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Influenza and Emergency Departments: How Influenza Season Severity Affects
Emergency Department Length of Visit

By

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Master of Public Health

Epidemiology

_____

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By


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Bachelor of Science

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# Abstract

Influenza and Emergency Departments: How Influenza Season Severity Affects
Emergency Department Length of Visit
By Delaney Dean

Background: Influenza season severity and emergency department length of visit (ED-LOV) are both issues of concern to EDs; however, very little work has been done linking them to each other. This study aims to understand the association between influenza season severity and ED-LOV, as well as quantify ED-LOV for a given influenza season severity.

Methods: The analysis utilized data from the National Hospital Ambulatory Medical Care Survey (NHAMCS) on ED-LOV, dates, and demographic characteristics from 2003-2015. Influenza season severity was defined using definitions from the Centers for Disease Control and Prevention. Linear regression, both unadjusted and adjusted, using complex survey design methods was conducted to examine associations between influenza season severity and ED-LOV.

Results: Influenza season severity was significantly related to ED-LOV (p-value < .0001), with low influenza severity seasons showing the largest increase in wait time compared to non-influenza season (3.5% increase; 95% CI: .45, 6.60; p-value: .0244). ED-LOV was also significantly increased for women, those age 65 and over, and those with Medicare.

Discussion: When considering how to properly staff an ED to lower wait times, ED-LOV should not be considered in isolation from influenza season severity. Results from the study, particularly the discovery that low severity seasons have the longest ED-LOV, should lead hospitals and EDs to consider investing in surge capacity measures during influenza season, regardless of influenza severity.

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**Background**

Severe influenza seasons continue to have a negative impact on many aspects of the healthcare system, and can particularly affect emergency departments (ED) (1,2). Influenza outbreaks usually occur in seasonal peaks between October and May, with severity ranging from endemic or normal levels to pandemic levels (3–5). Typical seasonal peaks affect 10-20% of the world's population each year (6). The most recent global influenza pandemic of 2009-2010, when the H1N1 influenza strain dominated, infected over 60 million Americans, leading to 270,000 hospitalizations and 12,500 deaths (7). Many of the infected individuals ended up at emergency departments (EDs), which although intended to serve only the most severe cases of illness and injury, have increasingly become the first stop for many under- or uninsured individuals seeking treatment for less severe ailments (8,9). This "safety net" effect has led to increased crowding of American EDs and increased use of EDs for assessment of influenza-like illness (10).

While not a commonly used term, "ED crowding"" is a descriptive metric used in ED-related research to generally describe a situation in which the identified need for emergency services outstrips available resources in the emergency department. This situation occurs in hospital emergency departments when there are more patients than staffed emergency department treatment beds and wait times exceed "a reasonable period" (11). Since ED crowding is not a strictly defined metric, researchers have developed multiple methods to assess crowding. One way to assess ED crowding is to calculate the time between patient arrival and discharge or admission/transfer, including

time spent in the waiting room and undergoing evaluation, testing, treatment, and transfer (1). This calculated time period is referred to as ED length of visit (ED-LOV), and increased ED-LOV has been linked to increased hospital length of stay, higher hospital mortality, increased cost of admission, ambulance diversions, lack of capacity for natural disasters or terrorist events, and financial loss of the hospital (2,10,12). Consequently, understanding what factors affect ED-LOV could greatly help hospitals plan for, prepare for, and mitigate the effects of increased ED-LOV on patients and on the hospital itself.

Both influenza severity and ED crowding are considerable public health issues that increase morbidity and mortality. Previous work has linked increased ED wait times to the severity of H1N1 influenza pandemic of 2009-2010; however, no research has established how ED wait times change from one influenza season to the next, taking seasonal severity into account (13). Understanding the relationship between influenza severity and ED wait times will help hospitals estimate how much longer a patient may have to wait to receive medical care and lead to better estimates on how many more resources, both staff and equipment, are needed to effectively treat patients presenting at the ED. Using data from the National Hospital Ambulatory Medical Cares Survey, this study aims to determine if ED length of visit differs by influenza season severity, and, if so, to quantify that difference to produce an estimate to how long any particular patient presenting in the ED is likely to wait during a given influenza season severity.

