining mortality data with ED data provides a more complete picture of the burden of stroke in North Carolina. NC DETECT has the potential to provide statewide approximations of population-based ED visit rates and subsequent hospitalizations. NC DETECT includes all ED visits, including those made by patients who had an acute stroke/TIA diagnosis but were discharged. Patients who elect not to receive further stroke/TIA therapy or for whom such an option does not exist would fall into this category. Reporting visits with diagnoses in any of 11 coding positions better defines the stroke burden since it identifies the following types of patients: 1) those who have previously been diagnosed with stroke/TIA and are at a greater risk for future stroke, 2) those with stroke/TIA and for whom further evaluation in an outpatient setting is appropriate, and 3) those with diagnosed acute stroke/TIA.

Table 10. North Carolina ED visits from 2009 with TIA, ischemic stroke, or hemorrhagic stroke diagnosis codes in any of 11 positions[1,2]

	TIA			Ischemic Stroke			Hemorrhagic Stroke		
	No.	%[3]	Rate[4]	No.	%[3]	Rate[4]	No.	%[3]	Rate[4]
Total	10,354	100	1.1	19,612	100	2.1	4,928	100	0.5
Sex									
Female	6,103	58.9	1.3	10,426	53.2	2.2	2,446	49.6	0.5
Male	4,251	41.1	0.9	9,184	46.8	2.0	2,482	50.4	0.5
Missing	0	---	---	<10	---	---	0	---	---
Age Group									
0-1	0	---	0.0	11	0.1	0.0	38	0.8	0.2
2-4	0	---	0.0	< 10	---	0.0	< 10	---	0.0
5-9	< 10	---	0.0	< 10	---	0.0	11	0.2	0.0
10-14	< 10	---	0.0	< 10	---	0.0	13	0.3	0.0
15-18	< 10	---	0.0	17	0.1	0.0	34	0.7	0.1
19-24	19	0.2	0.0	68	0.4	0.1	70	1.4	0.1
25-44	587	5.8	0.2	949	4.8	0.4	472	9.6	0.2
45-64	3,168	30.6	1.3	5,698	29.1	2.4	1516	30.8	0.6
65 and over	6,562	63.4	5.5	12,847	65.5	10.8	2764	56.1	2.3
Missing	0	---	---	0	---	---	<10	---	---
Region of Residence									
Coastal Plains	3,313	32.0	1.2	5,852	29.9	2.2	1,398	28.4	0.5
Piedmont	5,689	55.0	1.0	11,005	56.1	2.0	2,807	57.0	0.5
Mountains	979	9.5	0.8	2,035	10.4	1.8	474	9.6	0.4
Out of State	370	3.6	---	710	3.6	---	244	5.0	---
Missing	<10	---	---	10	---	---	<10	---	---

[1]Codes for one type of stroke are not mutually exclusive. For example, 4 visits had diagnosis codes for TIA, Ischemic Stroke, and hemorrhagic stroke, 822 visits included diagnosis codes for TIA as well as Ischemic stroke, 257 visits had diagnosis codes for ischemic and hemorrhagic stroke, and 39 visits had codes for TIA and hemorrhagic stroke.
[2]Visits with diagnoses for cerebrovascular disease (ICD-9-CM codes 437.0, cerebral athrosclerosis and 437.1, ischemic cerebrovascular disease) are included in the stroke/TIA totals shown in tables 6-9, but are not included in this table.
[3]Denominator is the total number of NC ED visits in 2009 for each disease grouping.
[4]Rate is reported per 1,000 person-years.

Cardiac arrest

In 2009, the rate of visits with a cardiac arrest diagnosis was less than 1/1,000 person-years (Table 6). It is fortunate that the rate was low because, of the 7,035 cardiac arrest visits, approximately 56% resulted in death and 38.9% were admitted/transferred (data not shown).

Cardiac arrest visit rates were highest for the following groups: men, visitors ages 65 and older, and residents of the coastal plains (Table 11). One hundred and thirty-nine infant visits were diagnosed with cardiac arrest. Patients ages 2 to 18 had approximately the same number of visits with a cardiac arrest diagnosis as infants (N=141).

Table 11. North Carolina ED visits from 2009 with cardiac arrest diagnosis codes in any of 11 possible positions

	ED Visits		
	No.	%[1]	Rate[2]
Total Cardiac Arrest	7035	100	0.8
Sex			
Female	2,925	41.6	0.6
Male	4,104	58.4	0.9
Missing	6	---	---
Age Group			
0-1	139	2.0	0.5
2-4	27	0.4	0.1
5-9	31	0.4	0.1
10-14	18	0.3	0.0
15-18	65	0.9	0.1
19-24	135	1.9	0.2
25-44	711	10.1	0.3
45-64	2,294	32.7	1.0
65 and over	3,594	51.2	3.0
Missing	21	---	---
Region of Residence			
Coastal Plains	2,295	32.7	0.9
Piedmont	3,772	53.8	0.7
Mountains	685	9.8	0.6
Out of State	260	3.7	---
Missing	23	---	---

[1] Denominator for the percentage is the total number of NC ED visits with first-listed or comorbid diagnosis for cardiac arrest in 2009.
[2] Rates are reported per 1,000 person-years

Psychiatric disorders

ICD-9-CM diagnosis codes for psychiatric disorders include a variety of conditions, such as dementia. Visits for dementia, identified using an ICD-9-CM code of 290, represented only 1.1% of the total psychiatric disorder visits. Therefore, we aggregated dementia with the other disorders. However, we included drug and alcohol intoxication and withdrawal in the substance abuse/dependence and alcohol intoxication/withdrawal (SAD/AIW) diagnostic group (see below).

Mental health is a global public health problem.[21, 22] Approximately 8.7% of ED visits from 2009 had a psychiatric disorder diagnosis in one or more of the 11 coding positions (Table 6). Approximately 24% of psychiatric-related ED visits had the psychiatric disorder diagnosis in the first position (Table 7). The rate of visits for psychiatric disorders in a first or comorbid diagnosis position increased from 37.8/1,000 in 2008 to 40.7/1,000 person-years in 2009 (Table 12).

The rate of psychiatric disorder visits for females was 1.7 times the rate for males (Table 12). Also, rates of psychiatric visits increased with age. For example, the rate for 25 to 44 year olds was almost twice that for

15 to 18 year olds. The rate for individuals ages 65 and older (88.4/1,000 person-years) was by far the highest, and nearly twice that for 25 to 64 year olds.

Visits with a diagnosis of dementia were almost exclusive to the elderly population. The mean and median ages of individuals with a dementia diagnosis in 2009 were 80 and 82, respectively. Among those 65 and older, the rate of visits for dementia-related disorders was much lower compared to the rate of visits for non-dementia, psychiatric disorders (4.1/1000 person-years compared to 84.4/1000 person-years).

In all regions, the rate of psychiatric visits increased from 2008 to 2009. In particular, the rate increased in the coastal plains, by 4.2 visits/1,000 person-years (Table 12). Nevertheless, residents of the mountains had the highest psychiatric visit rate (55.7 visits/1,000 person-years). The substantially higher rate among visitors from the mountains raises concerns that this region could have more socio-economic stressors, or limited access to outpatient mental health services compared to other areas.

The state or federal government was expected to pay for 57.5% of the visits with a psychiatric diagnosis. This proportion is much higher than that for all ED visits (44.9%; data not shown).

Substance abuse/dependence (SAD) and alcohol intoxication/withdrawal (AIW)

In 2009, 121,386 ED visits, representing 2.8% of all visits, had a first-listed or comorbid diagnosis for substance abuse or dependence (SAD) and alcohol intoxication or withdrawal (AIW) (Table 6). The 2009 rate of visits with a SAD/AIW diagnosis was nearly identical to the 2008 rate (12.9/1000 person-years in 2008 and 2009; Table 13, data from 2008 not shown).

The rate of ED visits with a SAD/AIW disorder diagnosis was below 1.0/1,000 person-years for people younger than 15. For people ages 15 to 18, the rate increased to 7.5/1,000 person-years. Rates were highest for visitors between the ages of 25 and 64. Rates were fairly high for those ages 65 and older (Table 13).

The regional comparison showed that patients from the coastal plains had the highest SAD/AIW rate of visits (14.3/1000 person-years). The rate for SAD/AIW visits among males was approximately two times the rate for females (17.1/1000 for males and 8.9/1,000 for females; Table 13). Of the 121,386 total SAD/AIW ED visits in 2009, 40.9% were paid for by the patient (data not shown).

These data suggest that substance abuse and dependence continues to affect North Carolinians. Current substance abuse treatment programs may be insufficient.[23] This is troubling since research suggests that treatment of these disorders is as effective as that for chronic disorders such as diabetes and hypertension.[24]

Table 12. North Carolina ED visits from 2008 and 2009 with psychiatric disorder diagnosis codes in any of 11 positions

	2008			2009		
	No.	%[1]	Rate[2]	No.	%[1]	Rate[2]
Total Psychiatric Disorders	348,874	100.0	37.2	382,005	100.0	40.7
Sex						
Female	222,951	63.9	46.6	245,169	64.2	51.3
Male	125,840	36.1	27.4	136,826	35.8	29.8
Missing	83	0.0	---	10	---	---
Age Group						
0-1	124	0.0	0.5	399	0.1	1.5
2-4	476	0.1	1.3	728	0.2	1.9
5-9	1,809	0.5	3.0	2,171	0.6	3.6
10-14	5,419	1.6	9.1	5,784	1.5	9.7
15-18	11,900	3.4	23.4	12,638	3.3	24.9
19-24	25,782	7.4	31.1	29,144	7.6	35.2
25-44	108,251	31.0	41.4	118,404	31.0	45.3
45-64	95,890	27.5	40.0	107,584	28.2	44.9
65 and over	99,096	28.4	83.3	105,145	27.5	88.4
Missing	127	0.0	---	<10	---	---
Region of Residence						
Coastal Plains	97,381	27.9	36.2	108,606	28.5	40.4
Piedmont	180,818	51.8	32.6	198,207	52.0	35.8
Mountains	60,248	17.3	52.3	64,215	16.8	55.7
Out of State	10,018	2.9	---	10,671	2.8	---
Missing	409	0.1	---	306	---	---

[1]Denominator is the total number of NC ED visits in 2009 with a first-listed or comorbid diagnosis of Psychiatric Disorder.
[2]Rate is reported per 1,000 person-years

Comparison of psychiatric disorders and substance abuse/dependence/intoxication/withdrawal

In 2009, 461,598 ED visits, representing 10.5% of total visits, reported a first-listed or comorbid diagnosis for a psychiatric disorder and/or a SAD/AIW condition (data not shown). The diagnosis was reported in the first position in 19.4% (N=89,668) of the psychiatric disorder visits and in 7.5% (N=34,791) of the SAD/AIW disorder visits. Among the 124,638 ED visits with a first-listed psychiatric disorder or SAD/AIW diagnosis, 18.3% also reported a comorbid psychiatric disorder or SAD/AIW code. This proportion is similar to that found in the 2008 NC DETECT data (18.4%).

