HHS Public Access

Author manuscript

J Stroke Cerebrovasc Dis. Author manuscript; available in PMC 2018 August 01.

Published in final edited form as:

J Stroke Cerebrovasc Dis. 2017 August ; 26(8): 1831–1840. doi:10.1016/j.jstrokecerebrovasdis.2017.04.018.

Impact of Hospital Admission for Patients with Transient Ischemic Attack

Eric M. Cheng, MD, MS[1,2], **Laura J. Myers, PhD**[3,4], **Stefanie Vassar, MS**[1,2], and **Dawn M. Bravata, MD**[3,4]

[1]Department of Neurology, VA Greater Los Angeles Healthcare System, Los Angeles, California

[2]Department of Neurology, David Geffen School of Medicine, University of California at Los Angeles, Los Angeles, California

[3]VA Health Services Research & Development (HSR&D) Center for Health Information and Communication (CHIC), Richard L. Roudebush VA Medical Center, Indianapolis, Indiana

[4]Department of Internal Medicine, Indiana University School of Medicine, Indianapolis, Indiana

Abstract

Objectives—To determine the impact of admission among TIA patients in the Emergency Department (ED).

Study Design—Retrospective cohort study using national Veterans Administration data (2008).

Methods—We first analyzed whether admitted patients were discharged from the hospital with a diagnosis of TIA. We then analyzed whether admission was associated with a composite outcome (new stroke, new myocardial infarction, or death in the year after TIA) using multivariate logistic regression modeling with propensity score matching.

Results—Among 3623 patients assigned a diagnosis of TIA in the ED, 2118 (58%) patients were admitted to the hospital or placed in observation compared with 1505 (42%) patients who were discharged from the ED. Among the 2118 patients who were admitted, 903 (43% of admitted group) were discharged from the hospital with a diagnosis of TIA, and 548 (26% of admitted group) were discharged with a diagnosis of stroke. Admitted patients were more likely than non-admitted patients to receive processes of care (i.e., brain imaging, carotid imaging, echocardiography). In matched analyses using propensity scores, the one-year composite outcome in the admitted group (15.3%) was not lower than the discharged group (13.3%, OR 1.17 [0.94–1.46), p=0.17).

Conclusions—Less than half of patients admitted with a diagnosis of TIA retained that diagnosis at hospital discharge. Although admitted patients were more likely to receive diagnostic

Corresponding author: Eric M Cheng, MD, MS, VA Greater Los Angeles Healthcare System, 11301 Wilshire Blvd, ML 127, Department of Neurology, Los Angeles, CA 90073.

procedures, we did not identify improvements in outcomes among admitted patients; however, evaluating care for patients with TIA is limited by the reliability of secondary data analysis.

Keywords

transient ischemic attack; diagnoses; health policy and outcome research; secondary prevention

Introduction

Persons who experience a transient ischemic attack (TIA) have a 90-day risk of stroke as high as 15%, about twice as much as persons with a recent stroke.[1] Prompt management of stroke risk factors can reduce the risk of future atherosclerotic events.[2] Two European randomized controlled trials of outpatient interventions showed that TIA can be managed as an outpatient.[3,4] Several United States studies have shown that the use of emergency department protocols for TIA expedites a diagnostic workup,[5] while decreasing costs due to a shorter length of hospital stay.[56] On the other hand, in-hospital initiation of secondary prevention has been associated with high rates of medication adherence and better vascular outcomes.[7,8] The American Heart Association guideline on TIA states that “it is reasonable to hospitalize patients with TIA if they present within 72 hours” if the predicted risk of stroke is high or an outpatient work-up cannot be completed within 2 days; however, this statement has a “C” level of evidence.[2]

Surveys of emergency department utilization[9–12] or administrative data[13] have identified predictors of admission for patients presenting with TIA to the emergency department. However, these data sources typically do not contain information on what happens to patients after admission or disposition. The objective of this study was to examine the impact of admission on the certainty of TIA diagnosis as well as health care utilization and outcomes among patients assigned a diagnosis of TIA in the emergency department.

Methods

Study setting and population

The Veterans Health Administration (VHA) is the largest integrated healthcare system in the United States. The VHA databases contain data in the inpatient, outpatient, and emergency department settings, so it does contain information about patients who either stayed overnight or were discharged from the emergency department. Of note, there was not a national VHA policy guiding whether patients presenting with TIA should be admitted.

We queried VHA national administrative databases to identify all patients assigned a primary diagnosis of TIA (International Classification of Disease, Ninth Revision (ICD-9) code of 435.x) at emergency departments in fiscal year (FY) 2008 [October 1, 2007 to September 30, 2008] at 131 acute care Veterans Affairs Medical Centers (VAMCs). This diagnosis code and method is used to identify patients with TIA in the majority of observational studies about predictors of admission,[9,11,12,14] though a few studies use a subset of the ICD-9 435 code.[10,13] If a patient had more than one presentation of TIA during this time period, we included only the first presentation.

The main variable of interest was whether the patient stayed overnight in the hospital – either admitted to the hospital or placed in observation – or was discharged from the emergency department. Since the vast majority of patients who stayed overnight were admitted instead of placed in observation, we labeled the group that stayed overnight as being admitted. We included all admissions that occurred within the second day after presentation because patients could remain in the emergency department for a prolonged period if there were no available hospital beds. For each patient in the sample, we obtained demographic characteristics of age and sex. We also searched for the following diagnosis codes of atherosclerotic risk factors assigned in the year prior to TIA presentation: hypertension, diabetes, atrial fibrillation, history of prior stroke, TIA, or myocardial infarction. If the patient was admitted, we also obtained the diagnosis code assigned at hospital discharge.