**Methods**

This study is a secondary analysis of data collected in the National Hospital Ambulatory Medical Care Survey (NHAMCS). The NHAMCS is national probability sample of ambulatory visits to hospitals in the United States. The survey is conducted annually by the Centers for Disease Control and Prevention, National Center for Health Statistics, and includes visits made to non-federal, general, and short-stay hospitals. Although the survey includes visits to all hospital outpatient departments, this analysis focuses specifically on EDs and did not include visits to other outpatient departments. Creation of the probability sample includes three stages: (1) a weighted probability selection of 112 geographic primary sampling units, (2) random selection of approximately 450-500 hospitals within the primary sampling units, and (3) random selection of patient visits within sampled EDs. Hospitals are contacted and asked to participate in the survey, and if they agree to participate, are assigned a 4-week reporting period by representatives from the U.S. Census Bureau. During the 4-week reporting period, data is recorded and abstracted from medical records by Census interviewers using an automated Patient Record form. The data collected includes information on demographics, reason for visit, causes of injuries, vital signs, diagnoses, length of visit, procedures and medications provide, and disposition including hospital discharge information (14,15).

The purpose of this analysis was to study the effect of influenza season severity on ED-LOV. To obtain outcome data on ED-LOV, we obtained data on ED-LOV from NHAMCS for 12 influenza seasons between 2003 and 2015. This time range was chosen

since the NHAMCS survey was restructured in 2003 to the current 3-stage probability sampling design, and 2015 was the most recent data available at the time of analysis (14). ED-LOV was defined as the time between patient arrival and discharge or admission/transfer, including time spent in the waiting room and undergoing evaluation, testing, treatment, and transfer (1).

An influenza season was defined as October-May, with seasonal severity designated as low, moderate, or high based on the CDC influenza season severity classification methods (16,17). Individuals visiting an ED from October through May were categorized as visiting the ED during one of the 12 influenza seasons spanning the 12 year timeframe of interest (16,18). Potential effect modifiers were also considered in the analysis and included gender, age, race, ethnicity, expected source of payment, if a patient left the hospital before being seen by a provider, if a patient was admitted to the hospital, and the geographic region of the hospital.

For this study, all ED visits captured in NHAMCS between 2003 and 2015 were considered, regardless of geographic region or reason for visit. The combined data ensured an adequate sample size for each level of influenza season severity and improved the associated standard error of the estimates. Survey data were analyzed using PROC SURVEY procedures in SAS to account for the complex sampling design of NHAMCS. Sample visit weights, stratum, and primary sampling unit design variables were used in all analyses to account for survey design and nonresponse (15). Due to a highly right-skewed distribution, ED-LOV was log-transformed to create a normal distribution. Initial analyses included weighted frequencies of visits by influenza season severity and covariates of interest. Median ED-LOV was then calculated for all eligible visits and

broken down by influenza season severity and covariates of interest. Interquartile ranges for ED-LOV were also calculated. Linear regression was used to calculate the percent change in ED-LOV by influenza severity level, and multivariable linear regression was used to calculate percent change in ED-LOV by influenza severity level while accounting for covariates of interest. In all but one regression analyses, "No Influenza Activity" served as the reference category, log-transformed ED-LOV was the outcome variable, 95% confidence intervals were calculated, and a two-tailed p-value of <.05 was considered statistically significant. One regression analysis used "Low Influenza Activity" as the reference category and found similar results.

NHAMCS is approved annually be the National Center for Health Statistics' Ethics Review Board in order to collect patient information. All patients provide informed consent and authorization for release of medical record data be health care providers (15). Since NHAMCS collection has been previously approved and is considered a publicly-available data source by the time it is published, no IRB approval was necessary for this study.

**Results**

There were 398,711 individual visit observations recorded in NHAMCS between 2003-2015. As shown in Table 1, 141,282 visits occurred during times of no influenza activity, 88,352 occurred during a low severity influenza season, 130,874 during a moderate severity influenza season, and 38,203 during a high severity influenza season. Table 2 shows the breakdown of visits by particular influenza season.

Table 1 details the demographic distribution of the study population. Approximately 55% of the visits were among female patients, and 45% were among male patients. Patients under age 15 accounted for 19.4% of visits, and 15.2% of visits occurred in patients over 65. The majority of patients were white (72.8%) and/or non-Hispanic (85.5%). The highest percentage of visits occurred in the South (39.1%), followed by the Midwest (23.1%), the West (19.5%), and the Northeast (18.3%). Approximately 11.6% of visits resulted in patients being admitted to the hospital, and 1.9% of visits resulted in patients leaving before being seen by a doctor. The majority of visits were covered by private insurance (33.5%), followed by Medicaid or SCHIP (28%), Medicare (18.2%), and Self-Pay (15.2%). Other methods of payment accounted for only a small fraction of the visits.