Table 13. North Carolina ED visits from 2009 with SAD/AIW diagnosis codes in any of 11 positions

	ED Visits		
	No.	%[1]	Rate[2]
Total Substance Abuse	121,386	100	12.9
Sex			
Female	42,760	35.2	8.9
Male	78,620	74.8	17.1
Missing	<10	---	---
Age Group			
0-1	45	0.0	0.2
2-4	32	0.0	0.1
5-9	49	0.0	0.1
10-14	406	0.3	0.7
15-18	3,823	3.2	7.5
19-24	13,017	10.7	15.7
25-44	50,074	41.3	19.1
45-64	45,862	37.8	19.2
65 and over	8,046	6.6	6.8
Missing	27	---	---
Region of Residence			
Coastal Plains	38,543	31.8	14.3
Piedmont	63,846	52.7	11.5
Mountains	15,013	12.4	13.0
Out of State	3,667	3.0	---
Missing	317	---	---

[1]Denominator is the total number of NC ED visits in 2009 with a first-listed or comorbid diagnosis of SAD/AIW.
[2]Rates are reported per 1,000 person-years

Tobacco use disorder

In the NC DETECT annual reports of data from 2008 and 2009, the SAD/AIW diagnostic group excludes diagnoses for tobacco use disorder (ICD-9-CM code 305.1). Visits with first-listed or comorbid diagnoses for tobacco use disorder totaled 365,302 in 2007, 407,468 in 2008, and 437,843 in 2009. Therefore, rates of visits for tobacco use disorder increased from 40.3/1000 person-years in 2007 to 46.7/1,000 person-years in 2009 (Table 14). The increase in the rate of visits with a tobacco use disorder diagnosis might be attributable to federal guidelines that call for improved documentation of personal and social history.[25]

In 2009, the rate remained below 1.0/1,000 person-years for patients ages 14 and younger and then increased to 25.0/1,000 for 15 to 18 year olds. The rate peaked at 80.5/1,000 person-years for people in the 19 to 24 year old category; however, it remained relatively high for 25 to 44 year olds (76.8/1,000 person-years). For residents of the mountains, the rate of visits with a tobacco use disorder diagnosis was 66.2/1,000 person-years; this is 1.6 times the rate for residents of the piedmont, and 1.5 times that for residents of the coastal plains (Table 14).

Table 14. North Carolina ED visits from 2007 to 2009 with tobacco use disorder diagnosis codes in any of 11 positions

	2007 ED Visits			2008 ED Visits			2009 ED Visits		
	No.	%[2]	Rate[3]	No.	%[2]	Rate[3]	No.	%[2]	Rate[3]
Total	365,302	100.0	40.28	407,468	100.0	44.16	437,843	100	46.7
Sex									
Female	184,503	50.5	40.18	206,875	50.8	44.28	225,429	51.5	47.1
Male	180,769	49.5	40.37	200,531	49.2	44.02	212,403	48.5	46.1
Missing	30	0	---	62	0	---	11	---	---
Age Group									
0-1	50	0.0	0.21	54	0.0	0.21	75	0.0	0.3
2-4	40	0.0	0.11	66	0.0	0.18	76	0.0	0.2
5-9	68	0.0	0.11	89	0.0	0.15	111	0.0	0.2
10-14	486	0.1	0.81	482	0.1	0.80	492	0.1	0.8
15-18	12,070	3.3	24.24	12,499	3.1	23.66	12,720	2.9	25.0
19-24	53,363	14.6	65.27	59,085	14.5	71.21	66,626	15.2	80.5
25-44	169,782	46.5	66.18	188,811	46.3	75.21	201,211	46.0	76.9
45-64	106,036	29.0	46.56	120,504	29.6	50.42	129,825	29.7	54.2
65 and over	23,396	6.4	21.51	25,802	6.3	22.64	26,696	6.1	22.5
Missing	11	0	---	76	0	---	11	---	---
Region of Residence [1]									
Coastal Plains	78,865	21.6	---	111,356	27.3	42.01	116,459	26.6	43.3
Piedmont	205,994	56.4	---	210,720	51.7	38.79	230,944	52.8	41.7
Mountains	62,005	17.0	---	71,158	17.5	62.18	76,379	17.5	66.2
Out of State	14,577	4.0	---	13,569	3.3	---	13,540	3.1	---
Missing	3,861	1.1	---	665	0.2	---	521	---	---

[1] Rates for geographic regions are not available for 2007 data.
[2]Denominator for the percentage is the total number of NC ED visits with a first-listed or comorbid diagnosis of Tobacco Use Disorder.
[3]Rates are reported per 1,000 person-years

Lower respiratory tract disorders

In this report, we used the same ICD-9-CM codes that the Centers for Disease Control use to define lower respiratory tract disorders (LRTDs),[26] which include the following disease groups: asthma, COPD, pneumonia, acute bronchitis, and wheezing.

Approximately 11% of the ED visits had a first or comorbid diagnosis for a LRTD (Table 6). Nearly 40% of the LRTD visits were asthma-related; there were 20.2 asthma visits per 1,000 person-years (Table 15). Visits for COPD represented a similarly high proportion of LRTD visits (37.2%). Compared to asthma and COPD, proportions of LRTD visits with pneumonia (8.8%), acute bronchitis (6.4%), or wheezing (3.4%) diagnoses in any of 11 positions were much lower.

Table 15. North Carolina ED visits from 2009 with lower respiratory tract disorder (LRTD) diagnosis codes in any of 11 positions

	ED Visits with First-listed Diagnosis			ED Visits with first-listed or comorbid diagnoses		
Disorder	No.	%[1]	Rate[2]	No.	%[3]	Rate[2]
Total LRTD	175,461	100	18.7	481,177	100	51.3
Asthma	50,126	28.6	5.3	189,716	39.4	20.2
COPD	46,889	26.7	5.0	178,784	37.2	19.1
Pneumonia	42,310	24.1	5.0	42,310	8.8	4.5
Acute bronchitis	71,596	40.8	7.6	59,754	12.4	6.4
Wheezing	3,741	2.1	0.4	16,339	3.4	1.7

[1]Denominator for the percentage is the total number of NC ED visits with first-listed diagnosis for a Lower Respiratory Tract Disorder.
[2]Rates are reported per 1,000 person-years
[3]Denominator for the percentage is the total number of NC ED visits with first-listed or comorbid diagnosis for a Lower Respiratory Tract Disorder.

Table 16 shows the demographic distribution of visits with a LRTD diagnosis in a first or comorbid position. Rates of visits for asthma, acute bronchitis and COPD were higher for females compared to males, while rates for pneumonia and wheezing were virtually the same for females and males. Similarly, rates of visits for pneumonia were fairly consistent across geographic regions. However, rates of visits for asthma, acute bronchitis, and wheezing were higher for patients from the coastal plains than for patients from the piedmont or mountains. The rate of visits for COPD was highest for patients from the mountains, followed by the rate for patients from the coastal plains and then the piedmont.

The most striking differences in the rates of visits for LRTDs were seen across categories of age. Rates of visits for pneumonia were highest among the youngest (0-1 years) and the oldest (65 years and older) patients. Rates of visits for wheezing were highest for the youngest patients, especially 0 to 1 year olds (12.7/1,000 person-years). Similarly, rates of visits for asthma were highest for patients between the ages of 0 and 9; the highest rate was for 2 to 4 year olds (33.0 visits/1,000 person-years). Asthma is commonly believed to be a disease of childhood. However, of the total 1,316,025 visits made by adults between the ages of 25 and 44 (Table 2), 4.1% (N=53,859) reported an acute or comorbid diagnosis of asthma (Table 16). Patients ages 65 and older had the highest rate of visits with a COPD diagnosis (65.7/1,000 person-years), followed by patients ages 45 to 64 (26.4/1,000 person-years), and 25 to 44 (8.6/1,000 person-years).

Table 16. North Carolina ED visits from 2009 with asthma, acute bronchitis, or pneumonia diagnosis codes in any of 11 positions

	Asthma Visits			Acute Bronchitis Visits			Pneumonia Visits			Wheezing visits			COPD visits		
	No.	%[1]	Rate[2]	No.	%[3]	Rate[2]	No.	%[4]	Rate[2]	No.	%[5]	Rate[2]	No.	%[6]	Rate[2]
Total Visits	189,716	100	20.2	59,754	100	6.4	88,665	100	9.4	16,339	100	1.7	178,754	100	19.1
Sex															
Female	118,269	62.3	24.7	36,682	61.4	7.7	46,319	52.2	9.7	8,328	51.0	1.7	99,903	55.9	20.9
Male	71,443	37.7	15.5	23,072	38.6	5.0	42,345	47.8	9.2	8,011	49.0	1.7	78849	44.1	17.1
Missing	<10	---	---	0	---	---	<10	---	---	0	---	---	< 10	---	---
Age Group															
0-1	6,278	3.3	24.3	2,037	3.4	7.9	7,383	8.3	28.5	3,282	20.1	12.7	2,080	1.2	8.0
2-4	12,472	6.6	33.0	2,260	3.8	6.0	5,355	6.0	14.2	1,916	11.7	5.1	2,307	1.3	6.1
5-9	16,811	8.9	27.5	2,526	4.2	4.1	3,730	4.2	6.1	1,368	8.4	2.2	2,271	1.3	3.7
10-14	12,571	6.6	21.0	1,840	3.1	3.1	1,405	1.6	2.4	640	3.9	1.1	1,414	0.8	2.4
15-18	10,623	5.6	20.9	2,492	4.2	4.9	942	1.1	1.9	412	2.5	0.8	1,800	1.0	3.5
19-24	19,142	10.1	23.1	6,985	11.7	8.4	2,333	2.6	2.8	906	5.6	1.1	4,917	2.8	5.9
25-44	53,859	28.4	20.6	20,537	34.4	7.9	11,073	12.5	4.2	3,010	18.4	1.2	22,562	12.6	8.6
45-64	39,217	20.7	16.4	14,394	24.1	6.0	20,926	23.6	8.7	2,995	18.3	1.3	63,235	35.4	26.4
65 and over	18,741	9.9	15.8	6,683	11.2	5.6	35,515	40.1	29.9	1,810	11.1	1.5	78,167	43.7	65.7
Missing	< 10	---	---	0	---	---	< 10	---	---	0	---	---	< 10	---	---
Region of Residence															
Coastal Plains	63,667	33.6	23.7	21,372	35.8	7.9	24,662	27.8	9.2	6,819	41.8	2.5	55,422	31.0	20.6
Piedmont	97,026	51.2	17.5	30,162	50.5	5.4	50,478	57.0	9.1	7,935	48.6	1.5	90,410	50.6	16.3
Mountains	23,577	12.4	20.4	6,034	10.1	5.2	10,701	12.1	9.3	1,045	6.4	0.9	27,479	15.4	23.8
Out of State	5,302	2.8	---	2,141	3.6	---	2,774	3.1	---	534	3.3	---	5,347	3.0	---
Missing	144	---	---	45	---	---	50	---	---	< 10	---	---	---	---	---

[1] Denominator for the percentage is the total number of NC ED visits with first-listed or comorbid diagnosis for asthma.
[2] Rates are reported per 1,000 person-years
[3] Denominator for the percentage is the total number of NC ED visits with first-listed or s comorbid diagnosis for acute bronchitis.
[4] Denominator for the percentage is the total number of NC ED visits with first-listed or comorbid diagnosis for pneumonia.
[5] Denominator for the percentage is the total number of NC ED visits with first-listed or comorbid diagnosis for wheezing
[6] Denominator for the percentage is the total number of NC ED visits with first-listed or comorbid diagnosis for COPD

Males and females had different age distributions for asthma visits (Table 17). Compared to females with an asthma-related diagnosis, a higher percentage of male visitors with this diagnosis were between the ages of 0 and 4 (approximately 17% of males and 6% of females with an asthma diagnosis were 0 to 4 years old). In contrast, asthma related visits by patients ages 45 and older were represented by a higher percentage of females than males (36% of females versus 21% of males). The 2008 ED data showed similar gender and age trends for asthma related ED visits.