Next, we identified the diagnostic work-up each patient received during a 90 day time window: 60 days prior to presentation of the index TIA to 30 days after presentation of the index TIA. Neuroimaging of the brain included either computerized tomography (CT) of the head or magnetic resonance imaging (MRI) of the brain. Internal carotid artery imaging included carotid ultrasound, magnetic resonance angiography (MRA) of the neck, computerized tomography angiography (CTA), or catheter-based angiography. Cardiac tests consisted of transthoracic echocardiography (TTE) or transesophageal echocardiography (TEE).

Finally, we obtained the occurrence of a composite outcome of a new stroke, new myocardial infarction, or death within the year after presentation of TIA. This composite outcome is used in landmark secondary stroke prevention studies,[15,16] and we used similar outcomes to ensure comparability. Stroke and myocardial infarction were ascertained through primary diagnosis codes assigned during VHA emergency department visits or hospitalizations, excluding those identified during the index presentation of TIA.[17] Mortality was ascertained using the Vital Status Files (VSF), which identifies deaths from a variety of VHA and non-VHA sources. Previous reports indicate that the VSF is relatively complete and accurate when compared with information contained in the National Death Index (NDI), the typical "gold standard" for death ascertainment; more than 98.3% of deaths in the VSF have been confirmed with deaths in the NDI.[18,19] The VSF does not contain cause of death, but studies have shown that death certificates are also not accurate.[20]

To validate the information obtained from the national VHA administrative databases, we performed a chart review of patients in our sample who presented with TIA at three of the 131 VAMCs. The chart abstractors reviewed the medical chart for the same information queried in the national VHA administration databases without knowing the results of those queries. The research team compared the data obtained in medical chart review against data obtained from the national databases. When a discrepancy was observed, the research team re-reviewed the medical chart to determine whether there was an error in the chart abstraction or whether the administrative database query should be revised. For example, the administrative databases could not identify whether hospitalized patients were assigned a bed with continuous cardiac rhythm monitoring (e.g., telemetry) as identified through chart review, so that variable was dropped. There was a high level of agreement; using the administrative databases, we were able to identify 95% of the diagnostic tests abstracted during chart review. We also determined that when the diagnosis of TIA was assigned in the ambulatory (non-emergency department) clinic, it almost always referred to a prior event instead of a new event. In addition, we determined that when patients were discharged with a diagnosis of stroke after being admitted from the index presentation, this meant that the original TIA event was re-diagnosed as a stroke after brain neuroimaging, and that a new stroke did not occur during the hospital stay.

Among all patients who were assigned a diagnosis of TIA in the emergency department, we calculated the proportion of patients who were not admitted (group 1) and who were admitted (group 2a). Among the patients admitted, we calculated the subset who were subsequently discharged from the hospital with a diagnosis of stroke or TIA (group 2b) and from that group, a further subset who were discharged with a diagnosis of TIA (group 2c).

We then calculated the median proportion of patients who were admitted at the hospital level. To limit the impact of hospitals who manage only a small number of patients with TIA, we also calculated the median proportion of patients who were admitted among hospitals where more than 10 patients were assigned with a diagnosis of TIA in the emergency department in that year.

The main analyses compared the groups admitted versus not admitted (Group 1 versus Group 2a). Chi-square or student t-tests were used to compare the two groups in terms of demographic and clinical characteristics, receipt of brain imaging and cardiac imaging, and in subsequent healthcare utilization. Finally, we compared whether the two groups differed in the occurrence of the composite outcome at one year after presentation of TIA in bivariate and multivariate analyses that adjusted for the presence of atherosclerotic risk factors. Because the decision to admit patients is not made at random, we analyzed predictors of admission, then performed matching by propensity scores, which described the likelihood that a patient was admitted, whether or not they were actually admitted. We derived propensity scores by building a logistic regression model using admission as the outcome variable, where the covariates consisted of stroke risk factors: age, sex, hypertension, hypercholesterolemia, diabetes, and history of stroke or TIA. For every patient in the sample who was not admitted, we matched the nearest neighbor in the admitted group by propensity score within one standard deviation of the probability estimate. Patients in the admitted group could only be matched with one patient in the non-admitted group; in other words, matching was performed without replacement. Matched analyses were performed on the paired patients.

We conducted multiple sensitivity analyses. In the first sensitivity analysis, we restricted the admitted group to only patients with a discharge diagnosis of TIA or stroke (group 2b). In the second sensitivity analysis, we further restricted the admitted group to only patients with a discharge diagnosis of TIA (group 2c). We re-ran all models using the outcome of stroke instead of a composite outcome of stroke, myocardial infarction, and death, and we re-ran models using a 30 or 90-day outcome instead of a one-year outcome. We re-ran all propensity score matching using the different samples of the admitted group and the different outcome of stroke. Institutional Review Board approval was obtained at the VAMCs affiliated with the authors. All analyses were performed using SAS 9.1 (Cary, NC).