Overall, the median ED-LOV was 150 minutes with small changes from year to year (Table 2). ED-LOV varied slightly for each level of influenza severity, with 149 minutes for no influenza activity, 156 minutes for low influenza severity, 149 minutes for moderate influenza activity, and 144 minutes for high influenza activity (Table 3). A similar pattern was seen across influenza seasons, with seasons of lower severity having

lower median ED-LOV (Table 2). Variations in median ED-LOV were also seen in different levels of covariates. Median ED-LOV was generally higher for females and increased with age. Blacks and Hispanics tended to have higher median ED-LOV than whites and non-Hispanics, and Medicare patients had the highest median ED-LOV among the different payment types. Visits that resulted in a patient leaving before being seen had a median ED-LOV of 172 minutes compared to 149 minutes, and visits resulting in hospital admission had a median ED-LOV of 270 minutes compared to 139 minutes. Median ED-LOV did not vary greatly between regions. ED-LOV covariate patterns remained fairly constant between the different levels of influenza season severity.

For the initial unadjusted model evaluating the association between influenza season severity and ED-LOV, influenza season severity was, overall, statistically significant. The average percent change in ED-LOV for low influenza severity versus no influenza activity was 3.50% (95% CI: 0.45, 6.60; p-value=.0244), .46% for moderate influenza severity versus no influenza activity (95% CI: -2.20, 3.18; p-value=.7377), and -3.68% for high influenza severity versus no influenza activity (95% CI: -7.81, .63; p-value=.0934) (Table 4). This means that, on average, a visit occurring during a low influenza severity season was 3.5% longer than a visit occurring outside of influenza season. Similar patterns held for the covariate adjusted models and for the model with low influenza activity as the reference group (Tables 5 and 6).

In the covariate adjusted models comparing low influenza severity to no influenza activity, males had an average percent change of -1.42% compared to females (95% CI: -5.79, 3.15; p-value: .5365). When comparing moderate influenza severity to no influenza

activity and high influenza severity to no influenza activity, these percent changes

decreased further to -7.03% (95% CI: -11.01, -2.88; p-value=.0011) and -12.38% (95%

CI: -17.90, -6.50, p-value<.00001), respectively, suggesting that males wait time is less

than females, especially in higher severity influenza seasons. In terms of age, those under

15 had a decreased percent change in ED-LOV when compared to 15-24 year olds over

all levels of influenza severity, and all other age groups had an increased percent change

when compared to 15-24 year olds. Compared to whites, blacks had a statistically

significant increased percent change in ED-LOV for low influenza severity and moderate

influenza severity, but not for high influenza severity. When comparing Hispanics to non-

Hispanics, percent change was only statistically significant for low influenza severity

seasons (6.68%; 95% CI: 1.24, 12.41; p-value=.0154). Compared to private insurance,

those on Medicaid and Worker's Comp had a shorter ED-LOV while those having

Medicare and No Charge/Charity had longer ED-LOV. The highest percent change was

seen during high influenza severity versus no influenza severity among those admitted to

the hospital. Visits resulting in admission to the hospital during high severity season were

93.98% times longer than visits that didn't result in hospital admission during non-

influenza seasons (95% CI: 80.05, 208.98; p-value<.0001). No significant differences

were found in ED-LOV between different geographic regions.

**Discussion**

This study is the first to quantify the length of an ED visits during influenza seasons of varying severities. Findings of this study suggest that differing levels of influenza severity do affect ED length of visit. In particular, visits during a low influenza severity season are 3.5% longer than those that occur outside an influenza season, increasing from a median of 149 minutes per visit to 156 minutes per visit. Moderate and high severity seasons do not seem to significantly impact ED length of visit, with a median of 149 minutes per visit and 144 minutes per visit, respectively. However, these differences may not be significant in a clinical setting. The decrease in time during high influenza activity seasons may be due to increased surge capacity measures established to handle high influenza-like illness activity.

Patients under age 15 tended to have the shortest ED-LOV while those over 75 had the longest. This could be due to additional procedures needed to care for the elderly that occur during the visit or due to underlying health conditions in elderly populations. Black patients had longer wait times than white patients when comparing visits occurring during low influenza severity seasons to visits occurring outside of influenza season, but this effect disappears for moderate and high severity seasons. When examining ED-LOV by insurance type, visits by individuals covered by Medicare were the longest. Again, this could relate to the age and associated underlying health statuses of older patients covered by Medicare. Those admitted to the hospital had longer ED-

LOV compared to those who were not admitted. Geographic region, leaving before being seen, and ethnicity did not strongly impact ED-LOV.

