# Emergency Department Use by Patients With End-stage Renal Disease in the United States

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**Research article**

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## Abstract

**Background**: We sought to describe the national characteristics of ED visits by patients with end-stage renal disease (ESRD) in the United States in order to improve the emergency treatment and screening of ESRD patients.

**Methods**: We analyzed data from 2014-2016 ED visits provided by the National Hospital Ambulatory Medical Care Survey. We sampled adult (age ≥ 18 years) ED patients with ESRD. By proportion or means of weighted sample variables, we quantified annual ED visits by patients with ESRD. We investigated demographics, ED resource utilization, clinical characteristics, and disposition of patients with ESRD vs. those without ESRD. Logistic regression models were used to estimate the association between these characteristics and ESRD ED visits.

**Results**: Approximately 722,692 (7.78%) out of 92,899,685 annual ED visits were ESRD patients. ED patients with ESRD were mostly non-Hispanic whites (51.5%) and males were more likely to be ESRD patients than females (aOR: 1.48; 95% CI: 1.47–1.48). ED patients with ESRD were more likely to be admitted to the hospital (aOR: 2.22; 95% CI: 2.21–2.22) and intensive care unit (ICU) (aOR: 1.53; 95% CI: 1.52–1.54) than patients without ESRD. ED patients with ESRD were more likely to receive blood tests, get medical imaging tests.

**Conclusion**: We described the unique demographic, socioeconomic, and clinical characteristics of ED patients with ESRD, using the most comprehensive, nationally representative study to date. These patients' higher hospital and ICU admission rates indicate that patients with ESRD require a higher level of emergency care.


## Background

Chronic diseases are now the leading cause of death worldwide. The World Health Organization (WHO) estimated that there were approximately 58 million deaths worldwide in 2005, with 35 million attributed to chronic disease [1, 2]. In the United States, kidney diseases are the ninth leading cause of death. Fifteen percent of US adults, about 37 million people, are estimated to have chronic kidney disease (CKD) in 2019 [3]. End-stage renal disease (ESRD), the final stage of CKD, has emerged as one of the most important public health concerns in the United States. In 2016, nearly 125,000 people in the United States started treatment for end-stage kidney disease and more than 726,000 on dialysis were living with a kidney transplant [3]. In 2016, total Medicare expenditure (excluding prescription drugs) for patients with ESRD or kidney failure reached $35 billion, accounting for about 7% of the Medicare paid claims costs [4]. Meanwhile, the prevalence of ESRD is expected to rise over the next several decades. The estimated number of patients that required renal replacement therapy worldwide was 2.618 million in 2010, and the number is expected to rise to 5.439 million in 2030 [5].

ESRD is associated with a 42 % higher rate of rehospitalizations [6], and the emergency department (ED) plays an essential role for patients with ESRD. According to research by London, nearly two-thirds of patients with ESRD are admitted to the hospital in the year prior to initiating renal replacement therapy [7]. Therefore, identifying characteristics of ED visits by ESRD patients would be beneficial in order to optimize ED resource utilization for the patients meanwhile reducing the burden currently placed on the ED. Previous studies have documented high hospital resource use among patients with ESRD; however, there is sparse literature on the ED utilization amongst this population and on the related encounters proportion of ESRD care specifically. As such, in the present study, we aim to examine national characteristics of ED utilization among patients with ESRD and corresponding usage proportion in the United States from 2014 to 2016.

## Methods

*Study Population*

The study population consists of all adult patients (age ≥ 18 years) ($N$ = 42,832; Weighted $N$ = 278,699,057) in the National Hospital Ambulatory Medical Care Survey Emergency Department Subfile (NHAMCS-ED) from 2014 to 2016 [8]. NHAMCS-ED is a nationally representative, multistage, stratified probability sample of ED visits in the United States, administered by the National Center for Health Statistics, a branch of the Centers for Disease Control and Prevention. The NHAMCS-ED sample is collected from approximately 300 hospital-based EDs per year, which are randomly selected from approximately 1900 geographic areas in all 50 states. The survey uses a standardized data collection form to gather detailed information from approximately 100 patients per hospital-based ED.

*Study Variables*

The primary outcome for the study is the patient ESRD status noted as "ESRD status". In NHAMCS, ESRD status refers to "includes end-stage renal chronic kidney failure due to diabetes or hypertension" [9].