Results

The analytic sample consisted of 3623 Veterans presenting to an emergency department with TIA in fiscal year 2008. Among these TIA patients, 2005 were admitted to the hospital and 113 placed in the observation unit within the second day after presentation, so there were 2118 (58% of sample, group 2a) who stayed overnight in the hospital and 1505 (42% of sample) who were discharged from the emergency department (Figure 1). Among the 2118 patients who stayed overnight, 903 (43% of admitted group, group 2c) were discharged with a diagnosis of TIA, and 548 (26% of admitted group) were discharged with a diagnosis of stroke. Of the remaining 667 patients (31% of admitted group), the five most frequent discharge diagnoses were skin sensation disturbance (46, 2%), syncope (45, 2%), migraine (21, 1%), hypertension (20, 1%), and speech disturbance (17, 1%, Table 1).

Among the 131 VHA hospitals, there were 9 hospitals without any patients assigned a diagnosis of TIA in the emergency department. Among the remaining 122 VHA hospitals, the median proportion of admission was 55.8% (interquartile range [41.0, 69.4]). We further excluded the 22 hospitals with fewer than ten patients presenting with TIA, and the median proportion of admission remained similar (57.1%, interquartile range [46.3, 71.8]), Figure 2).

Compared to patients who were not admitted, patients who were admitted were more likely to have stroke risk factors including: older age, male gender, atrial fibrillation, hypertension, and diabetes (Table 2). Multivariate logistic models that used the dependent variable of admission had low discriminatory ability to predict which patient got admitted (c-statistic = 0.55, data not shown). Patients who were admitted were much more likely than those who were not admitted to undergo any neuroimaging of the brain (91% vs. 78%), MRI scans (59% vs. 16%), carotid artery imaging (52% vs. 38%), or echocardiogram (46% vs. 22%, all p-values<0.01 in Table 2).

In the unadjusted main analyses (group 1 versus group 2a), the group that stayed overnight just missed having a significantly higher risk of the one-year composite outcome (15.3% versus 13.2%, p=0.06, Table 2). The sensitivity analyses that restricted the patients who stayed overnight to those with a discharge diagnosis of TIA or stroke (group 1 versus group 2b) or TIA (group 1 versus group 2c) also did not show that the admitted group had fewer occurrences in the composite outcome compared to the group not admitted (Table 2). In multivariate analyses, predictors of the composite outcome included older age, history of atrial fibrillation, and prior history of stroke, but not admission (odds ratio (OR) 1.12, 95% confidence interval (CI) [0.92–1.36]; Table 3). In the sensitivity analyses that restricted the admission group to either discharge diagnoses of stroke and TIA or TIA alone, admission remained unassociated with the composite outcomes (Table 3).

The propensity score analysis had similar results. Among the original 1505 patients who were not admitted at time of index TIA, 656 (44%) had an exact match of propensity scores, an additional 672 (45%) had matches within one standard deviation, leaving 177 (12%) without a match within one standard deviation. Therefore, the matched analyses consisted of 1328 pairs of patients with a match within one standard deviation. As expected when groups are matched by propensity score, there were no longer any significant differences in baseline characteristics (Table 4). Patients who were admitted remained more likely to get a diagnostic workup, similar to the original results (Table 4). For the composite outcome, there remained no difference between the admitted and not-admitted group in unadjusted comparisons (15.3% for the admitted group versus 13.3% for the not admitted group, p=0.15,Table 4) or adjusted comparisons (OR 1.17 [0.94 – 1.46), p=0.17, results not shown).

Further sensitivity analyses that incorporated a 30 or 90 day outcome instead of 365 day outcome, and used outcomes of either stroke or death instead of the composite outcome showed no differences from the main results.

Discussion

Although our initial objective was to compare outcomes between a group of TIA patients who were and were not admitted, we believe that the most important finding of this study is that among patients who were admitted, less than half are subsequently discharged from the hospital with that diagnosis. It is reasonable to believe that a considerable proportion in the non-admitted group may not retain the diagnosis of TIA either had they undergone further examination and testing. In fact, only 16% of the non-admitted patients underwent an MRI scan. Without methods of primary data collection that occur in cohort studies to confirm the diagnosis of TIA, we are concerned that secondary data collection methods are subject to biases regarding the certainty of the diagnosis of TIA.

Our findings are similar to a study conducted at a tertiary hospital serving the South Western Sydney Area Health Service. Among 570 patients who were assigned a diagnosis of TIA and subsequently admitted, only about half retained a diagnosis of TIA according to hospital discharge codes or by expert review; about a quarter had a diagnosis of stroke, and the remaining quarter had a diagnosis other than stroke or TIA.[21]

We only performed chart reviews at three hospitals instead of the entire sample, so we can only speculate why the diagnosis of TIA in the emergency department is different from the discharge diagnosis. Typically, physicians assign the diagnosis in the emergency department, whereas coders assign the diagnosis of the hospital stay after reviewing the entire medical record. In addition, making a definitive diagnosis of TIA is difficult, and there is frequent disagreement, even among experts.[22–24] One study suggested that routine use of MRI scans among patients with a diagnosis of TIA would change the diagnosis to stroke in about one-third of cases.[25] If MRIs are obtained, they are typically performed in the hospital setting and not in the emergency department setting. It is important to note that episodes that do not qualify as TIAs, such as “transient neurological attacks” or “transient ischemic attack mimics”, may still confer an elevated risk of stroke,[26] though it is not as high as for patients with transient ischemic attacks.[27]

The median admission proportion of 58% in our study is similar to concurrent data using nationally representative samples of emergency departments in the United States: the 2006–2008 National Emergency Department Sample[9] showed that 64% of patients presenting with TIA were admitted and the 2003–2008 National Hospital Ambulatory Medical Care Survey[12] showed that 62% of patients presenting with TIA were admitted (Table 5). Unique to our study is that we can report the proportion admitted at the hospital level. Even though all hospitals belong to the same integrated health care system which mitigates financial barriers to care, we found considerable variation in the proportion of TIA patients admitted by hospital.