Table 17. North Carolina ED visits from 2008 and 2009 with asthma diagnosis codes in any of 11 positions, stratified by categories of age and gender

	2008						2009					
	Females			Males			Females			Males		
	No.	%[1]	Rate[2]	No.	%[3]	Rate[2]	No.	%[1]	Rate[2]	No.	%[3]	Rate[2]
Asthma visits	112,078	100	23.8	69,569	100	15.4	118,269	100	24.7	71,443	100	15.5
Age												
0-4	7,756	6.9	25.3	13,441	19.3	41.9	6,844	5.8	22.0	11,906	16.7	36.6
5-9	5,538	4.9	18.7	8,907	12.8	29.0	6,392	5.4	21.3	10,419	14.6	33.5
10-14	4,310	3.9	14.8	6,236	9.0	20.6	5,221	4.4	17.8	7,350	10.3	24.2
15-24	16,413	14.7	25.7	9,636	13.9	14.2	18,840	15.9	29.0	10,922	15.3	15.9
25-44	35,761	31.9	27.5	15,177	21.8	11.6	38,284	32.4	29.4	15,575	21.8	11.8
45-64	27,837	24.8	22.9	10,771	15.5	9.6	28,684	24.3	23.1	10,533	14.7	9.1
≥ 65	14,445	12.9	21.6	5,324	7.7	11.0	14,002	11.8	20.4	4,738	6.6	9.4
Missing	18	-	-	16	-	-	<10	--	--	< 10	--	--

[1] Denominator for the percentage is the total number of female NC ED visits with first-listed or comorbid diagnosis for asthma.
[2] Rates are reported per 1,000 person-years
[3] Denominator for the percentage is the total number of male NC ED visits with first-listed or comorbid diagnosis for asthma.

Diabetes

In 2009, 7.9% of all ED visits had a first-listed or comorbid diabetes diagnosis (Table 6). The rate of 2009 North Carolina ED visits with diabetes reported as either the first or comorbid diagnosis was 36.7/1,000 person-years (Table 18); between the years 2008 and 2009, this rate increased by 1.6/1,000 person-years.[2,3]

Rates of ED visits with a diabetes diagnosis increased with age. For example, the rate for 25 to 44 year olds was more than 3 times that for 19 to 24 year olds (Table 18). Ninety-seven percent of ED visits with a diabetes diagnosis code in any of the 11 positions were made by people 25 years of age and older, and nearly 80% of the ED visits for diabetes were made by people 45 years of age and older. Compared to patients from the piedmont, those from the coastal plains and mountains regions had higher rates of ED visits with diabetes as a first or comorbid diagnosis (Table 18). In nearly one-third of diabetes related visits, the patient was admitted to the hospital. The state or federal government was expected to pay for 63.8% of visits with a diabetes diagnosis (data not shown).

Table 18. North Carolina ED visits from 2009 with diabetes diagnosis codes in any of 11 positions

	ED Visits		
	No.	%[1]	Rate[2]
Total Diabetes	344,690	100	36.7
Sex			
Female	199,854	58.0	41.8
Male	144,826	42.0	31.5
Missing	10	---	---
Age Group			
0-1	83	0.0	0.3
2-4	164	0.1	0.4
5-9	526	0.2	0.9
10-14	1,286	0.4	2.2
15-18	2,236	0.7	4.4
19-24	5,995	1.7	7.2
25-44	61,150	17.7	23.4
45-64	138,227	40.1	57.7
65 and over	135,019	39.2	113.6
Missing	<10	---	---
Region of Residence			
Coastal Plains	116,007	33.7	43.1
Piedmont	173,181	50.3	31.3
Mountains	45,047	13.1	39.1
Out of State	10,264	3.0	---
Missing	191	---	---

[1] Denominator for the percentage is the total number of NC ED visits with first-listed or comorbid diagnosis for diabetes.
[2] Rates are reported per 1,000 person-years

Neoplasm

Within the context of an ED visit, a neoplasm diagnosis typically indicates that the patient experienced cancer treatment complications. Therefore, a neoplasm diagnosis is not expected to be coded in the first position. In less than 1% of the 4,382,051 ED visits from 2009, the neoplasm diagnosis was the first-listed code. In 1.9% of all 2009 ED visits, neoplasm was coded as a first or comorbid diagnosis; the overall rate of neoplasm ED visits was 8.8 /1,000 person-years. Patients 65 and older had the highest neoplasm visit rate (34.0/1,000 person-years; Table 19). Rates were fairly consistent across categories of gender and geographic region. Over 60% of visits resulted in a hospital admission and a little over 30% were discharged (data not shown).

Table 19. North Carolina ED visits from 2009 with neoplasm diagnosis codes in any of 11 positions

	ED Visits		
	No.	%[1]	Rate[2]
Total	82,215	100	8.8
Sex			
Female	43,224	52.6	9.0
Male	38,985	47.4	8.5
Missing	6	---	---
Age Group			
0-1	155	0.2	0.6
2-4	246	0.3	0.7
5-9	318	0.4	0.5
10-14	186	0.2	0.3
15-18	328	0.4	0.7
19-24	1003	1.2	1.2
25-44	9905	12.1	3.8
45-64	29686	36.1	12.4
65 and over	40376	49.1	34.0
Missing	12	---	---
Region of Residence			
Coastal Plains	25,404	30.9	9.4
Piedmont	44,036	53.6	8.0
Mountains	9,508	11.6	8.2
Out of State	3,228	3.9	---
Missing	39	---	---

[1] Denominator for the percentage is the total number of NC ED visits with first-listed or comorbid diagnosis for diabetes.
[2] Rates are reported per 1,000 person-years

Dental conditions

To maintain consistency with the NC DETECT annual reports from 2007 and 2008, we used ICD-9-CM codes 521 and 522 to derive counts of visits with dental problems; we present these in Tables 6 and 7. In 2009, 47,029 ED visits had a first-listed or comorbid diagnosis for diseases of hard tissues of the teeth, or of pulpitis periapical tissues (Table 6). In 56.9% of these visits, either of these dental conditions was coded in the first position (Table 7). The statewide rate of visits with diagnoses for dental problems increased from 4.7/1,000 person-years in 2008 to 5.0 visits/1,000 person-years in 2009.

We identified ED visits for oral health conditions using a broader set of diagnoses and corresponding ICD-9-CM codes — diseases of hard tissues of teeth (ICD-9-CM 521), diseases of pulpitis, periapical tissues (ICD-9-CM 522), gingival and periodontal diseases (ICD-9-CM 523), other diseases and conditions of the teeth and supporting structures (ICD-9-CM 525), and diseases of the oral soft tissues (ICD-9-CM 528). In 2009, 94,719 ED visits had an oral health-related diagnosis; the statewide rate was 19.8 visits/1,000 person-years (Table 20). In 2009, 19 to 44 year olds had the highest rate of visits for oral conditions (23.3

visits/1,000 person-years). Rates for oral health conditions were approximately the same for males compared to females. Residents of the mountains had the highest rate of visits for oral health conditions, followed by residents of the piedmont and then the coastal plains regions (Table 20).

Table 20. North Carolina ED visits from 2009 with oral health condition diagnosis codes in any of 11 positions

	ED Visits		
	No.	%[1]	Rate[2]
Total Oral Health Conditions	94,719	100	19.8
Sex			
Female	48,731	51.5	10.2
Male	45,984	48.6	10.0
Missing	<10	---	---
Age Group			
0-1	1,127	1.2	4.4
2-4	1,247	1.3	3.3
5-9	1,550	1.6	2.5
10-14	956	1.0	1.6
15-18	2,977	3.1	5.6
19-24	19,257	20.3	23.3
25-44	51,231	54.1	19.6
45-64	14,436	15.2	6.0
65 and over	1,937	2.1	1.6
Missing	< 10	---	---
Region of Residence			
Coastal Plains	25,102	26.5	9.3
Piedmont	54,241	57.3	9.8
Mountains	11,880	12.6	10.3
Out of State	3,373	3.6	---
Missing	123	---	---

[1] Denominator for the percentage is the total number of NC ED visits with first or comorbid diagnosis for dental problems.
[2] Rates are reported per 1,000 person-years

Self-pay was the expected source of payment in 51.0% of visits with oral health condition codes in 2008 and in 53.1% in 2009. Meanwhile, insurance companies paid for 19.1% of oral health condition visits in 2008 but only 16.6% of such visits in 2009 (Table 21).

These data suggest that residents of North Carolina might not be receiving adequate preventative dental care. Several factors might be contributing to this phenomenon, including: 1) a lack of dental insurance, especially during a recession,[27] 2) a shortage of dentists, and 3) a large rural population that might be relying on non-fluoridated well water. Also, Medicare does not cover costs for dental care and Medicaid does not fully reimburse for dental attention.[28] In 2004, at the national level, there were 6.0 dentists per 10,000 population; in North Carolina, there were only 4.2 dentists per 10,000 population.[29] Moreover, in 2005, dentists were unevenly distributed across regions of North Carolina.[29] For example, there were 4.9

dentists per 10,000 people in metropolitan counties compared to 3.1/10,000 people in non-metropolitan counties, and there were no dentists in some North Carolina counties. This situation has probably not improved since 2005.

