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The Effect of Depression in Chronic Hemodialysis Patients on Inpatient Hospitalization Outcomes

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Abstract

Background/Aims—Depression is common in patients with end-stage renal disease (ESRD) on hemodialysis (HD). Although, depression is associated with mortality, the effect of depression on in-hospital outcomes has not been studied.

Methods—We analyzed the National Inpatient Sample (NIS) for trends and outcomes of hospitalizations with depression in patients with ESRD.

Results—Proportion of ESRD hospitalizations with depression doubled from 2005 to 2013 (5.01% to 11.78%). Hospitalized patients on HD with depression were younger (60.47 years vs 62.70 years, P <0.0001), more female (56.93% vs 47.81%, P<0.0001), more white (44.92 % vs 34.01%, P <0.0001), and had higher proportion of comorbidities. However, there was a statistically significant lower risk of mortality in HD patients within the top five reasons for admissions.

Conclusion—There were significant differences in demographics and comorbidities for hospitalized HD patients with depression. Depression was associated with an increased rate of adverse discharges, and decreased in-hospital mortality.

Keywords

Depression; ESRD; Hospitalization; Costs; Mortality

Introduction

Depression is a highly common comorbidity in patients with end-stage renal disease (ESRD) on hemodialysis (HD), with prevalence up to 46% [1,2]. Depression in ESRD patients is

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associated with a range of adverse outcomes, including increased fatigue, lower performance status, decreased physical activity, and decreased quality of life [3,4,5,6]. Depression rates amongst ESRD patients approach and may exceed those of patients with cancer, congestive heart failure, and other severe chronic conditions [7,8].

There has been mixed evidence regarding the effect of depression on mortality in ESRD patients. Some studies have not found that depression is not correlated with mortality, while other studies have found an increased risk of all-cause mortality [2,9]. Few studies have examined the effect of depression on hospitalization outcomes in ESRD patients. Depressed affect in ESRD patients has been associated with increased hospitalization risk and increased length of stay (LOS) [10]. However, these studies were based on explicit screening for depression in dialysis centers and do not reflect national trends and differences in in-hospital outcomes for ESRD patients with depression.

To address this knowledge gap, we explored temporal trends of depression in hospitalized patients on hemodialysis using the National (Nationwide) Inpatient Sample (NIS). We evaluated differences between HD patients with and without depression, and examined the effect on inpatient hospitalization outcomes such as LOS, costs, adverse discharge disposition (discharge to specialized care and against medical advice), and in-hospital mortality.

Methods

Study Data Source

This is a retrospective cohort study with data extracted from the National Inpatient Sample (NIS) of the Healthcare Cost and Utilization Project (HCUP) from the Agency for Healthcare Research and Quality (AHRQ). The NIS database contains a 20% sample of all discharges in the HCUP, amounting to more than 7 million hospitalizations each year [11]. Each hospitalization is associated with a weight variable which allowing for inflation to national estimates with high fidelity.

Study Population

We queried the NIS database using the International Classification of Diseases, 9th Revision, Clinical Modification (ICD-9-CM) diagnosis codes. ICD-9-CM codes for ESRD were introduced in 2005, so we selected hospitalizations of patients age 18 or older occurring between 2005-2013. For a list of ICD-9-CM codes used, please refer to Table 1. Hospitalizations were excluded if they were coded for AKI, peritoneal dialysis, or renal transplant, primary ESRD, and primary depression (Figure 1).

Study Variables

For each hospitalization we extracted patient demographic data, concurrent diagnoses, and procedures (cardiac catheterization and mechanical ventilation) as well as hospital level data (hospital size, location, and region). Additionally, we characterized the comorbidity burden with the Charlson Comorbidity Index (CCI) for all eligible hospitalizations [12,13].

Endpoints of interest included temporal trends in hospitalizations with secondary depression, LOS, costs, discharge to specialized care, and in-hospital mortality.

Statistical Analysis

We compared baseline characteristics for two groups of secondary ESRD patients with and without secondary depression. Chi-squared tests were used for categorical variables, student's t-tests were used for normally distributed continuous variables, and Wilcoxon rank sum was used for non-normally distributed continuous variables.

The proportion of hospitalizations, average LOS, and average cost for patients with secondary ESRD with and without secondary depression were calculated for each year in the study period. Temporal trends in patient hospitalizations with depression were then stratified by age, race, and gender.