The secondary outcomes include the emergency severity index (ESI) score (a five-level ED triage algorithm providing clinically relevant stratification of patients into five groups from 1 (most urgent) to 5 (least urgent) on the basis of acuity and resource needs); hospital admission; intensive care unit admission (ICU); blood tests; imaging (including X-ray, CT, ultrasound, MRI); procedures (BiPAP/CPAP; bladder

catheter; cast, splint, wrap; central line; IV fluids; CPR; endotracheal intubation; incision & drainage (I&D); IV fluids; lumbar puncture (LP); nebulizer therapy; pelvic exam; skin adhesives; suturing/staples; Other); whether the patient left before triage/treatment; length of stay; and whether the patient died in the ED/hospital.

The covariates examined include demographic characteristics (e.g., patient age, sex, race/ethnicity, region, residence type); time, date, and mode of arrival; insurance status; triage vital signs (including temperature, pain scale, blood pressure, etc.), and reasons for ED visits.

*Statistical Analysis*

Population characteristics between ESRD and non-ESRD groups were described and compared using chi-square or *t* test. We used logistic regression to examine the association between the primary outcome (ED patients with ESRD versus ED patients without ESRD) and the covariates. We also used logistic regression to test the association between the ESRD and secondary outcomes by adjusting for other covariates. Missing values were imputed with the median of each covariate when establishing the multivariable logistic regression. SAS (version 9.4) was used for analyses, with $\alpha = 0.05$ set as the statistical significance threshold. This study was determined to be exempt by the institutional review board.

## Results

Between 2014 and 2016, there were 278,699,057 total adult ED visits in the United States. Patients with ESRD made up approximately 2,168,075 (7.78%) (722,692 annually) of these visits. In addition, the proportion of ED visits by patients with ESRD increased between 2014 to 2016. Basic characteristics are described in Table 1. The proportion of ED visits by patients with ESRD varied by US census region: Northwest, 13.4%; Midwest, 19.8%; South, 45.6%; and West, 21.2% ($p < 0.01$). There was a significant difference between ESRD patients and non-ESRD patients in terms of patients' age and race ($p < 0.001$).

Table 2, Tables 3 and 4 describe the proportions and associations of ESI, hospital admission, ICU admission, and medical resources utilization for ESRD and non-ESRD patients. The hospital admission rate among ED patients was 2.22 times higher for patients with ESRD (95% CI: 2.21–2.22); ESRD patients were also 2.43 times more likely to receive immediate or emergent vs. semi- or non-urgent ESI scores (95% CI: 2.42–2.45) compared to patients without ESRD. The ICU admission rate was 1.53 times (95% CI: 1.52–1.54) higher for patients with ESRD. ED patients with ESRD were 2.68 times more likely (CI: 2.67–2.69) to receive blood tests as well as more likely to utilize X-rays and MRIs (CI: 1.92-1.93, 1.66-1.79), respectively. However, patients with ESRD were less likely (CI: 0.72-0.72) to get a CT scan than patients without ESRD.

In terms of association between ED patients' characteristics (demographic, socioeconomic, and clinical) and their ESRD status in Supplement Table 1, male ED patients were 48% (aOR: 1.48; CI: 1.47 –1.48) more likely than females to have ESRD. Among ED patients, non-Hispanic Blacks were 55% (aOR: 1.55; CI: 1.54 – 1.55) more likely than whites to have ESRD; Hispanics were 59% more likely (CI: 1.59–1.60); and Asians, 53% more likely (CI: 1.51–1.54). Compared to ED patients inhabiting a private residence, those who were living in nursing homes were 6.13 (CI: 6.10–6.15) times more likely to be ESRD patients. Compared to ED patients with private insurance, those with Medicare and Medicaid or CHIP were 7.62 (CI: 7.58–7.66) and 1.91 times (CI: 1.90–1.92), respectively, more likely to have ESRD. Compared to ED patients who have a body temperature of 36 °C-38°C, patients with a temperature higher than 38°C were 1.89 times (CI: 1.87–1.91) more likely to have ESRD. Compared to patients with a DBP of 60-80, ED patients with DBP lower than 60 were 2.77 (CI: 2.76–2.78) times to be ESRD patients. Compared to ED patients that did not revisit in 72 hours, patients that did revisit within 72 hours were 1.2 times (CI: 1.19–1.21) to have ESRD. Compared to patients who arrived at the ED by other means, patients who arrived by ambulance were 2.83 times more likely (CI: 2.83–2.84) to have ESRD. ED patients who presented with a heart rate of over 120 were 1.83 times more likely (CI: 1.82–1.85) to have ESRD than those presenting with a heart rate below 90. Meanwhile, ED patients who presented with an adverse effect of medical/surgical treatment were 12.56 times (CI: 12.48–12.64) more likely to have ESRD than those presenting with injury or trauma.