Table 21. North Carolina ED visits from 2008 to 2009 with oral health condition diagnosis codes in any of 11 positions, stratified by method of payment

	2008 ED visits		2009 ED visits	
	No.	%[1]	No.	%[2]
Total	89,337	100	94,719	100
Payment				
Insurance company	16,152	19.1	15,103	16.6
Medicare	5,177	6.1	5,486	6.0
Medicaid	18,964	22.4	20,908	23.0
Workers compensation	87	0.1	75	0.1
Other government payments	1095	1.3	1,115	1.2
Self pay	43,243	51.0	48,279	53.1
No charge	< 10	---	20	0.0
Missing	4,623	---	3,107	---

[1] Denominator for the percentage is the total number of NC ED visits with first or comorbid diagnosis for dental problems in 2008.
[2] Denominator for the percentage is the total number of NC ED visits with first or comorbid diagnosis for dental problems in 2009.

Traumatic head injuries

In 2009, 20,741 ED visits had a traumatic head injury diagnosis; there were 2.2 traumatic head injury visits per 1,000 person-years (Table 6). Head injury was recorded as the first diagnosis in 58.4% of these visits (Table 7). The rate of ED visits for traumatic head injury was higher for males than females (2.6/1,000 person-years and 1.9/1,000 person-years, respectively; Table 22). The head injury rate was highest for young adults (5.0/1,000 among 15 to 18 year olds and 3.2/1,000 among 19 to 24 year olds). A regional comparison showed that patients from the piedmont had a higher rate of traumatic head injuries than patients from the coastal plains or the mountains. Approximately 22.6% of head injury related visits were admitted or transferred to a hospital or other type of care facility; 76% were discharged from the ED.

Table 22. North Carolina ED visits from 2009 with traumatic head injury diagnosis codes in any of 11 positions

	ED Visits		
	No.	%[1]	Rate[2]
Total Head Injuries	20,741	100	2.2
Sex			
Female	8,947	43.2	1.9
Male	11,789	56.9	2.6
Missing	5	---	---
Age Group			
0-1	501	2.4	1.9
2-4	717	3.5	1.9
5-9	1,001	4.8	1.6
10-14	1,660	8.0	2.8
15-18	2,535	12.2	5.0
19-24	2,632	12.7	3.2
25-44	4,925	23.8	1.9
45-64	3,330	16.1	1.4
65 and over	3,428	16.5	2.9
Missing	12	---	---
Region of Residence			
Coastal Plains	5,060	24.4	1.9
Piedmont	12,435	60.1	2.2
Mountains	1,938	9.4	1.7
Out of State	1,275	6.2	---
Missing	33	---	---

[1] Denominator for the percentage is the total number of NC ED visits with first or comorbid diagnosis for head injury in 2009.
[2] Rates are reported per 1,000 person-years

Women and children

Pregnant women made less than 1% of the visits to North Carolina EDs (N=10,921, Table 23). As expected, several of the top ten first-listed diagnoses for these women were pregnancy related. Four other frequently appearing first-listed diagnoses in the visit records for this group were urinary tract infection, nausea, abdominal pain, and headache.

Women of childbearing age (ages 18 to 44) accounted for nearly 3% of the total visits to North Carolina EDs in 2009. The following were among the top ten first-listed diagnoses for women of childbearing age: backache, disorders of the teeth, chest pain, abdominal pain, and urinary tract infections.

Neonates, defined as infants younger than 29 days, made less than 1% of the visits to North Carolina EDs in 2009 (Table 23). Among the most common first-listed diagnoses in the ED records for these infants were the following: jaundice, constipation, feeding problems, acute upper respiratory infection, vomiting, diseases of the nasal cavity or sinuses, and fever.

In Table 23, we define children as anyone younger than 20. Patients between the ages of 1 and 5 made the highest proportion of child ED visits (7.6%). Children between the ages of 15 and 19 accounted for the second highest proportion of child ED visits (6.8%; Table 23).

Acute upper respiratory infection was one of the ten most common first-listed diagnoses for children of all ages. Fever was the first or second most common first-listed diagnosis for all age categories of children, with the exception of 15 to 19 year olds. Pneumonia was a common first-listed diagnosis for children younger than 1 and between the ages of 1 and 4, but asthma was a common first-listed diagnosis for children between the ages of 6 and 10. Headache was among the top ten first-listed diagnoses for children in the three oldest age groups (Table 23).

Among children, the majority of the common causes of injury were unintentional (Table 24). In particular, falls were the most common cause of injury for children in all age groups, with the exception of those between the ages 15 and19, for whom unintentional injuries due to motor vehicle traffic crashes were the most common. Unintentional injuries due to pedal cycle, non-traffic and otherwise were common in children between the ages of 6 and 14, whereas poisoning by drugs, medicines, biological, and other solids and liquids was common in ED visitors younger than age 1 and between the ages of 1 and 5. Adverse effects of medical treatment were a common cause of injury for all children seen in North Carolina EDs in 2009.

Table 23. The ten most common first-listed diagnoses for women and children who visited North Carolina EDs in 2009

	ED visits		
	No.[4]	%[5]	Most common first-listed diagnosis codes
Women			
Pregnant women [1]	10,921	0.2	Pregnant state incidental (V22.2), Supervision of other normal pregnancy (V22.1), Abdominal pain unspecified (789.00), Urinary tract infection (599.0), Supervision of normal first pregnancy (V22.0), Abdominal pain unspecified (789.09), Headache (784.0), Nausea with vomiting (787.01), Other specified noninflammatory disorders of the vagina (623.8), Vomiting alone (787.03)
Women of childbearing age[2]	112,360	2.6	Symptoms involving head and neck (784), Abdominal pain (789.00), Urinary tract infection (599.0), Abdominal pain (789.09), Acute pharyngitis (462), Chest pain (786.50), Disorder of teeth (525.9), Lumbago (724.2), Complications of pregnancy (648.93), Backache (724.5),
Children			
Neonates [3]	8,267	0.2	Other specified conditions originating in the perinatal period (779.89), Unspecified fetal and neonatal jaundice (774.6), Constipation, unspecified (564.00), Acute upper respiratory infection (465.9), Feeding problems in newborn (779.3), Vomiting alone (787.03), Other disease of nasal cavity and sinuses (478.19), Other specified suspected conditions (V71.89), Fever, unspecified (780.60)
< 1	104,754	2.4	Fever and other physiologic disturbances of temperature regulation (780.6), Acute upper respiratory infection (465.9), Otitis media (382.9), Cough (786.2),Unspecified viral infection (079.99), Vomiting alone (787.03), Acute bronchiolitis due to other infectious organism (466.19), Pneumonia (486), Other disease of nasal cavity and sinuses (478.19), Diarrhea (787.91)
1-5	332,059	7.6	Fever (780.60), Acute upper respiratory infection (465.9), Otitis media (382.9), Unspecified viral infection (079.99), Cough (786.2), Vomiting (787.03), Pneumonia (486), Acute pharyngitis (462), Contusion of face, scalp, and neck except eyes (920), With other respiratory manifestations (487.1)
6-10	177,214	4.0	Fever and other physiologic disturbances of temperature (780.6), Acute upper respiratory infection (465.9), Acute pharyngitis (462), Unspecified viral infection (079.99), Cough (786.2), Unspecified otitis media (382.9), Influenza (487.1), Asthma (493.90), Abdominal pain (789.00), Headache (784.0)
11-14	131,256	3.0	Acute pharyngitis (462), Fever, unspecified (780.60), Upper respiratory infection (465.9), Headache (784.0), Unspecified viral infection (079.99), Abdominal pain (789.00), Influenza with other respiratory manifestations (487.1),Ankle (845.00), Cough (786.2), Pain in limb (729.5)
15-19	298,476	6.8	Acute pharyngitis (462), Abdominal pain (789.00), Headache (784.0), Urinary tract infection (599.0), Acute upper respiratory infection (465.9), Abdominal pain (789.09), Sprains and strains of the ankle, unspecified site (845.00), Sprain and strains of the neck (847.0),Complications of pregnancy (648.93), Cough (786.2)

[1]Pregnant women were defined as visits with codes V22 or V23
[2]Childbearing ages are defined as 18 to 44
[3]Neonates are defined as infants younger than 29 days
[4]Total 2009 ED visits made by members of each subgroup
[5]Denominator for the percentages is the total number of NC ED visits (N=4,382,051) in 2009.

Table 24. The ten most common external causes of injury for children who visited North Carolina EDs in 2009

Age-group	No. ED visits with usable E-codes	No. ED visits with place of occurrence code only	Ten most common causes of injury, classified using E-codes
< 1	7,659	315	Unintentional injuries: Falls; Motor vehicle traffic; Struck against or struck accidentally by objects or persons; Mechanism unspecified; Natural and environmental factors; Foreign body; Poisoning by drugs, medicines, biological, other solids and liquids, or gases; Other and not elsewhere classified; Fire and flames, hot substance or object, caustic or corrosive material Adverse effects of medical treatment
1-5	62,857	2,986	Unintentional injuries: Falls; Struck against or struck accidentally by objects or persons; Natural and environmental factors; Foreign body, mechanism unspecified; Motor vehicle traffic; Cutting or piercing instruments or objects; Poisoning by drugs, medicines, biological, or other solids and liquids, or gases; Overexertion and strenuous movement Adverse effects of medical treatment
6-10	44,905	1,990	Unintentional injuries: Falls; Struck against or struck accidentally by objects or persons; Motor vehicle traffic; Natural and environmental factors; Cutting or piercing instruments or objects; Mechanism unspecified; Pedal cycle, non traffic and other; Overexertion and strenuous movement; Foreign body Adverse effects of medical treatment
11-14	43,411	2,090	Unintentional injuries: Falls; Struck against or struck accidentally by objects or persons; Overexertion and strenuous movement; Motor vehicle traffic; Cutting or piercing instruments or objects; Mechanism unspecified; Natural and environmental factors; Pedal cycle, non-traffic and other; Other and not elsewhere classified Adverse effects of medical treatment
15-19	77,963	3,284	Unintentional injuries: Motor vehicle traffic; Struck against or struck accidentally by objects or persons; Falls; Overexertion and strenuous movement; Mechanism unspecified; Cutting or piercing instruments or objects; Natural and environmental factors; Other and not elsewhere classified Adverse effects of medical treatment Intentional injuries: Assault-Unarmed fight or brawl, striking by blunt or thrown object

Among child ED visitors, the expected source of payment varied according to age (Table 25). Whereas Medicaid was the expected source in 68.7% of visits made by children ages 5 and under, it represented the expected source in approximately 45% of visits made by children older than 5. Also, a higher percentage of visits made by children between the ages of 6 and 18 were self-paid (14.7%, vs. 9.3% for children ages 0 to 5 years). Other government programs were expected to pay for a slightly higher percentage of visits by children in the 6 to18 year age group compared to visits by children ages 5 and younger (4.6% vs.

3.4%). Finally, private insurance companies were expected to pay for 34.7% of visits made by children between the ages of 6 and 18, but for only 18.5% of visits made by children ages 5 and younger.