Since, ESRD patients are admitted with a wide range of diagnoses, we wanted to elucidate whether outcomes associated with common primary diagnoses were disproportionately impacted by secondary depression. We subdivided the hospitalized ESRD patients according to the top five primary ICD-9-CM diagnosis codes associated with secondary ESRD (implant complications, hypertension, congestive heart failure, septicemia, and diabetes mellitus) and performed unadjusted univariate logistic regression followed by adjusted multivariate logistic regression. Temporal trends in hospitalization were evaluated using two sequential logistic regression models (Model 1: Changes in age, sex, race, and CCI; Model 2: Model 1 plus changes in comorbidity burden and procedures). The impact of depression on in-hospital mortality and discharges to specialized care facilities was evaluated using multivariate logistic regression to adjust for age, sex, race, hospital location, primary payer type, hospital bed size, zip code income, and CCI.

All analyses were performed using SAS 9.4 (SAS Institute Inc. Cary, NC, USA) and R Version 3.3.0 (R Foundation for Statistical Computing, Vienna, Austria). We considered the two-tailed *P* value of 0.05 as statistically significant.

Results

Temporal Trends in Hospitalizations

Between the years of 2005 to 2013, there were 4,948,902 hospitalizations for patients on HD. Of these admissions, 464,951 (9.3%) also had depression as a concurrent diagnosis. There was a substantial increase in rates of depression among hospitalized HD patients, more than doubling from 5.01% in 2005 to 11.78% in 2013 (Figure 2). When stratified by age, race, and gender, there was no appreciable difference in overall rate of increase among each group respectively (Figure 3). However, the proportion of hospitalizations complicated by depression in hospitalized HD patients was highest in the younger age groups (18-34 years and 35-49 years), white race, and females throughout the study period.

The top five clinical reasons for admission in patients on HD with depression were for implant complications, hypertension (HTN), congestive heart failure (CHF), septicemia, and diabetes mellitus (DM). Regardless of reason for admission, there was a significant increase in the number of admissions for HD patients with depression every year even after adjustment for patient characteristics (Table 2). This remained significant even after adjustment for patient demographics, comorbidities, and procedures for cardiac catheterization and mechanical ventilation. The largest increase in odds was seen for septicemia hospitalizations (adjusted odds ratio (aOR) 1.13 95% CI 1.08 – 1.12, P <0.0001).

Baseline Characteristics

Hospitalized patients on HD with depression were younger (median age 60.47 years vs 62.70 years, P <0.0001), more female (56.93% vs 47.81%, P<0.0001), more white (44.92 % vs 34.01%, P <0.0001), and had higher burden of comorbidity as measured by the Charlson Comorbidity Index (32.67% vs 27.58% with ≥5). Patients with depression had a higher proportion of multiple comorbidities, including obesity (13.07% vs 8.79%, P<0.0001), chronic obstructive pulmonary disease (19.52% vs 15.74%, P<0.0001), hypothyroidism (17.36% vs 11.03%, P<0.0001) and hyperlipidemia (33.79% vs 23.71%, P<0.0001). While there were statistical differences in hospital characteristics and insurance type, these were likely due to large sample size. (Table 3)

Outcomes by Admission Diagnosis

There was a statistically significant lower risk of mortality in HD patients admitted with depression compared to those without depression in admissions for implant complications (aOR 0.73, CI 0.63 - 0.85, p = <.0001), CHF (aOR 0.68, CI 0.55 – 0.84, p = .0005), septicemia (aOR 0.63, CI 0.57 - 0.70, p = <.0001), and DM (aOR 0.63 (0.46 - 0.86, p = .0035) after adjustment for patient and hospital characteristics (Table 4a). However, there was no difference in adjusted mortality in admissions for HTN.