## Discussion

To our knowledge, this is the first large–scale study describing national characteristics of ED visits by ESRD patients. A thoughtful study by Lovasik et al. [10] examined the use of ED among ESRD patients. However, the population of their study was limited to Medicare population with ESRD, which may not lead to a comprehensive evaluation of national characteristics of ED visits by ESRD patients. Namely, our study focused on all ED adult patient visits between 2014 and 2016 in the United States, and the results were concluded from the comparison of ED visits by patients ESRD and non-ESRD status. In addition, our study also provided the medical resource utilization information of ED visits by ESRD patients, such as blood tests and medical imaging. The Above information helped generate national-representative results about ED visits by ESRD patients. We also noticed another ED utilization analysis by Ronksley et al. [11] was under a national population scale, but they explored the emergency department use among patients with CKD, which has a different focus and interest compared to the present study.

From 2014 to 2016, there were 2,168,075 ED visits by ESRD patients in total, and the number of annual visits by those patients increased stably. Demographic factors were associated with the prevalence of ESRD in ED patients. In our study, compared to patients without ESRD, ED visits by ESRD patients were characterized to be associated with male senior patients. This same gender difference phenomenon in ESRD patients has been documented in the field of nephrology. A nationwide survey of ESRD by the Japanese Society for Dialysis Therapy revealed a higher incidence and prevalence in men than in women according to the research on gender differences in chronic kidney disease [12]. Age is usually considered as one of the risk factors for ESRD partly because aging is associated with cardiovascular diseases. Nearly half of incident dialysis patients in the United States annually are senior citizens [13]. It is known that the cardiovascular mortality rate in ESRD patients is 10–20 times higher than that in the general population [14]. Therefore, the clinical care of cardiovascular diseases among ED patients with ESRD is necessary.

Compared to non-ESRD patients, those with ESRD had higher rates of hospital and ICU admission as well as higher revisiting times in 72 hours. US Renal Data System reported that an overall rehospitalization rate for patients with ESRD was 34% within 30 days of discharge [15]. We also noticed that ED patients with ESRD were more likely to present clinical symptoms of high body temperature, high heart rate, and low DBP than the patients without ESRD. All the above symptoms related to the adverse effect of medical/surgical treatment which was the highest reason for ESRD patients visiting ED. Understanding the above characteristics of ED visits by ESRD patients may improve the efficiency of clinical care and reduce the high rates of hospital admission, which would benefit ESRD patients and benefit hospitals in terms of better resource allocation and better financial allocation.

Accordingly, ESRD is a complex clinical condition caused by chronic kidney disease, high blood pressure, and others, and the incidence of ESRD increased sharply with age in both sexes [16], and ESRD patients need special and professional health care in both emergency and non-emergency cases. Diabetes and hypertension account for more than 50 % of cases of ESRD, and care of patients will increasingly depend on primary care physicians [17]. In this study, we found that ED visits by ESRD patients were six times more likely to be from nursing homes than a private residence, and also more likely to be delivered by ambulance rides than other means. On a regular bias, Plantinga et al. [18] found that among older people, receiving hemodialysis in the post-dialysis initiation period was a high-risk time for falls.

*Limitations*

In the patient histories documented in the NHAMCS-ED data, patients are coded either having or not having ESRD status, information such as duration, treatment history were not tracked in the dataset. This information would enhance a better prediction of ESRD status among ED patients. As Iseki noted, ESRD is not a specific disease entity, but rather provides a framework for the consideration of treatment options [16]. Understanding the relationship between ESRD and other chronic diseases would determine risk factors in utilizing ED resources for ESRD patients. Another limitation was the dataset did not provide information about patients' health conditions. It is known that ESRD patients in ED were relatively stable for the elder age group as we found in the study. Knowing their health information would provide more predictors to the characteristics of ED visits by ESRD patients.

# Conclusion

The study enhanced the understanding of clinical characteristics of ED utilization of patients with ESRD. Our study aims to improve hospital care and clinical outcomes of patients with ESRD and reducing their ED burden. The study describes the characteristics of ED patients with ESRD on a national scale. We found that gender, age, racial/ethnic differences of ED patients with and without ESRD. Also, patients with ESRD were more likely to have a different visiting reason and residence type compared to non-ESRD patients. The above findings suggest that patients with ESRD have higher demands in utilizing ED care and resources. Also, identifying the national characteristics of ED patients with ESRD in the study will help advance the improvement of emergency treatment and screening of ESRD patients.