EDs are regularly considered a "safety net" for the American population, and particularly for those who lack ability to pay for regular urgent care appointments (8). Under the Emergency Medical Treatment and Active Labor Act, emergency departments are legally required to treat any American, regardless of his or her ability to pay (9). This "safety net" effect can lead to an increase in crowding, where "there are more patients than staffed emergency department beds and *wait times exceed a reasonable period"* (11). This is especially true during influenza seasons, when many patients are driven to ED to seek care for influenza-like illness, which typically doesn't warrant emergency care and is usually better treated in a regular clinic or urgent care (8). Previous research has shown peaks in ED visits during high influenza activity seasons, which would result in crowding (19). Crowding and increased waiting time can lead to increased mortality, increased cost, ambulance diversion, and lack of capacity for natural disasters or those in true need of emergency medical care (10,12,20).

While the general rule is that median ED-LOV should be less than 4 hours for discharged patients and less than 8 hours for those admitted to the hospital, 2 hours is considered best practice (2,21). There is currently no recommendation for wait times during influenza seasons, and this could partially be due to the lack of information on how influenza severity impacts ED-LOV and general ED operations. Until now, the only research done on influenza season severity and ED-LOV linked increased wait times to the H1N1 influenza pandemic of 2009-2010; however, this research focused specifically on one influenza season without taking into account changing patterns of influenza

severity from year to year (13). The research presented in this paper not only links ED-LOV to differing levels of influenza severity, but also provides estimates of median ED-LOV times for a variety of different combinations of influenza season severity and other covariates.

This analysis shows that differing influenza season severity does affect ED-LOV and should be taken into account. One important finding is that influenza seasons of low severity had the greatest increase in ED-LOV. This information provides motivation for hospitals to consider increasing surge capacity during even mild influenza seasons, since they appear associated with increased ED-LOV. Further information presented in this study shows that the elderly, whether identified through age or use of Medicare to pay for the visit, are often at the greatest risk of increased visit length. This knowledge could allow EDs to work on staffing their department with geriatric medicine specialists in order to help decrease the visit length for elderly patients.

Although the dataset for this analysis was large and came from a nationally-representative stratified sample, the study should still be viewed in the context of several limitations. This study is  cross-sectional and therefore does not provide strong evidence for causation. Covariates of interest, such as type of hospital, were unable to be analyzed since data for these covariates stopped being collected after 2012 due to privacy concerns (14). Furthermore, concerns have been raised about the reliability and accuracy of NHAMCS chart abstraction (22). However, even given these limitations, the large sample size and methodologically-sound sampling method provide a strong basis for reliable results from the analysis.

Further research should be conducted to analyze how other hospital departments besides the emergency department are affected by influenza season severity. Of greatest interest is how deploying surge capacity measures during times of high influenza activity affects ED-LOV. Finally, further research on how to more quickly classify influenza season severity would allow hospitals and EDs to quickly adjust their procedures in order to decrease ED-LOV for all patients presenting at the ED during a given influenza season.

In conclusion, this analysis shows the impact of variations in seasonal influenza activity on ED length of visit when compared with no influenza activity. The first study of its kind, this research not only provides evidence of increased ED-LOV during low activity influenza seasons, but also quantifies median waiting times based on influenza season severity and other underlying covariates. The results from the study provide strong motivation for individual hospitals and EDs to consider their own ED-LOV measures during influenza seasons to best prepare for future seasons and eventually decrease ED-LOV.

**Table 1. Characteristics of a Cross-section of U.S. Emergency Department (ED) Visits[a] by Influenza Season Severity[b] Based on the National Hospital Ambulatory Care Survey (NHAMCS) Data, 2003-2015**