On discharge, hospitalizations with depression and HD were more likely to have an adverse discharge disposition (45.71% vs 38.31%, p<0.0001). The odds of adverse discharge disposition were significantly higher in HD patients with depression for admissions of implant complications (aOR 1.66, 95% CI 1.57 – 1.76, P<0.0001), HTN (aOR 1.81, 95% CI 1.70 – 2.00, P<0.0001), CHF (aOR 1.66, 95% CI 1.54 – 1.78, P<0.0001), septicemia (aOR 1.30, 95% CI 1.21 – 1.40, P<0.0001), and DM (aOR, 1.42 95% CI 1.31 – 1.53, P <0.0001) (Table 4b). Hospitalization cost between HD patients with and without depression while statistically significant were similar (median USD 9123, interquartile range (IQR) 5470.4 – 15921 vs. 9166, IQR 5363.6 – 16350, P=<0.0001. Median LOS was not statistically different (3.80, IQR 1.95 – 7.06 vs. 3.69, IQR 1.82 – 6.97 days P=0.36), however, there was an overall decrease in LOS in both groups from 2005 to 2013.

Discussion

Our study demonstrates a significant increase in rates of depression in hospitalized HD patients, and that the rates differed by subgroups. We find several key differences in patient characteristics between those with depression and those without, including younger age, more females, more whites, and higher proportion of several comorbidities. Additionally, admissions for patients on HD with depression were longer, but not more costly. Finally, the adjusted odds of mortality were lower and the adjusted odds of adverse discharge were higher in ESRD hospitalizations with depression compared to those without depression.

We recognize that the rates of documented depression in the NIS are lower by several fold compared with other cohorts [14]. The reasons for this are likely multifactorial. It is well established that it is more difficult to diagnose depression in ESRD patients [15]. Additionally, published studies have explicitly screened for depression and therefore will generate higher proportion of patients with depression, as compared to the NIS where there is no standardized measure or reporting of depression. Undercoding of depression may also differentially affect different populations of patients.

One possible explanation of the doubling of admissions for ESRD and depression may be due to an increased screening and an increased coding for depression. Incentives through the Physician Quality Reporting System (PQRS) recommending Patient Health Questionnaire-2 (PHQ-2) screening likely contributed to increased diagnosis of depression by primary care and other providers. Overall secondary ICD-9-CM diagnosis coding may have also increased during this time period. However, given that the rates of depression have increased in the general population, we suspect that the increasing proportion of HD patients with depression is likely due to a combination of the above factors and a true increase in prevalence [16]. Furthermore, when we examined the odds of increase per year by different reasons for admissions, even after adjustment there was a significant increase of 7-13%. Therefore, temporal changes in comorbidities and procedures do not fully explain this increasing trend.

We have found that depression is increasing more in the younger female population and demonstrate that the rates of depression are lower in patients >65, which is consistent with prior studies [17,18,19]. It is possible that younger patients on hemodialysis have true higher rates of depression, or that depression is being underdiagnosed or undercoded in older populations and warrants further study. Our data also demonstrate that there were lower proportion of black patients with depression. This is in contrast to a study done by Weisbord et al. which found that whites and African Americans had the same prevalence of depression in maintenance HD patients, 27% in both groups [20]. Another study in incident dialysis patients did demonstrate a higher rate of depression in whites [21].

Depressed patients were significantly more likely to have an adverse discharge to specialized care facilities. Previous studies have shown that rates of depression are higher in long-term care facilities, and it is possible that more patients with depression were coming from these facilities [22].

Interestingly, our data showed that having a diagnosis of depression was associated with decreased in-hospital mortality. Depression has been associated with increased risk of in-hospital mortality after CABG in multiple prior studies [23,24]. However, decreased in-hospital mortality for patients with depression has also been previously described in hospitalizations for breast cancer and following major spine surgery [25,26]. In previous studies, it has been hypothesized that sicker patients would be less likely to have depression coded in their secondary ICD-9-CM diagnoses, which may signify that patients with hospitalizations that are coded with depression may be less acutely ill [27]. This may also explain the higher need for procedures that we see in HD admissions without depression. Lower in-hospital mortality in patients with depression may also reflect differences in overall care. We speculate that those patients who were screened for depression could have had more comprehensive and attentive care by their health care providers than those who were never identified leading to earlier identification and treatment of both acute and chronic comorbidities. Hospitalization rate may be different for patients with depression, so while our data reports in-hospital mortality, it may not reflect the overall yearly mortality for these patients. Unfortunately, we do not have sufficient data to comment on overall mortality (including out-of-hospital mortality), but our findings are intriguing and should be followed up future studies with more granular patient-level data.