# Abbreviations

aOR: Adjusted Odds Ratio; CI: Confidential Interval; ED: Emergency Department; NHAMCS-ED: National Hospital Ambulatory Medical Care Survey ED Subfile; ESI: Emergency Severity Index; ICU: intensive care unit; CT: Computed tomography; MRI: Magnetic Resonance Imaging; ESRD: End-stage Renal Disease.

# Declarations

**Ethics approval and consent to participate**

This study was a secondary analysis of a public database and did not require ethical approval.

**Consent for publication** Not applicable.

**Availability of data and materials**

The NHAMCS-ED dataset can be accessed through the website of the US Centers for Disease Control and Prevention (CDC) (https://www.cdc.gov/nchs/ahcd/index.htm ). The detailed explanation of the survey data for each year and the code book can be found here: https://ftp.cdc.gov/pub/Health_ Statistics/NCHS/dataset_documentation/nhamcs/

**Competing interests**

The authors declare that they have no competing interests. The funders/sponsors had no role in the design and conduct of the study; collection, management, analysis, and interpretation of the data; preparation, review, or approval of the manuscript; and decision to submit the manuscript for publication.

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**Author Contributions:**

XZ had full access to all the data in the study and take responsibility for the integrity of the data and the accuracy of the data analysis.

Concept and design: JP, XZ.

Acquisition, analysis, or interpretation of data: All authors.

Drafting of the manuscript: NW, JP, and YA.

Critical revision of the manuscript for important intellectual content: HF, JZ, XZ.

Statistical analysis: XZ, JP.

Obtained funding: JP.

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## Tables

Table 1. Baseline characteristics of patients presenting to the ED, stratified by ESRD, NHAMCS 2014–2016