| | All Eligible Visits (n=398,711) | | No Influenza Activity (n=141,282) | | Low Influenza Severity (n=88,352) | | Moderate Influenza Severity (n=130,874) | | High Influenza Severity (n=38,203) | |
|---|---|---|---|---|---|---|---|---|---|---|
| | No. | %[c] | No. | %[c] | No. | %[c] | No. | %[c] | No. | %[c] |
| Gender | | | | | | | | | | |
| Male | 182,592 | 45.2 | 65,266 | 45.6 | 40,379 | 45.3 | 59,345 | 44.8 | 17,602 | 45.2 |
| Female | 216,119 | 54.8 | 76,016 | 54.4 | 47,973 | 54.7 | 71,529 | 55.2 | 20,601 | 54.8 |
| Age (Years) | | | | | | | | | | |
| Under 15 | 76,947 | 19.4 | 25,718 | 18.3 | 17,648 | 19.1 | 25,524 | 19.5 | 8,057 | 21.3 |
| 15-24 | 62,412 | 15.7 | 22,488 | 16.0 | 13,802 | 15.9 | 20,269 | 15.6 | 5,853 | 15.2 |
| 25-44 | 114,770 | 28.5 | 41,589 | 29.1 | 24,886 | 28.0 | 37,211 | 28.2 | 11,084 | 28.7 |
| 45-64 | 84,920 | 21.2 | 30,612 | 24.6 | 18,681 | 21.2 | 28,101 | 21.4 | 7,526 | 19.9 |
| 65-74 | 24,758 | 6.4 | 8,799 | 6.4 | 5,320 | 6.2 | 8,243 | 6.4 | 2,396 | 6.5 |
| 75+ | 34,904 | 8.8 | 12,076 | 8.6 | 8,015 | 9.0 | 11,526 | 8.9 | 3,287 | 8.3 |
| Race | | | | | | | | | | |
| White | 285,761 | 72.8 | 101,869 | 73.3 | 63,055 | 72.0 | 92,999 | 72.5 | 27,838 | 73.8 |
| Black | 94,970 | 23.6 | 33,284 | 23.2 | 21,210 | 24.4 | 31,782 | 23.6 | 8,694 | 23.2 |
| Other | 17,980 | 3.6 | 6,129 | 3.5 | 4,087 | 3.6 | 6,093 | 3.9 | 1,671 | 3.1 |
| Ethnicity | | | | | | | | | | |
| Hispanic | 60,777 | 14.5 | 21,641 | 14.3 | 13,447 | 14.0 | 20,093 | 14.8 | 5,596 | 15.3 |
| Non-Hispanic | 337,934 | 85.5 | 119,641 | 85.7 | 74,905 | 86.0 | 110,781 | 85.2 | 32,607 | 84.7 |
| Expected Source of Payment | | | | | | | | | | |
| Private Insurance | 124,605 | 33.5 | 44,468 | 34.1 | 28,179 | 34.5 | 39,441 | 32.7 | 12,517 | 32.1 |
| Medicare | 65,498 | 18.2 | 23,035 | 18.3 | 13,865 | 17.2 | 22,401 | 18.8 | 6,197 | 17.8 |
| Medicaid/SCHIP | 107,957 | 28.0 | 37,049 | 27.0 | 24,305 | 27.5 | 36,357 | 28.3 | 10,246 | 31.6 |
| Worker's Compensation | 4,904 | 1.2 | 1,898 | 1.4 | 1,121 | 1.4 | 1,368 | 1.1 | 517 | 1.2 |
| Self-Pay | 55,194 | 15.2 | 20,469 | 15.6 | 11,952 | 15.4 | 17,786 | 15.0 | 4,987 | 13.8 |
| No Charge/Charity | 3,797 | 1.0 | 1,369 | 1.0 | 837 | 1.2 | 1,323 | 1.0 | 268 | 0.8 |
| Other | 10,400 | 2.8 | 3,585 | 2.6 | 2,156 | 2.9 | 3,696 | 3.1 | 963 | 2.7 |
| Unknown | 26,356 | - | 9,409 | - | 5,937 | - | 8,502 | - | 2,508 | - |
| Left Before Being Seen | | | | | | | | | | |
| Yes | 7,724 | 1.9 | 2,816 | 2.0 | 1,723 | 2.0 | 2,484 | 1.8 | 701 | 1.7 |
| No | 390,987 | 98.1 | 138,466 | 98.0 | 86,629 | 98.0 | 128,390 | 98.2 | 37,502 | 98.3 |
| Admitted to Hospital | | | | | | | | | | |
| Yes | 49,009 | 11.6 | 16,556 | 11.4 | 11,782 | 12.8 | 16,147 | 11.3 | 4,524 | 11.1 |
| No | 349,702 | 88.4 | 124,726 | 88.6 | 76,570 | 87.2 | 114,727 | 88.7 | 33,679 | 88.9 |
| Geographic Region | | | | | | | | | | |
| Northeast | 92,427 | 18.3 | 32,947 | 18.7 | 21,259 | 18.2 | 30,175 | 18.2 | 8,046 | 17.4 |
| Midwest | 88,328 | 23.1 | 31,861 | 23.3 | 18,641 | 22.6 | 28,906 | 23.6 | 8,920 | 22.2 |
| South | 139,178 | 39.1 | 49,447 | 39.0 | 32,013 | 41.4 | 45,668 | 37.9 | 12,050 | 38.2 |
| West | 78,778 | 19.5 | 27,027 | 19.0 | 16,439 | 17.8 | 26,125 | 20.4 | 9,187 | 22.1 |

[a]Data from NHAMCS is visit-level data; therefore, individual events are not analagous to single patients

[b]Infleunza season severity is determined by outpatient visits for influenza-like illness, influenza-related hospitalizations, and influenza/pneumonia related mortality. See Bigerstaff et al. for further details.