We did uncover one other study based in Sydney that also analyzed whether admission had an impact on outcomes, and they did find benefit at 28 days among the group that was admitted, though there was no difference in outcomes at subsequent endpoints.[14] Most of the other similar studies focused on predictors of admission and did not collect data beyond the time of hospital discharge.

Limitations

We believe that there are two explanations that explain why admission did not yield better outcomes. While we did not find improvements in outcomes among patients hospitalized with TIA, we did identify one other study that did a similar comparison, and contrary to our study, they found benefit at 28 days among the group that was admitted.[14] That study was conducted among six hospitals in the Sydney area, and we do not know why the results in these two studies differed. While the simplest explanation in our study is that the care delivered during admission was ineffective to prevent vascular events or that care delivered to patients not admitted was effective to prevent vascular events, we believe that two other explanations are more likely. One explanation is that the group not admitted contains a greater considerable proportion of patients without a true TIA, and thus had a lower risk of vascular events than the admitted group. A second explanation is that patients who are admitted have more severe clinical symptoms or prognosis than we measured in our clinical variables.. We performed multivariate analyses and propensity score matching, but such methods cannot fully compensate for missing clinical variables. Only studies that use chart reviews can obtain the clinical information to overcome this omitted variable bias.

There are several additional limitations of the study to highlight. The VHA databases do not provide information on non-VHA care and events. We cannot identify Veterans who drop out of VHA care altogether, although a comparison of Medicare databases indicate that many Veterans use both VHA and non-VHA services.[28] However, mortality ascertainment is expected to be complete, even when the death occurs outside VHA,[19] and we did not find differences in mortality. We did not have access to the results of diagnostic testing; thus, we could not determine if appropriate follow-up action was taken. Studies of the Veteran population may not be fully generalizable because of the predominantly male population with particular socioeconomic characteristics.[29] In particular, our sample has access to the primary care system within VHA, but that may be more for patients belonging to more fragmented health care systems. To this point, the study that reported the lowest proportion of admission was based in an integrated health care system, where physicians may be more certain that patients sent home from the emergency department could obtain diagnostic tests as an outpatient.[30]

Conclusions

We found considerable variation in the proportion of TIA patients admitted by hospital in this integrated healthcare system. Among patients who were assigned a diagnosis of TIA in the emergency department and admitted, less than half were discharged from the hospital with a diagnosis of TIA. Although persons with TIA who were admitted were more likely to receive a timely diagnostic workup, we could not detect improvements in one-year outcomes. While we could not identify improvements in outcomes among the admitted group compared to the group not admitted, we also conclude that evaluating care for patients with TIA is limited by lack of primary data collection on the certainty of diagnosis, especially among those not admitted.

Acknowledgments

Funding: The study was funded by VA Quality Enhancement Research Initiative (QUERI) Rapid Response Proposal 10-055. Dr. Cheng was supported by a Career Development Award from NIH/National Institute of Neurological Disorders and Stroke (NINDS), K23NS058571. Ms. Vassar is supported by the NIH/National Center for Advancing Translational Science (NCATS) UCLA CTSI Grant Number UL1TR000124. Dr. Cheng and Ms. Vassar were also supported by NIH/NINDS, U54NS081764.

The views expressed in this article are those of the authors and do not necessarily represent the position or policy of the Department of Veterans Affairs or the United States government.

References

1. Johnston SC, Rothwell PM, Nguyen-Huynh MN, et al. Validation and refinement of scores to predict very early stroke risk after transient ischaemic attack. The Lancet. 2007; 369(9558):283–292.
2. Easton JD, Saver JL, Albers GW, et al. Definition and evaluation of transient ischemic attack: a scientific statement for healthcare professionals from the American Heart Association/American Stroke Association Stroke Council; Council on Cardiovascular Surgery and Anesthesia; Council on Cardiovascular Radiology and Intervention; Council on Cardiovascular Nursing; and the Interdisciplinary Council on Peripheral Vascular Disease. Stroke. 2009; 40(6):2276–2293. [PubMed: 19423857]
3. Lavallee PC, Meseguer E, Abboud H, et al. A transient ischaemic attack clinic with round-the-clock access (SOS-TIA): feasibility and effects. Lancet Neurol. 2007; 6(11):953–960. [PubMed: 17928270]
4. Rothwell PM, Giles MF, Chandratheva A, et al. Effect of urgent treatment of transient ischaemic attack and minor stroke on early recurrent stroke (EXPRESS study): a prospective population-based sequential comparison. Lancet. 2007; 370(9596):1432–1442. [PubMed: 17928046]
5. Ross MA, Compton S, Medado P, Fitzgerald M, Kilanowski P, O'Neil BJ. An emergency department diagnostic protocol for patients with transient ischemic attack: a randomized controlled trial. Ann Emerg Med. 2007; 50(2):109–119. [PubMed: 17490788]
6. Nahab F, Leach G, Kingston C, et al. Impact of an emergency department observation unit transient ischemic attack protocol on length of stay and cost. J Stroke Cerebrovasc Dis. 2012; 21(8):673–678. [PubMed: 21482142]
7. Ovbiagele B, Saver JL, Fredieu A, et al. PROTECT: a coordinated stroke treatment program to prevent recurrent thromboembolic events. Neurology. 2004; 63(7):1217–1222. [PubMed: 15477541]
8. Rahiman A, Saver JL, Porter V, et al. In-hospital initiation of secondary prevention is associated with improved vascular outcomes at 3 months. J Stroke Cerebrovasc Dis. 2008; 17(1):5–8. [PubMed: 18190814]