| | Unweighted Sample | | | Weighted Sample | | | *p* value |
|---|---|---|---|---|---|---|---|
| | All | No ESRD | ESRD | All | No ESRD | ESRD | |
| | 42,832 | 42,465 | 367 | 278,699,057 | 276,530,981 | 2,168,075 | |
| Male | 18,469(43.1) | 18,283(43.1) | 186(50.7) | 119,751,766(43.0) | 118,611,308(42.9) | 1,140,459(52.6) | 0.0033 |
| Age | | | | | | | |
| 18–39 | 17,912(41.8) | 17,862(42.1) | 50(13.6) | 118,068,691(42.4) | 117,768,064(42.6) | 300,627(13.9) | <0.001 |
| 40–49 | 6,662(15.6) | 6,629(15.6) | 33(9.0) | 43,185,040(15.5) | 43,021,286(15.6) | 163,755(7.6) | |
| 50–59 | 6,707(15.7) | 6,638(15.6) | 69(18.8) | 42,679,091(15.3) | 42,215,775(15.3) | 463,316(21.4) | |
| 60–74 | 6,678(15.6) | 6,542(15.4) | 136(37.1) | 43,420,164(15.6) | 42,634,581(15.4) | 785,583(36.2) | |
| >=75 | 4,873(11.4) | 4,794(11.3) | 79(21.5) | 31,346,071(11.2) | 30,891,277(11.2) | 454,793(21.0) | |
| Race/ethnicity | | | | | | | |
| White | 27,251(63.6) | 27,079(63.8) | 172(46.9) | 175,775,546(63.1) | 174,659,617(63.2) | 1,115,929(51.5) | <0.001 |
| Black | 9,207(21.5) | 9,092(21.4) | 115(31.3) | 62,663,628(22.5) | 62,051,038(22.4) | 612,590(28.3) | |
| Hispanic | 5,152(12.0) | 5,094(12.0) | 58(15.8) | 33,391,671(12.0) | 33,055,349(12.0) | 336,322(15.5) | |
| Asian | 804(1.9) | 793(1.9) | 11(3.0) | 4,392,213(1.6) | 4,349,798(1.6) | 42,415(2.0) | |
| Other | 418(1.0) | 407(1.0) | 11(3.0) | 2,475,999(0.9) | 2,415,180(0.9) | 60,819(2.8) | |
| Residence type | | | | | | | |
| Private residence | 39,819(95.1) | 39,498(95.1) | 321(89.7) | 258,354,513(95.3) | 256,528,244(95.3) | 1,826,269(85.6) | <0.001 |
| Nursing home | 885(2.1) | 856(2.1) | 29(8.1) | 5,875,161(2.2) | 5,632,038(2.1) | 243,123(11.4) | |
| Homeless | 534(1.3) | 534(1.3) | 0(0.0) | 2,480,109(0.9) | 2,480,109(0.9) | 0(0.0) | |
| Other | 651(1.6) | 643(1.5) | 8(2.2) | 4,501,686(1.7) | 4,437,115(1.6) | 64,571(3.0) | |
| Insurance type | | | | | | | |
| Private insurance | 12,446(30.8) | 12,411(31.0) | 35(9.8) | 79,443,111(30.5) | 79,249,592(30.7) | 193,519(9.1) | <0.001 |
| Medicare | 10,517(26.0) | 10,278(25.7) | 239(66.8) | 66,956,323(25.7) | 65,443,229(25.3) | 1,513,093(71.2) | |
| Medicaid or CHIP | 11,148(27.6) | 11,080(27.7) | 68(19.0) | 71,529,605(27.5) | 71,197,275(27.6) | 332,331(15.6) | |
| Uninsured | 4,886(12.1) | 4,876(12.2) | 10(2.8) | 33,248,283(12.8) | 33,203,302(12.8) | 44,981(2.1) | |
| Other | 1,406(3.5) | 1,400(3.5) | 6(1.7) | 9,371,908(3.6) | 9,329,217(3.6) | 42,691(2.0) | |
| Year | | | | | | | |
| 2014 | 15,319(35.8) | 15,194(35.8) | 125(34.1) | 90,554,699(32.5) | 89,955,504(32.5) | 599,195(27.6) | 0.4261 |
| 2015 | 14,041(32.8) | 13,926(32.8) | 115(31.3) | 89,005,064(31.9) | 88,333,021(31.9) | 672,043(31.0) | |
| 2016 | 13,472(31.5) | 13,345(31.4) | 127(34.6) | 99,139,294(35.6) | 98,242,457(35.5) | 896,837(41.4) | |
| Day of Week | | | | | | | |
| Sunday | 5,622(13.1) | 5,584(13.1) | 38(10.4) | 35,918,011(12.9) | 35,645,109(12.9) | 272,901(12.6) | 0.0409 |
| Monday | 6,930(16.2) | 6,856(16.1) | 74(20.2) | 44,958,717(16.1) | 44,501,462(16.1) | 457,255(21.1) | |
| Tuesday | 6,347(14.8) | 6,287(14.8) | 60(16.3) | 40,922,676(14.7) | 40,576,419(14.7) | 346,257(16.0) | |
| Wednesday | 6,225(14.5) | 6,166(14.5) | 59(16.1) | 40,888,226(14.7) | 40,553,923(14.7) | 334,303(15.4) | |
| Thursday | 5,952(13.9) | 5,894(13.9) | 58(15.8) | 39,069,043(14.0) | 38,751,056(14.0) | 317,987(14.7) | |
| Friday | 5,960(13.9) | 5,920(13.9) | 40(10.9) | 38,869,467(13.9) | 38,671,654(14.0) | 197,813(9.1) | |
| Saturday | 5,796(13.5) | 5,758(13.6) | 38(10.4) | 38,072,918(13.7) | 37,831,359(13.7) | 241,559(11.1) | |
| Arrive by | 7,729(18.5) | 7,600(18.4) | 129(35.8) | 49,769,047(18.3) | 48,948,071(18.2) | 820,977(38.3) | <0.001 |