We recognize several limitations to our study. As the NIS is an administrative database, we recognize that undercoding can be a potential bias. However, given that undercoding may make our two populations look more similar, that we have found several significant differences in the groups is encouraging. We also do not have sufficient granular data to examine factors that may affect mortality such as vintage of dialysis and access type. In addition, the unit of analysis was a hospitalization and thus we were unable to account for patients with multiple hospitalizations within a calendar year. However, the NIS is a nationally representative database, which allows for good generalizability to the national HD cohort. Given these limitations and surprising findings, we believe further studies with patient-level data are warranted including both in hospital and out of hospital outcomes.

Conclusions

Depression is highly prevalent in ESRD patients on hemodialysis and has been increasing over the past 8 years. Depression was associated with an increased rate of adverse discharges, no difference in LOS, decreased hospital costs, and decreased in-hospital mortality. These results call for further studies to evaluate the effect of depression in HD patients on hospitalization outcomes.

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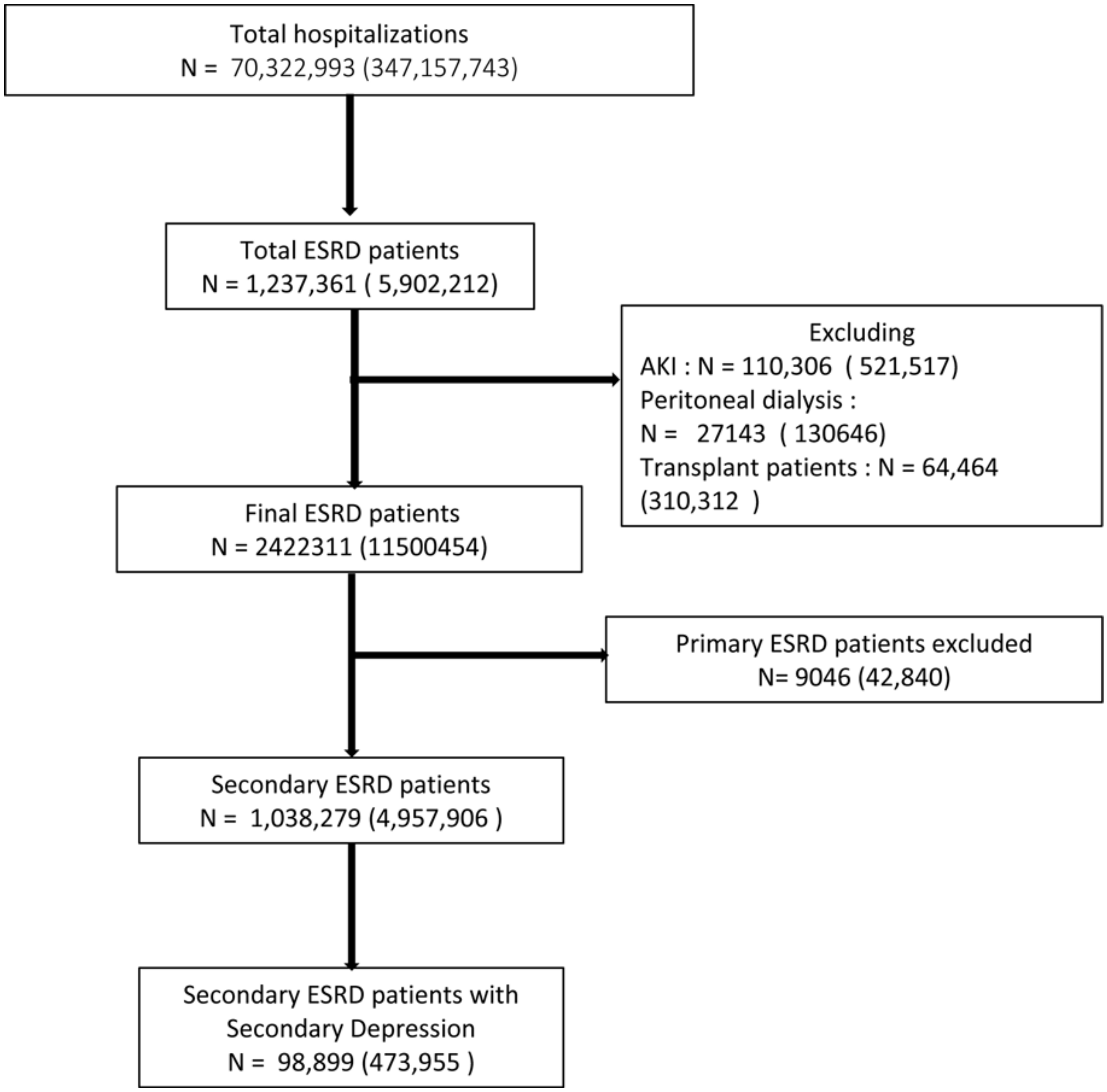


Figure 1.
Study Flow Chart.