Table 25. North Carolina ED visits from 2009 made by children, stratified by expected source of payment

	Ages 5 and younger		Ages 6 to 18	
	No.	%[1]	No.	%[2]
Total	436,813	100	525,359	100
Payment				
Insurance company	77,855	18.5	174,951	34.7
Medicare	370	0.1	358	0.1
Medicaid	288,953	68.7	228,358	45.4
Workers compensation	39	0.0	2,381	0.5
Other government payments	14,131	3.4	23,282	4.6
Self pay	39,274	9.3	74,211	14.7
No charge	< 10	---	< 10	---
Missing	16,189	---	21,814	---

[1]Denominator for the percentages is the total number of NC ED visits made by children ages 5 and younger.
[2]Denominator for the percentages is the total number of NC ED visits made by children ages 6 to 18.

The distribution of ED visits with a first-listed or comorbid diagnosis for sickle cell disease or other hemoglobinapothies is shown in Table 26. Less than 1% of the visits to North Carolina EDs in 2009 had a diagnosis for sickle cell disease, sickle cell thalassemia, or other hemoglobinopathy. However, relatively large percentages of the 9,038 total ED visits with these diagnoses resulted in hospital admissions. For example, in nearly 27% of the 8,812 visits with a sickle cell disease diagnosis, and in 65% of the 116 ED visits with a sickle cell thalassemia with crisis diagnosis, the patient was admitted to the hospital.

Only 71 of the North Carolina ED visits in 2009 had a whooping cough diagnosis — listed either first or as a comorbidity. However, in slightly more than 50% of the visits with this diagnosis, the patient was admitted to the hospital (data not shown).

Table 26. North Carolina ED visits from 2009 with sickle cell or other hemoglobinopathies diagnosis codes in any of 11 positions

	ED visits		Admitted to hospital	
	No.	%[1]	No.	%[2]
Sickle cell disease (282.6x)	8,812	0.2	2,334	26.5
Sickle cell thalassemia without crisis (282.41)	54	0.0	26	49.1
Sickle cell thalassemia with crisis (282.42)	116	0.0	73	64.6
Other hemoglobinopathies (282.7)	56	0.0	29	51.8

[1]Denominator for the percentages is the total number of NC ED visits in 2009 (N=4,382,051).
[2] Denominator for the percentages is the total number of NC ED visits with a first-listed or comorbid diagnosis code for that particular disease group, and the numerator is the total number of ED visits with that diagnosis that were admitted to the hospital.

ED visits by select injuries

In accordance with NHAMCS guidelines, we defined injury-related visits [9] as records with: 1) any one of 11 *diagnosis* fields with ICD-9-CM codes 800-999, or 2) an External Cause of Injury (E-code) in any one of five coded *cause of injury* fields. E-codes are expected to be reported with every ICD-9-CM code that falls within the 800-999 range. These codes are critical for counting and classifying all injury related ED visits; they identify the cause of injury or the adverse event that resulted in the ED visit. However, E-codes are not reimbursable, and even though the universal billing form has two coding slots for these codes, they are not used for institutional billing purposes.

Approximately 14% of injury-related ED visits in 2009 NC DETECT data were missing secondary E-codes. While the percentage of injury records with missing E-codes was relatively high, it represents a decrease from 2008, when 19% of injury related ED visits were missing E-codes.

Table 27 presents injury counts sorted by E-code. The majority of injuries were unintentional (72.2%). This is consistent with national trends, which show the proportions of intentional and unintentional injuries shifting such that unintentional injures - primarily transport-related -- predominate, even in urban areas.[30] Only 7.4% of injury ED visits were related to adverse effects of medical treatment (E870-E879, E930-E949); however, these might be under-reported because of poor and/or inadequate ICD-9-CM coding. Overall, 83% of injury related ED visits were discharged home; however, disposition varied according to injury type. For example, only 24% of intentional poisonings and 45% of self-inflicted cutting were discharged home (data not shown).

The Injury Surveillance Workgroup from the State and Territorial Injury Prevention Directors Association recommends classifying hospital discharge injury data by body region and nature of injury.[31] Upon request, NC DETECT can provide a Barell Matrix,[32] which classifies the 2009 North Carolina ED injury visit data in this way.

Table 27. North Carolina ED visits from 2009 with cause of injury codes or with injury-related diagnosis codes in any of 11 positions[1]

Intent and mechanism of injury[2]	No.	% of injury related visits[3]	% of ED visits[4]
Injury-related visits	1,066,124	100	24.3
Unintentional injuries	**770,084**	**72.2**	**17.6**
Falls	232,572	21.8	5.3
Motor vehicle traffic	120,157	11.3	2.7
Struck against or struck accidently by objects or persons	85,510	8.0	2.0
Overexertion and strenuous movements	74,104	7.0	1.7
Cutting or piercing instruments or objects	46,565	4.4	1.1
Natural and environmental factors	41,708	3.9	1.0
Poisoning by drugs, medicinal substances, biologicals, other solid and liquid substances, gases, and vapors	13,210	1.2	0.3
Fire and flames, hot substance or object, caustic or corrosive material, steam	10,527	1.0	0.2
Machinery	3,065	0.3	0.1
Pedal cycle, nontraffic and other	7,317	0.7	0.2
Motor vehicle, nontraffic	11,567	1.1	0.3
Other transportation	3,130	0.3	0.1
Suffocation	659	0.1	0.0
Firearm missile	1,711	0.2	0.0
Drowning or submersion	497	0.1	0.0
Foreign body	15,358	1.4	0.4
Caught accidentally in or between objects	10,168	1.0	0.2
Other and not elsewhere classified	22,335	2.1	0.5
Mechanism unspecified	69,924	6.6	1.6
Intentional Injuries	**50,135**	**4.7**	**1.1**
Assault:	37,663	3.5	0.9
Unarmed fight or brawl, striking by blunt or thrown object	19,368	1.8	0.4
Cutting or piercing with instrument	2,853	0.3	0.1
Firearms	1,169	0.1	0.0
Other and unspecified mechanism	14,273	1.3	0.3
Self-inflicted:	11,605	1.1	0.3
Poisoning by solid or liquid substances, gases and vapors	7821	0.7	0.2
Cutting and piercing instrument	2611	0.2	0.1
Suffocation	182	0.0	0.0
Other and unspecified mechanism	991	0.1	0.0
Other causes of violence	867	0.1	0.0
Injuries of undetermined intent	**4,014**	**0.4**	**0.1**
Adverse effects of medical treatment[5]	**78,334**	**7.4**	**1.8**
Unclassifiable external cause of injury	**163,557**	**14.2**	**3.5**
Only E-code is place of occurrence	36,964	3.5	0.8
Missing E-code	126,593	11.9	2.9

[1]Includes all visits with selected injury diagnosis codes (ICD-9-CM codes 800-999) reported as any of 11 first-listed or comorbid diagnoses or any E-code E800-E999 reported in any one of five cause of injury fields.
[2]Based on the "Supplementary Classification of External Cause of Injury and Poisoning," ICD-9-CM [18]

[3]Denominator for the percentage is the total number of NC injury related ED visits in 2009 (N=1,066,130).

[4]Denominator for the percentage is the total number of NC ED visits in 2009 (N=4,382,051).
[5]Excludes accidental drug overdose or wrong drug given (E850.0-858.9), and drug administered with suicidal intent (E980.0-980.5)

Poisonings

Unintentional poisonings accounted for a little over 1.2% of injury-related visits to North Carolina EDs in 2009. Approximately the same proportion of injury related visits were attributable to unintentional poisonings in 2008. However, the rate of visits due to unintentional poisonings increased from 2007 to 2009-from 1.27/1,000 in 2007 to 1.34/1,000 in 2008 to 1.41/1,000 person-years in 2009. This rate increase corresponds to national trends. For example, using data from the Nationwide Inpatient sample, researchers showed that from 1999 to 2006, hospitalizations for poisonings by prescription opioids, sedatives, and tranquilizers increased by 65%, and hospitalizations for poisonings by other drugs, medicinal, and biological substances increased by 33%.[33] Recently, the issue of increasing rates of unintentional injury due to poisoning has received substantial media attention, especially after several celebrities died from overusing prescription medications.[34]

Falls

In 2009, the largest proportion of injury-related visits was attributable to falls (approximately 22%, Table 27). The overall rate of fall-related ED visits was 22.7/1,000 person-years (Table 28). Those in the oldest age-group made the highest proportion of fall-related injury visits (27.7%). This group also had the highest rate of fall-related visits (54.2/1,000 person-years; Table 28).

Table 28. North Carolina ED visits from 2009 with an unintentional fall reported in any cause of injury field

	ED Visits		
	No.	%[1]	Rate[2]
Total	232,572	100	24.8
Sex			
Female	133,870	57.6	28.0
Male	98,695	42.4	21.5
Missing	7	---	---
Age Group			
0-1	9,301	4.0	35.9
2-4	13,344	5.7	35.3
5-9	13,901	6.0	22.8
10-14	13,406	5.8	22.4
15-18	9,162	3.9	18.0
19-24	14,944	6.4	18.0
25-44	47,313	20.3	18.1
45-64	46,803	20.1	19.5
65 and over	64,396	27.7	54.2
Missing	2	---	---

[1]Denominator for the percentage is the total number of NC ED visits in 2009 (N=4,382,051)
[2]Rates are presented per 1,000 person-years

Young boys made the most visits for falls, and older women made the second most such visits (Figure 8). The majority of patients who made a fall-related visit to the ED were discharged (83.1%, data not shown). Of the ED visits with fall injuries recorded in 2009, 329 resulted in admission to the Intensive Care Unit, and 58% of these admits were 65 or older.

Because North Carolina's population is aging, rates of morbidity and mortality from falls by the elderly are expected to increase. Injuries from falls, especially among the older population, represent a serious public health problem that deserves attention. The issue should be addressed using a comprehensive approach [35] that integrates research, improved resource allocation, prevention, intervention, and rehabilitation.