| | | | | | | | |
|---|---|---|---|---|---|---|---|
| ambulance | | | | | | | |
| Seen within last 72 hours | 1,914(4.9) | 1,898(4.9) | 16(4.8) | 11,953,039(4.8) | 11,874,648(4.8) | 78,391(4.1) | 0.8948 |
| Pain level | | | | | | | |
| No pain | 7,711(24.4) | 7,610(24.2) | 101(39.8) | 46,478,004(23.1) | 45,940,926(23.0) | 537,078(37.6) | <0.001 |
| Mild | 2,916(9.2) | 2,903(9.2) | 13(5.1) | 18,235,636(9.1) | 18,178,674(9.1) | 56,962(4.0) | |
| Moderate | 9,430(29.8) | 9,363(29.8) | 67(26.4) | 60,509,861(30.1) | 60,090,165(30.1) | 419,696(29.4) | |
| Severe | 11,602(36.6) | 11,529(36.7) | 73(28.7) | 75,762,102(37.7) | 75,347,113(37.8) | 414,989(29.0) | |
| Temperature | | | | | | | |
| 36 °C–38 °C | 38,083(94.6) | 37,784(94.7) | 299(90.6) | 249,171,894(95.1) | 247,406,971(95.1) | 1,764,922(92.5) | <0.001 |
| <=36 °C | 1,522(3.8) | 1,504(3.8) | 18(5.5) | 9,089,224(3.5) | 9,001,036(3.5) | 88,187(4.6) | |
| >38 °C | 635(1.6) | 622(1.6) | 13(3.9) | 3,863,922(1.5) | 3,808,689(1.5) | 55,233(2.9) | |
| Heart Rate | | | | | | | |
| <=90 | 28,489(66.5) | 28,242(66.5) | 247(67.3) | 184,822,552(66.3) | 183,317,566(66.3) | 1,504,986(69.4) | 0.5082 |
| 90–100 | 7,169(16.7) | 7,109(16.7) | 60(16.3) | 46,314,663(16.6) | 45,999,951(16.6) | 314,712(14.5) | |
| 100–110 | 3,906(9.1) | 3,876(9.1) | 30(8.2) | 25,427,295(9.1) | 25,268,229(9.1) | 159,066(7.3) | |
| 110–120 | 1,988(4.6) | 1,974(4.6) | 14(3.8) | 13,118,183(4.7) | 13,062,583(4.7) | 55,600(2.6) | |
| >120 | 1,280(3.0) | 1,264(3.0) | 16(4.4) | 9,016,363(3.2) | 8,882,652(3.2) | 133,711(6.2) | |
| DBP | | | | | | | |
| 60–80 | 19,358(45.2) | 19,213(45.2) | 145(39.5) | 125,677,278(45.1) | 124,830,342(45.1) | 846,937(39.1) | <0.001 |
| <60 | 4,312(10.1) | 4,233(10.0) | 79(21.5) | 26,198,088(9.4) | 25,714,760(9.3) | 483,328(22.3) | |
| >80 | 19,162(44.7) | 19,019(44.8) | 143(39.0) | 126,823,690(45.5) | 125,985,881(45.6) | 837,810(38.6) | |
| SBP | | | | | | | |
| 80–120 | 9,773(22.8) | 9,687(22.8) | 86(23.4) | 61,351,488(22.0) | 60,857,637(22.0) | 493,851(22.8) | 0.4365 |
| <80 | 1,588(3.7) | 1,570(3.7) | 18(4.9) | 9,419,022(3.4) | 9,310,953(3.4) | 108,068(5.0) | |
| >120 | 31,471(73.5) | 31,208(73.5) | 263(71.7) | 207,928,547(74.6) | 206,362,392(74.6) | 1,566,155(72.2) | |
| Census Region | | | | | | | |
| Northeast | 7,176(16.8) | 7,140(16.8) | 36(9.8) | 43,967,048(15.8) | 43,675,459(15.8) | 291,588(13.4) | 0.0004 |
| Midwest | 10,893(25.4) | 10,807(25.4) | 86(23.4) | 74,304,118(26.7) | 73,875,207(26.7) | 428,911(19.8) | |
| South | 15,430(36.0) | 15,268(36.0) | 162(44.1) | 105,760,507(37.9) | 104,771,742(37.9) | 988,765(45.6) | |
| West | 9,333(21.8) | 9,250(21.8) | 83(22.6) | 54,667,385(19.6) | 54,208,574(19.6) | 458,811(21.2) | |
| This visit is related to | | | | | | | |
| Injury/trauma | 12,286(30.1) | 12,248(30.3) | 38(11.0) | 78,178,483(29.5) | 77,992,283(29.6) | 186,200(9.1) | <0.001 |
| Overdose/poisoning | 499(1.2) | 498(1.2) | 1(0.3) | 3,358,380(1.3) | 3,349,593(1.3) | 8,787(0.4) | |
| Adverse effect of medical/surgical treatment | 1,099(2.7) | 1,063(2.6) | 36(10.4) | 7,170,683(2.7) | 6,961,906(2.6) | 208,777(10.2) | |
| Visit not related to any above | 26,692(65.4) | 26,424(65.3) | 268(77.7) | 174,903,611(66.0) | 173,277,339(65.9) | 1,626,272(79.4) | |
| Questionable injury status | 214(0.5) | 212(0.5) | 2(0.6) | 1,546,669(0.6) | 1,528,096(0.6) | 18,573(0.9) | |