9. Chaudhry SA, Tariq N, Majidi S, et al. Rates and factors associated with admission in patients presenting to the ED with TIA in the United States-2006 to 2008. Am J Emerg Med. 2013; 31(3): 516–519. [PubMed: 23380097]
10. Coben JH, Owens PL, Steiner CA, Crocco TJ. Hospital and demographic influences on the disposition of transient ischemic attack. Acad Emerg Med. 2008; 15(2):171–176. [PubMed: 18275447]
11. Edlow JA, Kim S, Pelletier AJ, Camargo CA Jr. National study on emergency department visits for transient ischemic attack, 1992–2001. Acad Emerg Med. 2006; 13(6):666–672. [PubMed: 16609106]
12. Kamel H, Fahimi J, Govindarajan P, Navi BB. Nationwide patterns of hospitalization after transient ischemic attack. J Stroke Cerebrovasc Dis. 2013; 22(7):e142–145. [PubMed: 23149150]
13. Durrani-Tariq S, Eskin B, Allegra JR. Admission rates of ED patients with transient ischemic attack have increased since 2000. Am J Emerg Med. 2013; 31(9):1349–1351. [PubMed: 23906624]
14. Kehdi EE, Cordato DJ, Thomas PR, et al. Outcomes of patients with transient ischaemic attack after hospital admission or discharge from the emergency department. Med J Aust. 2008; 189(1): 9–12. [PubMed: 18601633]
15. Amarenco P, Bogousslavsky J, Callahan A 3rd, et al. Stroke Prevention by Aggressive Reduction in Cholesterol Levels (SPARCL) Investigators. High-dose atorvastatin after stroke or transient ischemic attack. N Engl J Med. 2006; 355(6):549–559. [PubMed: 16899775]
16. Sacco RL, Diener H-C, Yusuf S, et al. Aspirin and Extended-Release Dipyridamole versus Clopidogrel for Recurrent Stroke. New England Journal of Medicine. 2008; 359(12):1238–1251. [PubMed: 18753638]
17. Reker DM, Rosen AK, Hoenig H, et al. The Hazards of Stroke Case Selection Using Administrative Data. Medical Care. 2002; 40(2):96. [PubMed: 11802082]
18. Lorenz KA, Asch SM, Yano EM, Wang M, Rubenstein LV. Comparing strategies for United States veterans' mortality ascertainment. Popul Health Metr. 2005; 3(1):2. [PubMed: 15730553]
19. Sohn MW, Arnold N, Maynard C, Hynes DM. Accuracy and completeness of mortality data in the Department of Veterans Affairs. Popul Health Metr. 2006; 4:2. [PubMed: 16606453]
20. Smith Sehdev AE, Hutchins GM. Problems with proper completion and accuracy of the cause-of-death statement. Arch Intern Med. 2001; 161(2):277–284. [PubMed: 11176744]
21. Ghia D, Thomas PR, Cordato DJ, et al. Validation of emergency and final diagnosis coding in transient ischemic attack: South Western Sydney transient ischemic attack study. Neuroepidemiology. 2010; 35(1):53–58. [PubMed: 20431303]
22. Prabhakaran S, Silver AJ, Warrior L, McClenathan B, Lee VH. Misdiagnosis of Transient Ischemic Attacks in the Emergency Room. Cerebrovascular Diseases. 2008; 26(6):630–635. [PubMed: 18984948]
23. Schrock JW, Glasenapp M, Victor A, Losey T, Cydulka RK. Variables associated with discordance between emergency physician and neurologist diagnoses of transient ischemic attacks in the emergency department. Ann Emerg Med. 2012; 59(1):19–26. [PubMed: 21624703]
24. Castle J, Mlynash M, Lee K, et al. Agreement Regarding Diagnosis of Transient Ischemic Attack Fairly Low Among Stroke-Trained Neurologists. Stroke. 2010; 41(7):1367–1370. [PubMed: 20508192]
25. Ovbiagele B, Kidwell CS, Saver JL. Epidemiological Impact in the United States of a Tissue-Based Definition of Transient Ischemic Attack. Stroke. 2003; 34(4):919–924. [PubMed: 12637701]
26. Bos MJ, van Rijn MJ, Witteman JC, Hofman A, Koudstaal PJ, Breteler MM. Incidence and prognosis of transient neurological attacks. JAMA. 2007; 298(24):2877–2885. [PubMed: 18159057]
27. Amort M, Fluri F, Schafer J, et al. Transient ischemic attack versus transient ischemic attack mimics: frequency, clinical characteristics and outcome. Cerebrovasc Dis. 2011; 32(1):57–64. [PubMed: 21613786]
28. Jia H, Zheng Y, Reker DM, et al. Multiple system utilization and mortality for veterans with stroke. Stroke. 2007; 38(2):355–360. [PubMed: 17194888]

29. Liu C-F, Maciejewski M, Sales A. Changes in characteristics of veterans using the VHA health care system between 1996 and 1999. Health Research Policy and Systems. 2005; 3(1):5. [PubMed: 15836789]