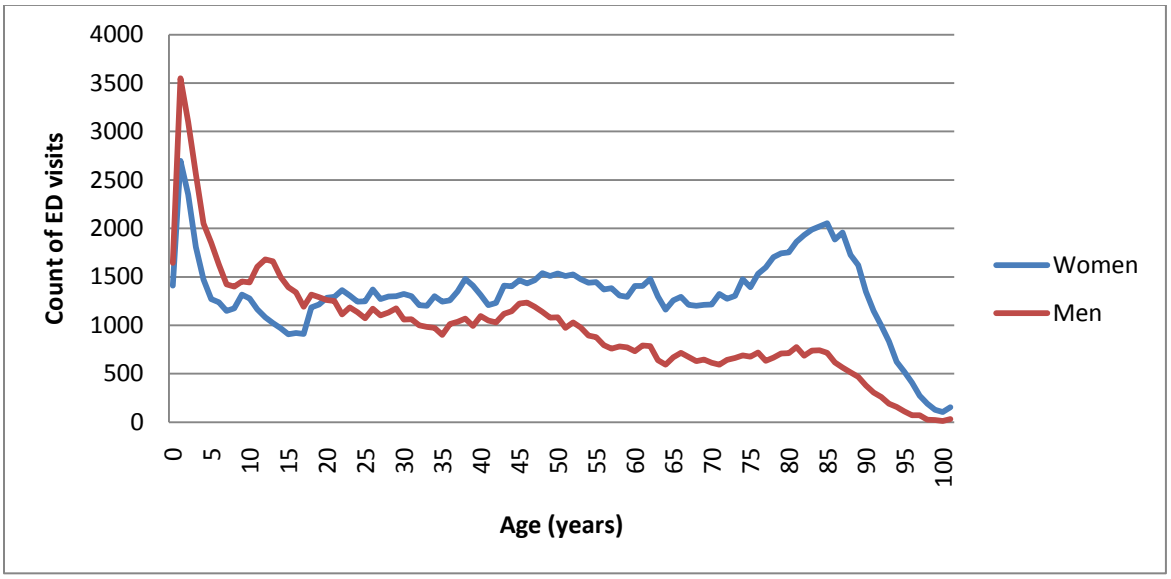


Figure 8. North Carolina ED visits from 2009 with a cause of injury code for an unintentional fall, by sex and age[1]

[1]Due to small counts, all individuals older than 100 are included in the same category

Transportation-related accidents

Motor vehicle crashes

In 2009, motor vehicle crashes (MVC) accounted for 11.3% of injury-related ED visits, and for 2.7% of all ED visits (Table 27). There were 11.0 visits per 1,000 person-years attributable to injuries from traffic-related MVCs (Table 29); this represents an increase from a rate of 9.9/1000 person-years in 2008.

Members of certain populations are more likely to be involved in MVCs than others -- young drivers, alcohol and drug-intoxicated drivers, for example. NC DETECT data helps identify vulnerable populations and illustrates trends in MVC related ED visits. For example, 19 to 24 year olds experienced the highest rate of ED visits for MVCs that involved drivers or passengers (23.2/1,000 person-years), while

people ages 65 and older had the lowest rate of such visits (4.9/1,000 person-years; Table 30). Rates of visits for traffic-related MVCs involving drivers or passengers ranged from 9.5/1,000 person-years for residents of the mountains to 12.3/1000 person-years for residents of the coastal plains (Table 30).

Table 29. North Carolina ED visits from 2009 with a transportation-related crash reported in any cause of injury field

Injury Type	ED Visits		
	No.	%[1]	Rate[2]
MVC Traffic, Driver/Passenger	103,430	2.4	11.0
MVC non-Traffic, Driver/Passenger	4,801	0.1	0.5
Pedal Cyclist	8,462	0.2	0.9
Pedestrian	3,526	0.1	0.4

[1]Denominator for the percentage is the total number of NC ED visits in 2009 (N=4,382,051).
[2]Rates are presented per 1,000 person-years.

While NC DETECT data do not provide information on the cause of these transportation crashes, MVC-related visits should continue to be monitored, especially as communication technologies -- cell phones and texting, for example -- become increasingly available. In a recent study, the use of cell phones while driving was associated with a fourfold increase in the risk of being in an accident.[36] A simulation study of college students showed that messaging/texting while driving decreases driver response time, increases movement within lanes of traffic, and increases the risk of being in an accident by a factor of eight.[37] Nevertheless, in a national survey, 67.4% of drivers reported that within the previous 30 days they had used a phone while driving.[38]

Pedal cycle and pedestrian injuries

In 2009, there were 8,462 visits for pedal cycle injuries (Table 30). This number far exceeds the fewer than 1,000 police-reported bicycle injuries that the North Carolina Division of Bicycle and Pedestrian Transportation tracked[12] and provides a more complete picture of statewide injuries. Pedal cyclist injury visits were the highest in the younger population, especially compared with MVC related injury visits (5-14 year olds; Table 30). This finding is consistent with 2007 and 2008 NC DETECT data,[2,3] and with national ED data.[39] Similarly, rates of pedestrian injury visits were highest for 15 to 24 year olds (Table 30). Pedestrian injury has been reported as the second leading cause of unintentional injury-related deaths for children ages 5 to 14.[40]

Table 30. North Carolina ED visits from 2009 with traffic MVC, non-traffic MVC, pedal cyclist, and pedestrian accidents reported in any cause of injury field

	MVC traffic[1]			MVC non-traffic[1]			Pedal Cyclist			Pedestrian		
	No.	%[2]	Rate[3]	No.	%[4]	Rate[3]	No.	%[5]	Rate[3]	No.	%[6]	Rate[3]
Total	103,430	100	11.0	4,801	100	0.5	8,462	100	0.9	3,526	100	0.4
Sex												
Female	57,828	55.9	12.1	1,535	32.0	0.3	2,339	27.7	0.5	1,345	38.2	0.3
Male	45,587	44.1	9.9	3,266	68.0	0.7	6,121	72.4	1.3	2,180	61.8	0.5
Missing	15	---	---	0	----	----	<10	---	---	<10	---	---
Age Group												
0-1	1,391	1.4	5.4	28	0.6	0.1	29	0.3	0.1	26	0.7	0.1
2-4	2,100	2.0	5.6	98	2.0	0.3	501	5.9	1.3	92	2.6	0.2
5-9	3,206	3.1	5.3	270	5.6	0.4	1,990	23.5	3.3	155	4.4	0.3
10-14	3,679	3.6	6.2	496	10.3	0.8	1,882	22.2	3.2	185	5.3	0.3
15-18	9,957	9.6	19.6	615	12.8	1.2	666	7.9	1.3	309	8.8	0.6
19-24	19,216	18.6	23.2	798	16.6	1.0	638	7.5	0.8	575	16.3	0.7
25-44	37,669	36.4	14.4	1653	34.4	0.6	1,457	17.2	0.6	1,248	35.4	0.5
45-64	20,318	19.7	8.5	602	12.5	0.3	1,151	13.6	0.5	733	20.8	0.3
65 and over	5,868	5.7	4.9	241	5.0	0.2	148	1.8	0.1	201	5.7	0.2
Missing	26	---	---	0	---	---	0	---	---	<10	---	---
Region of Residence												
Coastal Plains	33,150	32.1	12.3	1,337	27. 9	0.5	2,170	25.7	0.8	1,103	31.3	0.4
Piedmont	54,877	53.1	9.9	2,160	45.1	0.4	4,665	55.2	0.8	1,882	53.5	0.3
Mountains	10,930	10.6	9.5	950	19.8	0.8	1,182	14.0	1.0	388	11.0	0.3
Out of State	4,333	4.2	---	346	7.2	---	434	5.1	---	147	4.2	---
Missing	140	---	---	<10	---	---	11	---	---	<10	---	---

[1]Driver and passengers only
[2]Denominator for the percentage is the total number of NC ED visits in 2009 with a MVC traffic cause of injury code.
[3]Rates are presented per 1,000 person-years.
[4] Denominator for the percentage is the total number of NC ED visits in 2009 with a MVC non-traffic cause of injury code.
[5]Denominator for the percentage is the total number of NC ED visits in 2009 with a pedal cyclist cause of injury code.
[6]Denominator for the percentage is the total number of NC ED visits in 2009 with a pedestrian cause of injury code.

Limitations of NC DETECT ED data

Hospitals collect the data in NC DETECT as a part of routine ED processes, and primarily for patient care, billing and administrative management purposes. These data are not collected for public health surveillance and research purposes. Certain limitations and caveats are associated with analyzing and using these data; we list some of these below.

Personal and institutional privacy needs.

Personal and institutional privacy are protected by the Health Insurance Portability and Accountability Act [41] and by the legislation that permits collection of ED data for public health surveillance in North Carolina.[1] Respect for institutional privacy limits data access to the institution itself, and to authorized local, regional and state public health officials. Individual privacy is important; it is protected by removing patient identifiers in NC DETECT data. Still, these aggregated and de-identified data provide important statewide information on the demographic distribution and epidemiology of illness and injury. They are useful for public health and policy purposes.

Limited data elements

North Carolina legislation mandates that specific data elements be collected from EDs for public health surveillance (Appendix 1). Additional legislative action would be needed to mandate the inclusion of additional data elements. The legislative mandate for collecting ED visit data in North Carolina is limited to those data elements that each hospital captures electronically. Some hospitals are unable to provide key data elements electronically; for example, not all facilities provide the free text 'triage note,' which enables a more detailed assessment of the patient's reason for the ED visit.

Administrative hospital data

Administrative and clinical systems within each hospital send information to NC DETECT. Therefore, the quality and consistency of the data in NC DETECT depend on institutional coding and electronic reporting practices. Lack of statewide standardization of some data elements, such as triage acuity and chief complaints, prevents aggregation and analysis of important items.[42] While most elements in NC DETECT data are of high quality,[43] the system depends on the continued cooperation, enthusiasm, and motivation of all participating North Carolina hospitals.

Not all hospitals in North Carolina contribute data to NC DETECT; however, we estimate that NC DETECT captured over 99.5% of ED visits in North Carolina in 2009. In addition, because they are excluded from the legislation that mandates the collection and use of these data, the 2009 NC DETECT data do not include information from military, Veterans Administration (VA), prison, behavioral health and other specialty hospital EDs. In late 2008, North Carolina's four VA hospitals began to voluntarily submit ED visit data to NC DETECT; however, data from the VA hospitals are not included in this report except for the annotation analyses in the syndromic surveillance section.

Future goals

While originally developed specifically to address the threat of bioterrorism in North Carolina, NC DETECT has proven to be useful for many public health purposes. Timely, statewide data from EDs and other sources are a valuable resource for statewide public health surveillance. We encourage the use of NC DETECT data for investigations that can improve the public health of the citizens of North Carolina.

While this report mostly represents only 2009 ED visit data, additional clinical data sources are available in NC DETECT, including the following: ED visit data from North Carolina-based VA hospitals, pre-hospital EMS data from PreMIS, and visit data from urgent care clinics in the Greater Charlotte area. The addition of ED data from behavioral health hospitals and military hospitals in North Carolina should be explored. Lastly, use of the available urgent care clinic data has indicated that these are important data to include in NC DETECT; this warrants the exploration of expanding to collect state-wide urgent care data.