Table 2 Selected Reason for Visit and Emergency Department Diagnosis among ED Patients with ESRD, NHAMCS 2014–2016

| | Unweighted Sample | | | Weighted Sample | | |
|---|---|---|---|---|---|---|
| | All | No ESRD | ESRD | All | No ESRD | ESRD |
| Reason for visit | | | | | | |
| General Symptoms | 8,187(19.1) | 8,069(19.0) | 118(32.2) | 53,664,580(19.3) | 52,934,900(19.2) | 729,680(33.7) |
| Symptoms Referable to Psychological and Mental Disorders | 1,700(4.0) | 1,687(4.0) | 13(3.5) | 9,426,523(3.4) | 9,331,220(3.4) | 95,303(4.4) |
| Symptoms Referable to the Nervous System | 3,304(7.7) | 3,279(7.7) | 25(6.8) | 20,833,741(7.5) | 20,708,936(7.5) | 124,805(5.8) |
| Symptoms Referable to the Cardiovascular and Lymphatic Systems | 889(2.1) | 877(2.1) | 12(3.3) | 5,993,917(2.2) | 5,914,527(2.1) | 79,390(3.7) |
| Symptoms Referable to the Eyes and Ears | 848(2.0) | 847(2.0) | 1(0.3) | 5,778,778(2.1) | 5,772,695(2.1) | 6,083(0.3) |
| Symptoms Referable to the Respiratory System | 4,198(9.8) | 4,135(9.8) | 63(17.2) | 27,856,021(10.0) | 27,508,840(10.0) | 347,181(16.0) |
| Symptoms Referable to the Digestive System | 6,807(15.9) | 6,758(15.9) | 49(13.4) | 46,038,272(16.5) | 45,725,454(16.6) | 312,819(14.4) |
| Symptoms Referable to the Genitourinary System | 2,477(5.8) | 2,462(5.8) | 15(4.1) | 14,984,361(5.4) | 14,913,890(5.4) | 70,470(3.3) |
| Symptoms Referable to the Skin, Nails, and Hair | 1,333(3.1) | 1,328(3.1) | 5(1.4) | 8,716,118(3.1) | 8,690,203(3.1) | 25,915(1.2) |
| Symptoms Referable to the Musculoskeletal System | 6,519(15.2) | 6,493(15.3) | 26(7.1) | 42,820,579(15.4) | 42,682,302(15.5) | 138,277(6.4) |
| Other | 6,501(15.2) | 6,461(15.2) | 40(10.9) | 42,147,135(15.1) | 41,908,983(15.2) | 238,152(11.0) |

Table 3. Proportion of Emergency Severity Index, Hospital admission, ICU admission, Medical resources utilization, stratified by ESRD, NHAMCS 2014–2016

| | Unweighted Sample | | | Weighted Sample | | | |
|---|---|---|---|---|---|---|---|
| | All | No ESRD | ESRD | All | No ESRD | ESRD | *p* value |
| ESI score | | | | | | | |
| Immediate | 239(0.8) | 235(0.8) | 4(1.5) | 1,496,327(0.8) | 1,471,879(0.7) | 24,448(1.7) | <0.001 |
| Emergent | 3,615(11.6) | 3,529(11.5) | 86(32.8) | 23,433,327(11.8) | 22,976,847(11.7) | 456,480(31.6) | |
| Urgent | 15,392(49.5) | 15,248(49.5) | 144(55.0) | 97,000,149(49.0) | 96,286,096(49.0) | 714,053(49.4) | |
| Semi-urgent | 10,051(32.3) | 10,034(32.6) | 17(6.5) | 65,085,335(32.9) | 64,950,854(33.0) | 134,480(9.3) | |
| Non-urgent | 1,784(5.7) | 1,773(5.8) | 11(4.2) | 11,046,598(5.6) | 10,931,909(5.6) | 114,689(7.9) | |
| Hospital Admission | 5,852(13.7) | 5,695(13.4) | 157(42.8) | 36,388,538(13.1) | 35,517,254(12.8) | 871,284(40.2) | <0.001 |
| ICU | 698(1.6) | 669(1.6) | 29(7.9) | 4,647,353(1.7) | 4,506,861(1.6) | 140,492(6.5) | <0.001 |
| In hospital death | 201(0.5) | 192(0.5) | 9(2.5) | 1,342,510(0.5) | 1,298,220(0.5) | 44,290(2.0) | <0.001 |
| Left before/after triage | 1,085(2.5) | 1,076(2.5) | 9(2.5) | 6,792,175(2.4) | 6,722,799(2.4) | 69,376(3.2) | 0.9212 |
| Blood test | 21,958(51.3) | 21,654(51.0) | 304(82.8) | 142,656,097(51.2) | 140,833,111(50.9) | 1,822,986(84.1) | <0.001 |
| Any image | 21,950(51.2) | 21,709(51.1) | 241(65.7) | 144,824,612(52.0) | 143,375,099(51.8) | 1,449,513(66.9) | <0.001 |
| X-ray | 15,099(35.3) | 14,894(35.1) | 205(55.9) | 99,429,274(35.7) | 98,179,495(35.5) | 1,249,778(57.6) | <0.001 |
| CT | 8,414(19.6) | 8,338(19.6) | 76(20.7) | 54,986,804(19.7) | 54,559,942(19.7) | 426,863(19.7) | 0.6063 |
| Ultrasound | 2,218(5.2) | 2,205(5.2) | 13(3.5) | 14,936,538(5.4) | 14,833,060(5.4) | 103,478(4.8) | 0.1554 |
| MRI | 446(1.0) | 438(1.0) | 8(2.2) | 2,831,626(1.0) | 2,791,440(1.0) | 40,186(1.9) | 0.0309 |
| Other Imaging | 604(1.4) | 595(1.4) | 9(2.5) | 4,297,097(1.5) | 4,239,282(1.5) | 57,815(2.7) | 0.0890 |
| Procedure | 21,021(49.1) | 20,807(49.0) | 214(58.3) | 133,801,012(48.0) | 132,620,938(48.0) | 1,180,074(54.4) | 0.0011 |
| Waiting time (minutes, MEANS (95% CI)) | 41.1(40.3-41.8) | 41.0(40.3-41.8) | 45.2(37.7-52.7) | 39.9(39.2-40.6) | 39.9(39.1-40.6) | 46.5(38.8-54.1) | 0.7500 |
| Length of visit (minutes, MEANS (95% CI)) | 245.6(241.6-249.6) | 244.1(240.1-248.1) | 422.7(339.2-506.3) | 230.2(226.7-233.8) | 228.7(225.2-232.2) | 450.3(358.0-542.5) | <.0001 |