30. Josephson SA, Sidney S, Pham TN, Bernstein AL, Johnston SC. Factors associated with the decision to hospitalize patients after transient ischemic attack before publication of prediction rules. Stroke. 2008; 39(2):411–413. [PubMed: 18096832]

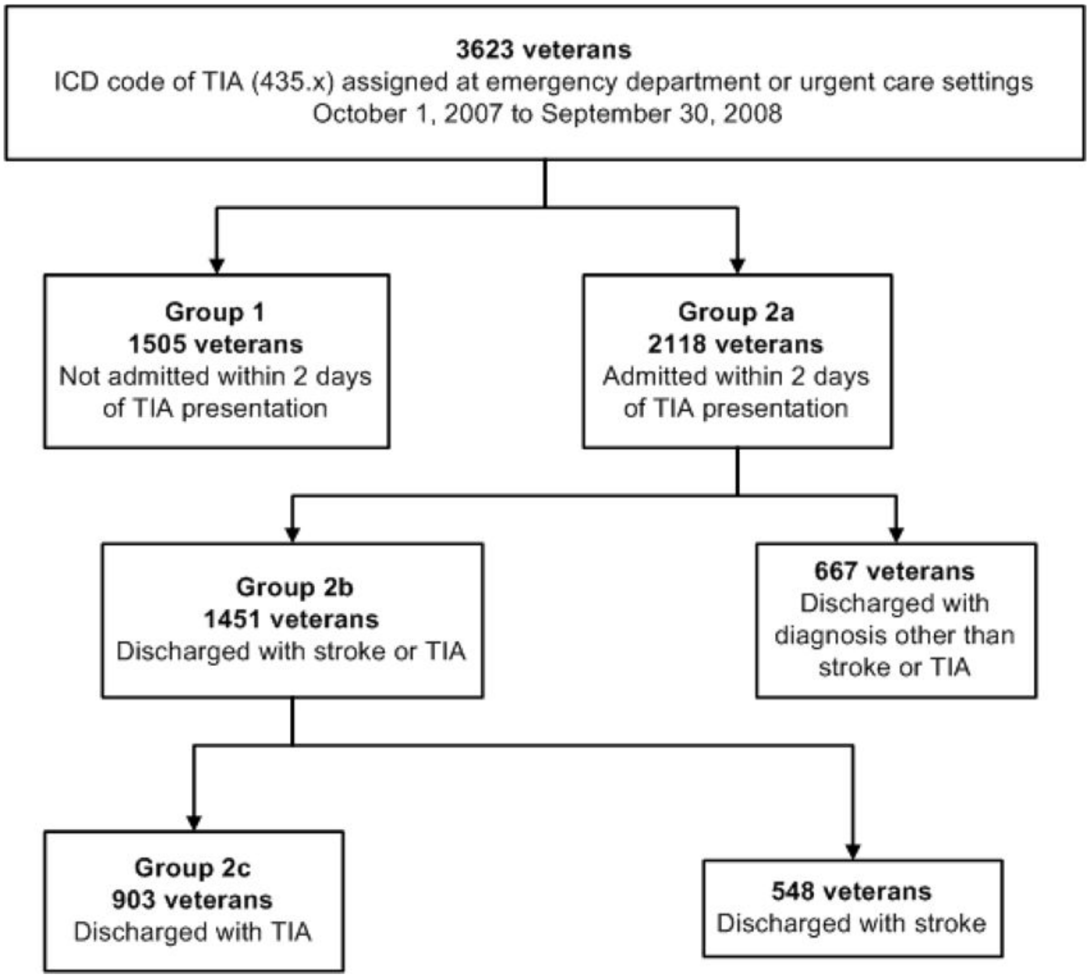

FIGURE 1.

Subgroups of admitted patients compared to patients not admitted.