[c]Percentages are weighted in accordance with stratified sampling design

**Table 2. Mean and Median Emergency Department Length of Visit (ED-LOV) by Influenza Season, NHAMCS, 2003-2015**

|  | n | Mean | Median |
| --- | --- | --- | --- |
| 2003-2004 (High) | 21,685 | 200.8 | 140 |
| 2004-2005 (Moderate) | 21,630 | 212.97 | 149 |
| 2005-2006 (Low) | 21,045 | 214.15 | 152 |
| 2006-2007 (Low) | 22,446 | 221.32 | 155 |
| 2007-2008 (Moderate) | 22,034 | 215.61 | 158 |
| 2008-2009 (Low) | 22,182 | 207.08 | 156 |
| 2009-2010 (Moderate) | 22,288 | 207.27 | 150 |
| 2010-2011 (Moderate) | 19,858 | 218.02 | 159 |
| 2011-2012 (Low) | 17,608 | 223.61 | 156 |
| 2012-2013 (Moderate) | 17,107 | 223.53 | 153 |
| 2013-2014 (Moderate) | 15,307 | 227.07 | 150 |
| 2014-2015 (High) | 12,776 | 209.29 | 152 |

*Low, Moderate, and High refer to influenza season severity

**Table 3. Median ED-LOV by Selected Characteristics, Based on the 2003-2015 National Hospital Ambulatory Care Survey Data**

| | All Eligible Visits (n=398,711) | | No Influenza Activity (n=141,282) | | Low Influenza Severity (n=88,352) | | Moderate Influenza Severity (n=130,874) | | High Influenza Severity (n=38,203) | |
|---|---|---|---|---|---|---|---|---|---|---|
| | Median | Q1-Q3 | Median | Q1-Q3 | Median | Q1-Q3 | Median | Q1-Q3 | Median | Q1-Q3 |
| Overall | 150 | 87-245 | 149 | 86-246 | 156 | 90-254 | 149 | 88-243 | 144 | 83-235 |
| Gender | | | | | | | | | | |
| Male | 143 | (83, 237) | 141 | (82, 238) | 147 | (85, 242) | 142 | (83, 235) | 138 | (80, 228) |
| Female | 156 | (91, 252) | 155 | (90, 253) | 163 | (94, 264) | 154 | (91, 250) | 149 | (87, 240) |
| Age (Years) | | | | | | | | | | |
| Under 15 | 110 | (68, 176) | 108 | (66, 170) | 116 | (70, 184) | 110 | (68, 176) | 109 | (66, 177) |
| 15-24 | 134 | (79, 217) | 135 | (79, 215) | 139 | (82, 230) | 132 | (80, 214) | 130 | (76, 207) |
| 25-44 | 149 | (86, 244) | 148 | (85, 246) | 154 | (88, 252) | 148 | (86, 241) | 144 | (84, 233) |
| 45-64 | 175 | (103, 283) | 177 | (102, 285) | 181 | (107, 294) | 172 | (103, 279) | 169 | (100, 272) |
| 65-74 | 195 | (120, 300) | 192 | (115, 303) | 198 | (123, 307) | 196 | (121, 296) | 190 | (123, 295) |
| 75+ | 210 | (135, 311) | 209 | (134, 310) | 214 | (135, 319) | 210 | (136, 313) | 201 | (128, 288) |
| Race | | | | | | | | | | |
| White | 148 | (86, 242) | 146 | (84, 241) | 152 | (88, 247) | 148 | (87, 241) | 145 | (83, 234) |
| Black | 157 | (91, 258) | 158 | (93, 263) | 168 | (96, 275) | 153 | (89, 249) | 141 | (84, 236) |
| Other | 152 | (87, 249) | 156 | (89, 255) | 155 | (90, 254) | 148 | (85, 246) | 142 | (81, 231) |
| Ethnicity | | | | | | | | | | |
| Hispanic | 154 | (89, 255) | 153 | (88, 257) | 162 | (93, 268) | 152 | (88, 251) | 153 | (87, 243) |
| Non-Hispanic | 149 | (87, 244) | 149 | (86, 244) | 155 | (89, 252) | 149 | (88, 242) | 142 | (83, 232) |
| Expected Source of Payment | | | | | | | | | | |
| Private Insurance | 144 | (85, 234) | 143 | (84, 234) | 149 | (88, 239) | 144 | (86, 234) | 140 | (82, 225) |
| Medicare | 195 | (120, 300) | 194 | (119, 300) | 201 | (121, 307) | 196 | (122, 299) | 190 | (122, 286) |
| Medicaid/SCHIP | 135 | (79, 225) | 135 | (78, 224) | 142 | (82, 236) | 134 | (80, 222) | 130 | (74, 216) |
| Worker's Compensation | 102 | (65, 159) | 101 | (64, 150) | 106 | (65, 166) | 103 | (67, 169) | 99 | (62, 156) |
| Self-Pay | 139 | (81, 233) | 142 | (82, 238) | 147 | (84, 241) | 137 | (79, 226) | 125 | (76, 228) |
| No Charge/Charity | 189 | (112, 307) | 196 | (120, 335) | 183 | (110, 287) | 197 | (112, 313) | 154 | (94, 232) |
| Other | 150 | (86, 245) | 144 | (84, 239) | 158 | (87, 253) | 158 | (88, 250) | 133 | (78, 224) |
| Left Before Being Seen | | | | | | | | | | |
| Yes | 172 | (94, 286) | 178 | (100, 298) | 168 | (90, 276) | 174 | (97, 289) | 136 | (76, 251) |
| No | 149 | (87, 245) | 149 | (86, 245) | 155 | (90, 254) | 149 | (87, 243) | 144 | (83, 234) |
| Admitted to Hospital | | | | | | | | | | |
| Yes | 270 | (181, 395) | 273 | (184, 397) | 269 | (177, 398) | 271 | (182, 398) | 256 | (170, 367) |
| No | 139 | (82, 225) | 138 | (81, 224) | 143 | (84, 231) | 138 | (83, 223) | 135 | (79, 218) |
| Geographic Region | | | | | | | | | | |
| Northeast | 162 | (92, 274) | 159 | (89, 272) | 164 | (91, 278) | 166 | (95, 278) | 157 | (91, 258) |
| Midwest | 143 | (82, 235) | 145 | (83, 240) | 146 | (84, 241) | 139 | (81, 226) | 145 | (83, 232) |
| South | 147 | (87, 238) | 146 | (86, 238) | 156 | (91, 250) | 146 | (87, 237) | 134 | (77, 219) |
| West | 155 | (90, 251) | 153 | (89, 249) | 159 | (92, 259) | 154 | (91, 250) | 157 | (90, 250) |