Completeness and quality of the ED visit data continue to be challenges for NC DETECT. A great deal of time and effort are needed to ensure that the highest quality data are provided. Efforts are ongoing to decrease levels of missing data and to increase both the reliability and validity of the data. We will continue to pursue efforts to encourage complete data submission within the 24 hour timeframe that the North Carolina legislation requires. The American Recovery and Reinvestment Act (ARRA) of 2009 includes provisions to encourage eligible professionals and hospitals to adopt electronic health record (EHR) technology.[43]

Medicare and Medicaid incentive payments will be directed to those who demonstrate meaningful use of certified EHRs. The final rule, published in July 2010, requires hospitals to participate in one of the following three public health menu options to demonstrate meaningful use: electronic laboratory reporting, immunization registry reporting, or syndromic surveillance. For eligible providers, the menu options include immunization registry reporting and syndromic surveillance. As a result of these regulations, there may be changes in the timeliness, quality, amount, and type of data that health care providers send to NC DETECT.[43]

Appendix 1: Emergency Department data elements sent to NC DETECT

DEEDS No.	Element Name	Description/Notes
1.01	Patient ID	Unique identifier masked to prevent re-identification
1.04	Date of Birth	Date/time
1.05	Sex	M, F, U
1.08	Address	City, State, County, Zip
1.10	Visit ID	Unique identifier masked to prevent re-identification
2.01	ED facility ID	Location where patient sought care
3.01	Insurance coverage or other expected source of payment	Entity or person expected to be responsible for patient's bill for this ED visit
4.01	Date/Time first documented in ED	First date and time documented in patient's record for this ED visit
4.02	Mode of transport to ED	Patient's mode of transport to ED
4.06	Chief Complaint	Patient's reason for seeking care or attention, expressed in terms as close as possible to those used by patient or responsible informant
4.06a	Triage Note	Supporting information for chief complaint
4.08	First ED Acuity Assessment	First ED assessment of patient's acuity by practitioner
4.18	First ED SBP	Systolic blood pressure
4.20	First ED DBP	Diastolic blood pressure
4.26	First ED temperature	
4.27	First ED temperature reading route	
5.04	Coded Cause of Injury	Encoded description of injury event that precipitated Patient's ED visit; ICD-9-CM E-code
6.02	ED procedure	ICD-9-CM codes and CPT codes for procedures
8.02	ED Disposition	Patient's anticipated location or status following ED Visit
8.23	ED Disposition Diagnosis Description	Practitioner's description of condition or problem for which services were provided during patient's ED Visit, recorded at time of disposition
8.24	ED Disposition Diagnosis Code(s)	ICD-9-CM code(s) assigned to ED disposition diagnosis

Appendix 2: ICD-9-CM codes for disease group aggregations

Diagnosis codes in the first-listed, or in any of the 11 possible positions (for Tables 6-22, and 26):

Chest Pain and Ischemic Heart Disease: 410-414, 426, 427, 786.5, 786.50-786.59; STEMI 410.0-410.6, 410.8, 410.0; Non-STEMI 410.7

Heart Failure: 428 and 518.4, excluding failure due to fumes and vapors

TIA: 435

Ischemic Stroke: 433-434

Hemorrhagic Stroke: 430-432

Cerebrovascular disease: 437.0, 437.1

Strokes and TIA combined: 430-435, 437.0, 437.1

Psychiatric disorders: 290, 293-302, 306-312. Dementia: 290

Substance Abuse/Dependence (SAD) and Alcohol Intoxication/Withdrawal (AIW): 291, 292, 303, 304, 305 (excluding 305.1 Tobacco use), 980

Asthma: 493

Wheezing: 786.07

Pneumonia: 480-486

Bronchitis: 466.0

COPD: 490, 491, 492, 494, 495, 496

Diabetes: 250 (excluding 250.3), 251.0, 357.2, 362.0, 648.0, 707.1

Neoplasms: 140-239

Dental Conditions: 521-522

Oral Health Conditions: 521-523, 525, 528

Traumatic Head Injuries: 850-854

Cardiac Arrest: 427.5

Sickle cell disease: 282.6

Sickle cell thallassemia without crisis: 282.41

Sickle cell thallassemia with crisis: 282.42

Other hemoglobinapothies: 282.7

Whooping cough: 033

Any one of 5 E-codes (for Tables 24, 27-30):

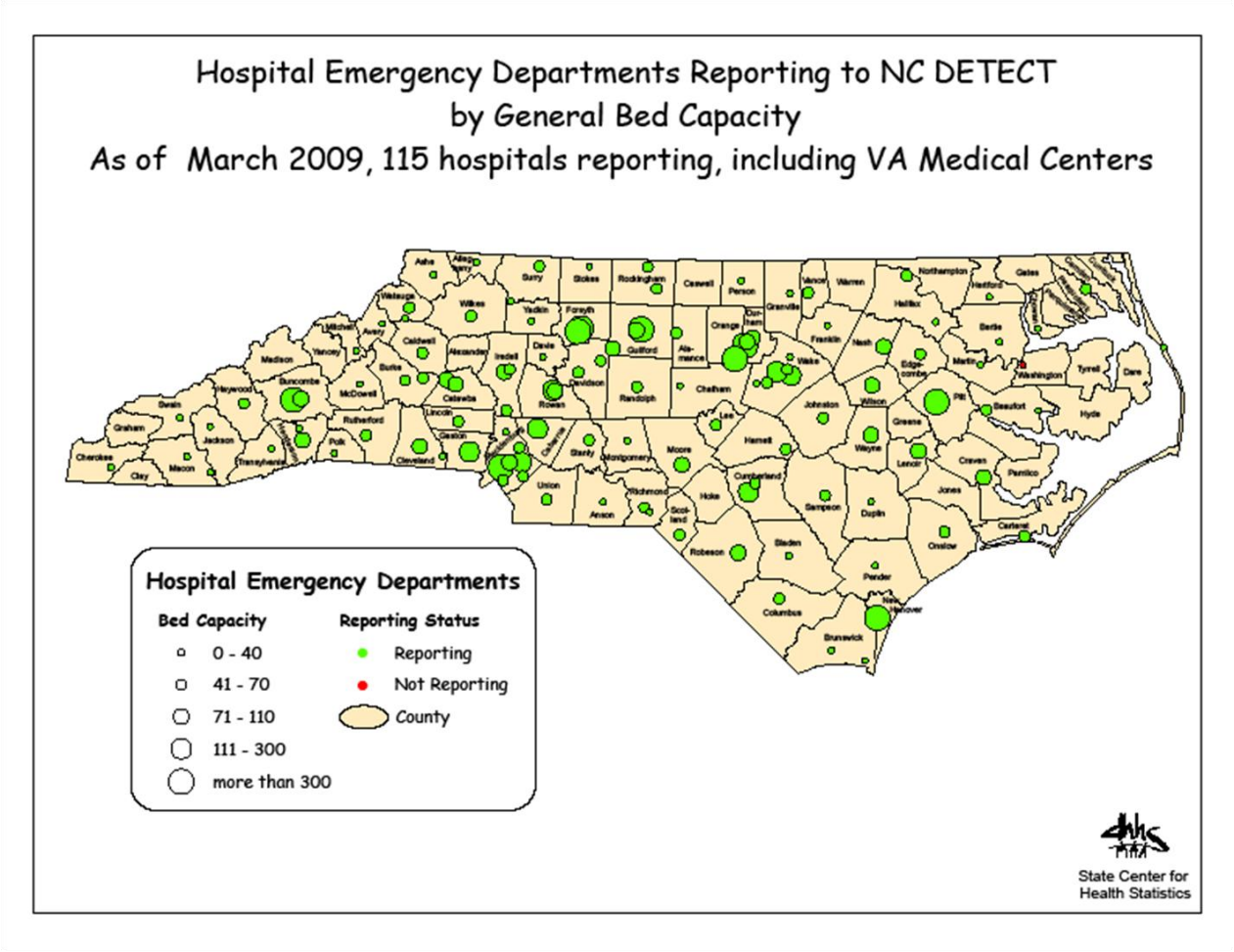
MVC Traffic: E810-819(.0 = driver); E810-819 (.1 = passenger)

MVC Non-Traffic: E820-825 (.0 = driver); E820-825 (.1 = passenger)

Pedal Cyclist: E800-807(.3), E810-825(.6), E826-829(.1), E826.9

Pedestrian Accident: E800-807(.2), E810-825(.7), E826-829(

Appendix 3: North Carolina Hospitals Reporting to NC DETECT, 2009



Appendix 4: NC DETECT related publications and presentations from 2009

2009 Publications

Dekoning EP, Hakeneworth A, Platts-Mills TF, Tintinalli JE. Epidemiology of burn injuries presenting to North Carolina emergency departments in 2006-2007. Burns. 2009; 35(6): 776-782.

Hakenewerth AM, Waller AE, Ising AI, Tintinalli JE. North Carolina Disease Event Tracking and Epidemiologic Collection Tool (NC DETECT) and the National Hospital Ambulatory Medical Care Survey (NHAMCS): Comparison of emergency department data. Academic Emergency Medicine. 2009; 16(3): 261-269.

Kaydos-Daniels SC, Rojas Smith L, Ising AI, Barnett C, Farris T, Waller AE, Wetterhall S. A Case Study of the Role of Biosurveillance in Early Detection, Situational Awareness, and Response to Public Health Threats: The North Carolina Disease Event Tracking and Epidemiologic Collection Tool (NC DETECT). In: Kass-Hout T, Zhang X, eds. Biosurveillance: A Health Protection Priority. CRC Press; September, 2009

Mears G, Glickman SW, Moore F, Cairns CB. Data based integration of critical illness and injury patient care from EMS to emergency department to intensive care unit. Current Opinion in Critical Care. 2009; 15(4) 1070-5295.

Rein DB. A Snapshot of Situational Awareness: Using the NC DETECT System to Monitor the 2007 Heat Wave. In: Kass-Hout T, Zhang X, eds. Biosurveillance: A Health Protection Priority. CRC Press; September, 2009

Tintinalli J. Letter to the Editor. North Carolina Medical Journal. 2009; 70:191

Travers D, Waller A, Katznelson J, Agans R. Reliability and Validity of the Emergency Severity Index for Pediatric Triage. Academic Emergency Medicine 2009; 16:843-849; published online August 31, 2009.

Wynter SA. Modeling to quantify the capacity and efficacy of emergency preparedness and response systems: A study of the North Carolina health alert network. Masters Thesis. North Carolina State University, Operations Research and Industrial Engineering, Raleigh, NC; 2009.

2009 Conference/Meeting Presentations

Ising, Amy. Evaluation of Triage Note Negation Processing for Syndromic Surveillance. International Society for Disease Surveillance Annual Conference, Miami, FL, December 2-4, 2009.

Ising, Amy. NC DETECT Disaster Modules Facilitate Efficient Population Monitoring. International Society for Disease Surveillance Annual Conference, Miami, FL, December 2-4, 2009.

Ising, Amy. Poison Center DataUse for Enhanced Public Health Surveillance. International Society for Disease Surveillance Annual Conference, Miami, FL, December 2-4, 2009.

Scholer, Matt. Classification in Biosurveillance Systems. International Society for Disease Surveillance Annual Conference, Miami, FL, December 2-4, 2009.

Barnett, Clifton. Evaluating the Validity of Emergency Department Data for Biosurveillance. International Society for Disease Surveillance Annual Conference, Miami, FL, December 2-4, 2009.