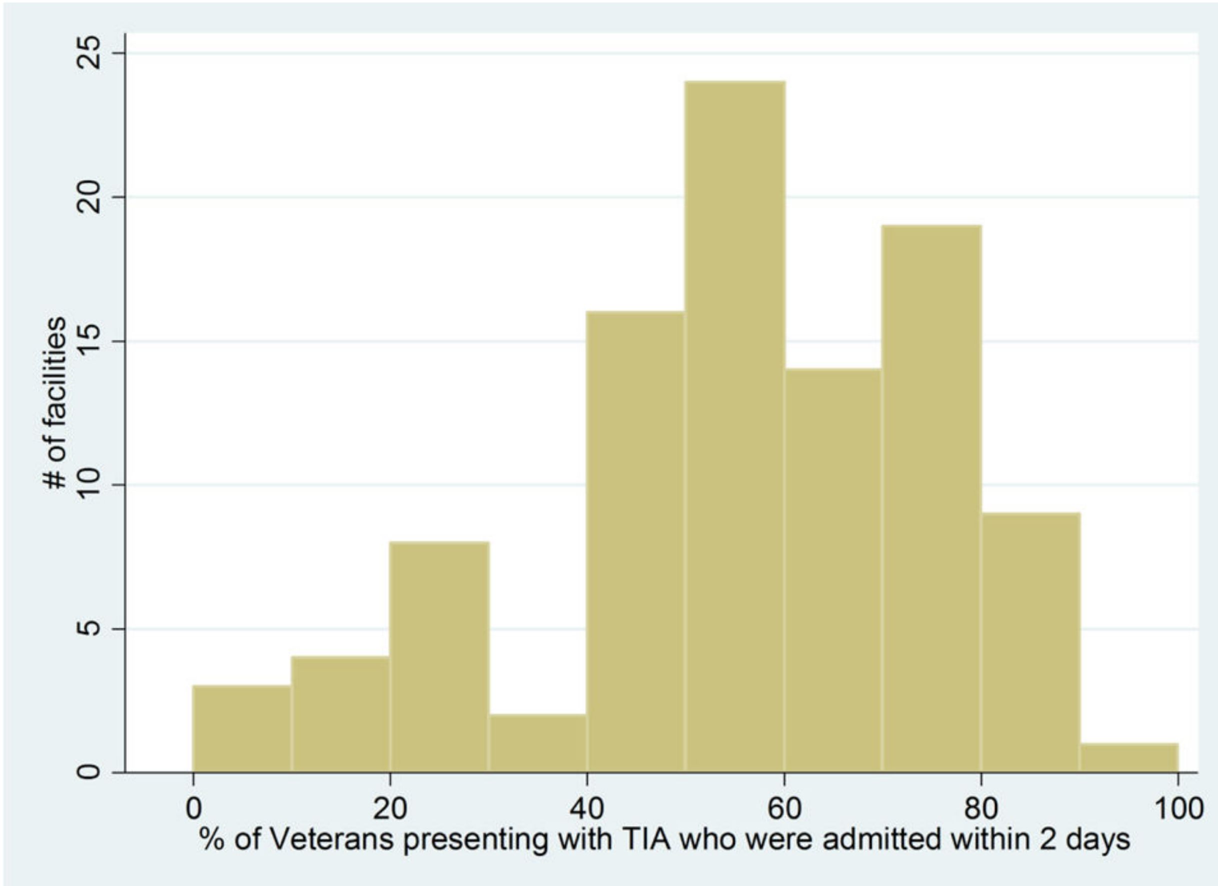

FIGURE 2.

Proportion of patients with TIA who were admitted, among hospitals with greater than 10 TIA patients presenting in FY2008, by hospital (N=100)

TABLE 1

Most common diagnosis codes assigned at hospital discharge among veterans assigned a diagnosis code of TIA in the emergency department (n=2118)

Diagnosis	ICD Code	Number (%)
TIA	435.x	903 (43%)
Ischemic stroke	433.x1, 434, 436	548 (26%)
Skin sensation disturbance	782.0	46 (2%)
Syncope	780.2	45 (2%)
Migraine	346.90	21 (1%)
Hypertension	401.9	20 (1%)
Speech disturbance	784.5	17 (1%)
Orthostatic hypotension	458.0	16 (1%)
Malaise and fatigue	780.79	16 (1%)
Convulsions	780.39	15 (1%)
Dizziness	780.4	15 (1%)
Headache	784.0	14 (1%)
Altered mental status	780.97	12 (1%)
Chest pain	786.59	12 (1%)
Mental disorder	294.8	11 (1%)
Bell's palsy	351.0	11 (1%)

TABLE 2

Characteristics of Veterans presenting with TIA (N=3623)

	Group 1: Not admitted (N=1505)	Group 2a: All admissions (N=2118)	Group 2b: Admissions with discharge diagnoses of TIA or stroke (N=1451)	Group 2c: Admissions with discharge diagnosis of TIA (N = 903)
Baseline characteristics				
Age	68	68	**69** **	**69** **
Male	94	**96** **	**96** **	**96** **
Prior History of:				
TIA	14	13	12	13
Stroke	17	18	18	17
TIA or stroke	26	25	25	25
Atrial fibrillation	15	**19** **	**19** **	**19** **
Hypertension	69	**74** **	**76** **	**74** **
Diabetes	38	**44** **	**46** **	**43** *
Myocardial infarction	1	2	2	2
Diagnostic work-up				
CT or MRI of the brain	78	**91** **	**92** **	**91** **
MRI of the brain	16	**59%** **	**54%** **	**49%** **
Carotid artery imaging	38	**52** **	**57** **	**55** **
Echocardiogram	22	**46** **	**51** **	**49** **
Outcomes				
Ischemic stroke	5.4	6.3	**7.4** *	5.0
Any stroke	5.5	6.4	**7.4** *	5.0
MI	1.1	1.4	1.4	1.2
Death	7.4	8.7	8.2	7.3
Composite outcome: any stroke, MI, or death	13.2	15.3	**15.8** *	12.9

p-values refer to bivariate analyses compared to Group 1

* p <0.05

** p<0.01

TABLE 3

Odds ratios (95% confidence intervals) for predicting one-year composite outcome of stroke, MI, or death

	Group 1 and Group 2a (all admissions), N=3623	Group 1 and Group 2b (admissions with discharge diagnosis of TIA or stroke), N=2956	Group 1 and Group 2c (admissions with discharge diagnosis of TIA), N=2408
Hospital admission	1.12 (0.92 – 1.36)	1.15 (0.93, 1.41)	0.89 (0.69 – 1.14)
Age	**1.02 (1.02 – 1.03)** **	**1.02 (1.01, 1.03)** **	**1.02 (1.01 – 1.03)** **
Hypertension	1.06 (0.84 – 1.34)	1.10 (0.85, 1.43)	1.12 (0.83 – 1.52)
Atrial fibrillation	**1.43 (1.14 – 1.80)** **	**1.36 (1.05, 1.76)** *	**1.41 (1.05 – 1.90)** *
Diabetes	1.20 (0.98 – 1.46)	1.20 (0.96, 1.49)	1.15 (0.89 – 1.48)
Stroke	**1.74 (1.38 – 2.20)** *	**1.78 (1.38, 2.29)** **	**1.90 (1.42 – 2.54)** **
TIA	0.78 (0.59 – 1.04)	0.78 (0.57, 1.08)	0.76 (0.53 – 1.09)
MI	1.62 (0.90 – 2.93)	1.65 (0.86, 3.17)	**3.10 (1.53 – 6.27)** *

[*] $p < 0.05$

[**] $p < 0.01$

TABLE 4

Comparison of characteristics and outcomes between patients not admitted and admitted after matching by propensity scores.