Notes: Waiting time: time from arrival to seeing the physician. Length of visit: time from arrival to discharge.

Table 4. Odds Ratio of Emergency Severity Index, Hospital admission, ICU admission, Medical Resources Utilization for ESRD vs. Non-ESRD Patients, NHAMCS 2014–2016

| | Crude Odds Ratio | Adjusted for | | |
|---|---|---|---|---|
| | | Demographics | + Social economic | + Visiting & Clinical |
| ESI Score: Immediate or Emergent vs. Semi- or Non-Urgent | 5.99(5.96-6.01) | 4.21(4.19-4.23) | 3.84(3.82-3.86) | 2.43(2.42-2.45) |
| ESI Score: Urgent vs. Semi- or Non-Urgent | 2.26(2.25-2.27) | 1.93(1.92-1.94) | 1.81(1.80-1.82) | 1.32(1.31-1.32) |
| Hospital Admission | 4.56(4.55-4.57) | 3.03(3.02-3.04) | 2.92(2.91-2.93) | 2.22(2.21-2.22) |
| ICU | 4.18(4.16-4.21) | 2.46(2.45-2.47) | 2.28(2.26-2.29) | 1.53(1.52-1.54) |
| Death | 4.42(4.38-4.47) | 2.36(2.34-2.38) | 1.97(1.95-1.99) | 1.12(1.10-1.13) |
| Left | 1.33(1.32-1.34) | 1.64(1.63-1.66) | 1.53(1.52-1.54) | 1.23(1.22-1.24) |
| Blood test | 5.09(5.07-5.11) | 3.92(3.91-3.94) | 3.73(3.72-3.75) | 2.68(2.67-2.69) |
| Any imaging | 1.87(1.87-1.88) | 1.40(1.39-1.40) | 1.39(1.39-1.40) | 1.41(1.41-1.41) |
| X-ray | 2.47(2.47-2.48) | 1.86(1.86-1.87) | 1.78(1.78-1.79) | 1.92(1.92-1.93) |
| CT | 1.00(0.99-1.00) | 0.74(0.74-0.74) | 0.75(0.75-0.75) | 0.72(0.72-0.72) |
| Ultrasound | 0.88(0.88-0.89) | 1.06(1.06-1.07) | 1.16(1.15-1.16) | 1.08(1.08-1.09) |
| MRI | 1.85(1.83-1.87) | 1.29(1.28-1.30) | 1.39(1.37-1.40) | 1.67(1.66-1.69) |
| Procedure | 1.21(1.20-1.21) | 1.14(1.14-1.14) | 1.14(1.14-1.15) | 1.11(1.11-1.12) |

Note: *+ Demographics include: gender, age group, race/ethnicity; +Social economic: residence type, insurance type, census region; + Visiting & Clinical: year, week of day, arrive by ambulance, seen within last 72 hours, pain level, temperature, heart rate, dialytic blood pressure, injury status, reason for visit.

## Supplementary Files

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- SupplementTable1.docx