[a]Data from the National Hospital Ambulatory Care Survey (NHAMCS) is visit-level data; therefore, individual events are not analagous to single patients

[b]Infleunza season severity is determined by outpatient visits for influenza-like illness, influenza-related hospitalizations, and influenza/pneumonia related mortality. See Bigerstaff et al. for further details.

[c]Percentages are weighted in accordance with stratified sampling design

**Table 4. Percent Change in ED-LOV by Influenza Severity Level, No Influenza Activity as Reference Group, NHAMCS 2003-2015**

| | Low Influenza Severity | (n=88,352) | | Moderate Influenza Severity (n=130,874) | | | High Influenza Severity | (n=38,203) | |
|---|---|---|---|---|---|---|---|---|---|
| | % Change | 95% CI | p-value | % Change | 95% CI | p-value | % Change | 95% CI | p-value |
| **Unadjusted** | 3.50 | (0.45, 6.60) | 0.0244 | 0.46 | (-2.20, 3.18) | 0.7377 | -3.68 | (-7.81, .63) | 0.0934 |

*Overall p-value <.0001

**Table 5. Percent Change in ED-LOV by Influenza Severity Level, Low Influenza Activity as Reference Group, NHAMCS 2003-2015**

|  | Moderate Influenza Severity (n=130,874) | | | High Influenza Severity | (n=38,203) | |
|---|---|---|---|---|---|---|
|  | % Change | 95% CI | p-value | % Change | 95% CI | p-value |
| **Unadjusted** | -2.93 | (-6.16, .40) | 0.0842 | -6.93 | (-11.42, -2.22) | 0.0044 |