	Not admitted (N = 1328)	Admitted (N = 1328)
Demographic characteristics		
Age	68.0 (11.9)	68.1 (11.8)
Male	1268 (95.5)	1269 (95.5)
Prior History of:		
TIA	167 (12.6)	183 (13.8)
Stroke	229 (17.2)	239 (18.0)
Atrial fibrillation	206 (15.5)	214 (16.1)
Hypertension	945 (71.2)	943 (71.0)
Diabetes	540 (40.7)	555 (41.8)
Myocardial infarction	18 (1.4)	23 (1.7)
Diagnostic tests performed near the time of TIA presentation		
Neuroimaging of the brain	1037 (78.1)	**1203 (90.6)** **
Carotid atery imaging	506 (38.1)	**690 (51.9)** **
Echocardiogram	290 (21.8)	**616 (46.4)** **
One year outcome among Veterans with TIA		
Ischemic stroke	69 (5.2)	88 (6.6)
Any stroke	70 (5.3)	89 (6.7)
MI	15 (1.1)	17 (1.3)
Death	103 (7.8)	113 (8.5)
Composite outcome: any stroke, MI, or death	177 (13.3)	203 (15.3)

p-values refer to bivariate analyses compared to the not admitted group

* p <0.05

** p<0.01

TABLE 5

Literature about admission rates for persons presenting with TIA to the emergency department

Reference Pubmed ID	Data source	Cohort definition	Sample size Admission	Multivariate model predictors of admission
Gladstone, 2004[31]	Ontario Stroke registry, May to December 2000	registry	N=371 24% admission [19–37%]	Did not compare admitted versus not admitted. Analysis focused on those not admitted.
Edlow, 2006[11]	National Hospital Ambulatory Medical Care Survey, 1992–2001. 4 week collection period per year	435 in any of three diagnosis fields	N=769 Weighted N= 2.9 million 54% admission, no change over time	NE region of US
Josephson, 2008[30]	16 Kaiser hospitals Feb 1997–1998	Primary diagnosis (code not mentioned)	N=1707 14% admission	Atrial fibrillation, prior TIA, persistent symptoms, use of ticlpoidine, speech impairment, gait disturbance, or weakness. $ABCD_2$ score was weakly associated with admission, (explained only 4% of the variance)
Kehdi, 2008[14]	6 hospitals in southwest Sydney, 2001–2005	435	N=2535 72% admission (66–78%)	Did not analyze predictors of admission. Admission was beneficial in preventing early recurrence, no difference from 29to 365 days
Coben, 2008[10]	2002 Healthcare Cost and Utilization Project, represents 93% of all hospitals in 11 states	435.8 435.9 as principal diagnosis	N=34,843 53% admission	Age younger than 85, women, urban, comorbidities, Medicare, weekend presentation
Ghia, 2010[21]	1 hospital in southwestern Sydney, 2003–2007	435	N=750 82% admission	Did not analyze predictors of admission.
Chaudhry, 2013[9]	National Emergency Department Sample (NEDS), 2006–2008. Composed of HCUP, state Emergency Department and Inpatient databases. Represents about 20% of all ED (28 million visits at 980 hospitals)	435.xx Primary diagnosis	Weighted N= 812908 64% admission	Age younger than 60,, women, comorbidities, higher income, Medicare, teaching hospital
Durrani-Tariq, 2013[13]	6 New Jersey hospitals that have at least 25,000 visits per year from January 2000 to December 2010 using the same billing service	435.9 based on physician's diagnosis	N-8216 Increase from 2000 (70%) to 2010 (91%)	No multivariate analysis was done.
Kamel 2013[12]	National Hospital Ambulatory Medical Care Survey, 1997–2008. 4 week collection period per year. 87–98% participation by the	435.xx only in primary field	N=782 57% admission 1997–2002 (52%) increased to 2003–2008 (62%)	NE region of US, non-white, Private insurance, off hours, arrival by ambulance, higher BP

Reference Pubmed ID	Data source	Cohort definition	Sample size Admission	Multivariate model predictors of admission
	approximately 10% of US EDs			
Kapral, 2016 [32]	Ontario Stroke Registry from April 1, 2008 to March 31, 2011. Study includes both minor ischemic stroke and TIA	Registry diagnosis	N=8540 47% admission	Disabled prior to event, hypertension, hyperlipidemia, current smoker, atrial fibrillation, wekness at presentation, speech disturbance at presentation, duration of symptoms>10 minutes, arrival by ambulance, emergency department overcrowding, weekend presentation.
Lesenskyj, 2016 [33]	One hospital from January 2014 to April 2015	Primary diagnosis (code not mentioned)	N=260 68% admission	No multivariate analysis was done on the predictors of admission
Current project	Veterans Health Administration inpatient and outpatient databases from Oct 1, 2007 to Sept 30, 2008	435.xx Primary diagnosis	N=3623 58% admission	Atrial fibrillation, hypertension, diabetes. Admission did not change outcomes at one-year