Samoff, Erika. Use of Syndromic Surveillance for Outbreak Detection and Management, North Carolina 2008-9. International Society for Disease Surveillance Annual Conference, Miami, FL, December 2-4, 2009.

Ising, Amy. Bridging the Gap: Incorporating Data Entry for Lab-based & Inpatient Surveillance into NC DETECT. International Society for Disease Surveillance Annual Conference, Miami, FL, December 2-4, 2009. (Poster)

Waller, Anna. Public Health Surveillance Systems Research- How can we make NC DETECT more useful to North Carolina public health agencies? NCPHA Conference, Asheville, NC, September 30-October 2, 2009. (Poster)

Ising, Amy. NC DETECT Disaster Modules Facilitate Efficient Population Monitoring. PHIN Conference, Atlanta, GA, August 31-September 2, 2009.

Ising, Amy. Determining ROI for Public Health IT. NCHICA 15th Annual Conference, Asheville, NC September 20-23, 2009.

Samoff, Erika. System Improvements to Facilitate Situational Awareness, Event Detection, and Communication in Early Detection Surveillance. 2nd Annual Keeneland Conference, Lexington, KY, April 7-9, 2009.

Travers D, Scholer M, Crouch J, Wetterhall S. Evaluation of a new method for identifying biosurveillance search terms. 2009 American Medical Informatics Association Spring Congress, Orlando, FL, May 28-30, 2009.

Ising A, Buehler M, Deyneka L, Waller A, Ford M. Poison center data use for enhanced public health surveillance. 2009 American Medical Informatics Association Spring Congress, Orlando, FL, May 28-30, 2009.

References

1. North Carolina General Statutes. Section 10.34 (b), Article 22 of Chapter 130A-480 of the North Carolina General Statutes (H1414 SL 2004-124). 2004.

2. The UNC Department of Emergency Medicine Carolina Center for Health Informatics Report, NC DETECT Emergency Department Data: 2008. Chapel Hill: NC. Carolina Center for Health Informatics, Department of Emergency Medicine, University of North Carolina at Chapel Hill, 2010. Available at: http://www.ncdetect.org/pubs.html.

3. The UNC Department of Emergency Medicine Carolina Center for Health Informatics Report, NC DETECT Emergency Department Data: 2007. Chapel Hill: NC. Carolina Center for Health Informatics, Department of Emergency Medicine, University of North Carolina at Chapel Hill, 2009. Available at: http://www.ncdetect.org/pubs.html.

4. Centers for Disease Control and Prevention. National Center for Injury Prevention and Control. Data Elements for Emergency Department Systems. Atlanta, 1997.

5. Centers for Disease Control and Prevention. BioSense. 2010. Available from: http://www.cdc.gov/biosense/index.html. Accessed March 9, 2011.

6. International Society for Disease Surveillance. The Distribute Project. 2011. Available from: http://isdsdistribute.org. Accessed March 9, 2011.

7. CDC Emergency Risk Communication Branch (ERCB), Division of Emergency Operations (DEO), Office of Public Health Preparedness and Response (OPHPR). Syndrome definitions for diseases associated with critical bioterrorism-associated agents. 2003. Available from: http://emergency.cdc.gov.libproxy.lib.unc.edu/surveillance/syndromedef/. Accessed March 6, 2011.

8. Hutwagner LC, Maloney EK, Bean NH, et al. Using laboratory-based surveillance data for prevention: an algorithm for detecting Salmonella outbreaks. *Emerg Infect Dis*. 1997;3:395-400.

9. Nistka RW, Bhuiya F, Xu J. National hospital and ambulatory medical care survey: 2007 emergency department summary. National Health Statistics Reports; no. 26 Hyattsville, MD. 2010. Available from: http://www.cdc.gov/nchs/data/nhsr/nhsr026.pdf. Accessed May 4, 2011.

10. North Carolina Trauma Registry. Office of Emergency Medical Services. 2010. Available from: http://www.ncdhhs.gov/dhsr/EMS/trauma/traumaregistry.html. Accessed March 9, 2011.

11. Nathans, AB. National trauma data bank 2010 annual report. American College of Surgeons. 2010. Available from: http://www.facs.org/trauma/ntdb/pdf/ntdbannualreport2010.pdf. Accessed May 4, 2011.

12. North Carolina Division of Bicycle and Pedestrian Transportation. Bicycle and Pedestrian Safety in North Carolina. Available from: http://www.ncdot.gov/bikeped/safetyeducation/default.html. Accessed March 7, 2011.

13. Schappert, MA, Rechtsteiner, EA. Ambulatory medical care utilization estimates for 2006. National health statistics report, no. 8. Hyattsville, MD. 2008. Available from: http://www.cdc.gov/nchs/data/nhsr/nhsr008.pdf. Accessed May 4, 2011.

14. Cook LJ, Knight S, Junkins EP, et al. Repeat patients to the emergency department in a statewide database. *Acad Emerg Med*. 2004;11(3):256.

15. U.S. Census Bureau. 2009 Population Estimates by County. 2010. Available from: http://www.census.gov. Accessed May 3, 2011.

16. NCpedia Home Page. Available from: http://ncpedia.org. Accessed March 9, 2011.

17. U.S. Department of Health and Human Services. Centers for Disease Control and Prevention. ICD-9-CM official guidelines for coding and reporting. 2010. Available from: http://www.ama-assn.org/resources/doc/cpt/icd9cm_coding_guidelines_08_09_full.pdf. Accessed May 4, 2011.

18. U.S. Department of Health and Human Services. Centers for Disease Control and Prevention, Centers for Medicare and Medicaid Services. Official version International International Clasification of Diseases, Ninth Revision, Clinical Modification, Sixth Edition. DHHS Pub No. (PHS) 06-1260.

19. Denavas-Walt CB, Proctor BD, Smith JC. U.S. Census Bureau, Current population reports, P60-238, Income, Povery, and health Insurance Coverage in the United States: 2009. 2010. Available from: http://www.census.gov/prod/2010pubs/p60-238.pdf. Accessed May 4, 2011.

20. NC Stroke Registry. Stroke Distributions in North Carolina. 2008. Available from: http://www.ncstrokeregistry.com/stroke2008/Overview/Stkdistribution.htm. Accessed May 4, 2011.

21. World Health Organization. Mental Health. 2011. Available from: http://www.who.int.libproxy.lib.unc.edu/mental_health/en. Accessed March 7, 2011.

22. Borges G, Benjet C, Medina-Mora ME, et al. Treatment of mental disorders for adolescents in Mexico City. *Bulletin of the World Health Organization*. 2008;86(10):757-764.

23. Substance Abuse and Mental Health Services Administration. Results from the 2008 National Survey on Drug Use and Health: National Findings. Office of Applied Studies, NSDUH Series H-36, HHS

Publication No. SMA 09-4434. Rockville, MD. 2009. Available from: http://www.oas.samhsa.gov. Accessed May 3, 2011.

24. McLellan AT, Lewis DC, O'Brien CP, Kleber HD. Drug dependence, a chronic medical illness: implications for treatment, insurance, and outcomes evaluation. *JAMA*. 2000;284(13):1689.

25. Fiore MC, Jaen CR, Baker TB, et al. Treating tobacco use and dependence: 2008 update. Clinical Practice Guideline. Rockville, MD: US Department of Health and Human Services. 2008. Available from: http://www.surgeongeneral.gov/tobacco/treating_tobacco_use08.pdf. Accessed May 4, 2011.

26. Hall MJ, DeFrances CJ, Williams SN, Golosinskiy A, Schwartsman A. National hospital discharge survey: 2007 summary. National health statistics report, no. 29. Hyattsville, MD 2010.Available from: http://www.cdc.gov/nchs/data/nhsr/nhsr029.pdf. Accessed May 4, 2011.

27. Parker MA. Dental care during a recession. *NC Med J*. 2009;70(4):352-353. 28. Kaiser Daily Health Policy Report: Dentist shortage, lack of coverage affecting access to care in North Carolina. Updated 2009.

29. Frakher E, Gaul K, King J, Hadley H, de la Varre C, Ricketts TC. Trends in the supply of dentists in North Carolina, 1996-2005. 2007. Available from: http://www.shepscenter.unc.edu/hp//publications/nc_dentists05.pdf Accessed May 4, 2011.

30. Cothren CC, Moore FF, Hedegaard HB, et al. Epidemiology of urban trauma deaths: A comprehensive reassessment 10 years later. *World J Surg*. 2007;31(7):1507-1511.

31. Injury Surveillance Workgroup Consensus Recommendations for Using Hospital Discharge Data for Injury Surveillance. Marietta (GA): State and Territorial Injury Prevention Directors Association. 2003. Available from: http://www.nahdo.org/documents/hdd.pdf. Accessed May 4, 2011

32. The Barrel injury diagnosis matrix, classification by body region and nature of injury Available from: http://www.cdc.gov/nchs/data/ice/final_matrix_post_ice.pdf. Accessed March 7, 2011.

33. Coben JH, Davis SM, Furbee PM, Sikora RD, Tillotson RD, Bossarte RM. Hospitalizations for poisoning by prescription opioids, sedatives, and traquilizers. *American Journal of Preventative Medicine*. 2010;38(5):517-524.

34. Science Daily. Poisoning by prescription drugs on rise. 2010. Available from: http://www.sciencedaily.com/releases/2010/04/100406073637.htm. Accessed May 4, 2011.

35. Stevens JA, Mack KA, Paulozzi I, et. al. Self-reported falls and fall related injuries among persons aged ≥ 65-US, 2006. *J Safety Res*. 2008;39(3):345-349.

36. Redelmeier DA, Tibshirani RJ. Associations between cellular-telephone calls and motor vehicle collisions. *NEJM*. 1997;336(7):453-458.

37. Drews FA, Yazdani H, Godfrey CN, Cooper JN, Strayer DL. Text messaging during simulated driving. *Human factors*. 2009;51(5):762-770.

38. AAA Foundation for Traffic Safety. Text messaging and cell phone use while driving. 2009. Available from: http://www.aaafoundation.org/pdf/TextingFS091012.pdf. Accessed November 17, 2010.

39. Mehan TJ, Gardner R, Smith GA, McKenzie LB. Bicycle-related injuries among children and adolescents in the United States. *Clinical Pediatrics*. 2009;48(2):166-173.

40. Chakravarthy B, Vaca FE, Lotfipour S, et al. Pediatric pedestrian injuries: emergency care considerations. *Pedatri Emerg Care*. 2007;23(10):738-744.

41. Health Insurance Portability and Accountability Act; Title I 1996, Title II. Updated 2003.

42. Hakenewerth AM, Waller AE, Ising AI, Tintinalli JE. NC DETECT and NHAMCS: Comparison of emergency department data. *Academic Emergency Medicine*. 2009;16(3):261-269.

43. 42 CFR Parts 412, 413, 422 et al. Medicare and Medicaid Programs; Electronic Health Record Incentive Program; Final rule. Vol. 74, No. 144. Updated 2010.