*Overall p-value <.0001

**Table 6. Multivariate Adjusted Percentage Change in ED-LOV by Selected Characteristics, NHAMCS 2003-2015**

|  | Low Influenza Severity (n=88,352) | | | Moderate Influenza Severity (n=130,874) | | | High Influenza Severity (n=38,203) | | |
|---|---|---|---|---|---|---|---|---|---|
|  | % | 95% CI | p-value | % | 95% CI | p-value | % | 95% CI | p-value |
| Gender |  |  |  |  |  |  |  |  |  |
| Male | -1.42 | (-5.79, 3.15) | 0.5365 | -7.03 | (-11.01, -2.88) | 0.0011 | -12.38 | (-17.90, -6.50) | <.0001 |
| Female |  |  |  |  | Reference |  |  |  |  |
| Age (Years) |  |  |  |  |  |  |  |  |  |
| Under 15 | -17.02 | (-19.48, -14.50) | <.0001 | -16.01 | (-18.48, -13.46) | <.0001 | -14.58 | (-19.13, -9.78) | <.0001 |
| 25-44 | 7.39 | (4.81, 10.02) | <.0001 | 9.60 | (7.22, 12.04) | <.0001 | 9.23 | (4.95, 13.69) | <.0001 |
| 45-64 | 26.66 | (23.39, 30.01) | <.0001 | 28.44 | (25.46, 31.48) | <.0001 | 28.52 | (23.39, 33.87) | <.0001 |
| 65-74 | 38.11 | (32.85, 43.58) | <.0001 | 43.76 | (39.22, 48.44) | <.0001 | 46.66 | (39.63, 54.05) | <.0001 |
| 75+ | 46.05 | (40.45, 51.87) | <.0001 | 55.62 | (50.97, 60.43) | <.0001 | 48.48 | (40.52, 56.89) | <.0001 |
| 15-24 |  |  |  |  | Reference |  |  |  |  |
| Race |  |  |  |  |  |  |  |  |  |
| Black | 9.85 | (4.57, 15.39) | 0.0002 | 4.27 | (0.07, 8.65) | 0.0461 | 1.06 | (-5.64, 8.24) | 0.7636 |
| Other | 3.04 | (-4.48, 11.15) | 0.4382 | 0.53 | (-5.62, 7.08) | 0.8704 | 2.37 | (-6.15, 11.67) | 0.5969 |
| White |  |  |  |  | Reference |  |  |  |  |
| Ethnicity |  |  |  |  |  |  |  |  |  |
| Hispanic | 6.68 | (1.24, 12.41) | 0.0154 | 3.37 | (-1.66, 8.65) | 0.1927 | 6.37 | (-0.11, 13.26) | 0.0542 |
| Non-Hispanic |  |  |  |  | Reference |  |  |  |  |
| Expected Source of Payment |  |  |  |  |  |  |  |  |  |
| Medicare | 28.73 | (24.43, 33.18) | <.0001 | 32.47 | (29.41, 35.61) | <.0001 | 33.54 | (27.39, 39.98) | <.0001 |
| Medicaid/SCHIP | -4.85 | (-8.16, -1.41) | 0.0060 | -5.79 | (-8.29, -3.21) | <.0001 | -7.30 | (-12.00, -2.34) | 0.0044 |
| Worker's Compensation | -28.97 | (-33.87, -23.7) | <.0001 | -27.10 | (-31.16, -22.80) | <.0001 | -25.88 | (-34.59, -16.00) | <.0001 |
| Self-Pay | -2.52 | (-6.68, 1.83) | 0.2523 | -5.94 | (-9.29, -2.46) | 0.0010 | -2.47 | (-8.26, 3.68) | 0.4221 |
| No Charge/Charity | 16.59 | (1.87, 33.43) | 0.0259 | 29.44 | (15.40, 43.95) | <.0001 | 7.18 | (-3.84, 19.47) | 0.2100 |
| Other | 1.02 | (-8.62, 11.68) | 0.8422 | 5.65 | (-1.71, 13.57) | 0.1358 | -5.37 | (-15.43, 5.87) | 0.3349 |
| Private Insurance |  |  |  |  | Reference |  |  |  |  |
| Left Before Being Seen |  |  |  |  |  |  |  |  |  |
| Yes | -0.06 | (-7.34, 7.79) | 0.9870 | 12.49 | (6.45, 18.88) | <.0001 | -1.85 | (-15.29, 13.71) | 0.8031 |
| No |  |  |  |  | Reference |  |  |  |  |
| Admitted to Hospital |  |  |  |  |  |  |  |  |  |
| Yes | 84.56 | (76.59, 92.90) | <.0001 | 97.00 | (90.03, 204.23) | <.0001 | 93.98 | (80.05, 208.98) | <.0001 |
| No |  |  |  |  | Reference |  |  |  |  |
| Geographic Region |  |  |  |  |  |  |  |  |  |
| Northeast | 3.63 | (-6.73, 15.14) | 0.5070 | 7.86 | (-0.65, 17.10) | 0.0713 | 3.12 | (-8.39, 16.08) | 0.6103 |
| Midwest | -8.51 | (-18.96, 3.28) | 0.1501 | -9.51 | (-17.80, -0.38) | 0.0416 | -5.55 | (-15.03, 4.98) | 0.2893 |
| South | -2.20 | (-11.22, 7.74) | 0.6524 | -4.59 | (-11.73, 3.12) | 0.236 | -12.37 | (-20.62, -3.26) | 0.0089 |
| West |  |  |  |  | Reference |  |  |  |  |

*Reference group for all % changes is "No Influenza Activity"

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