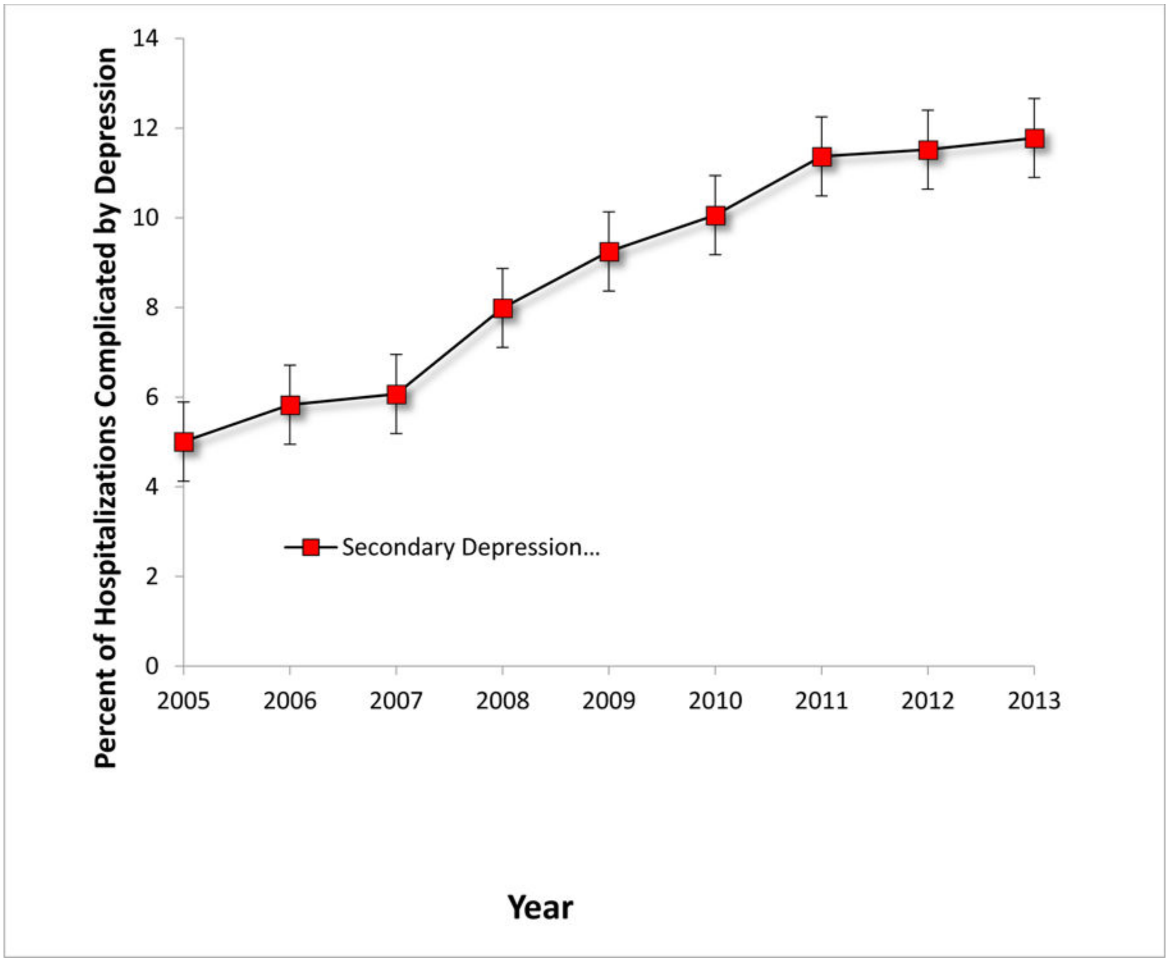
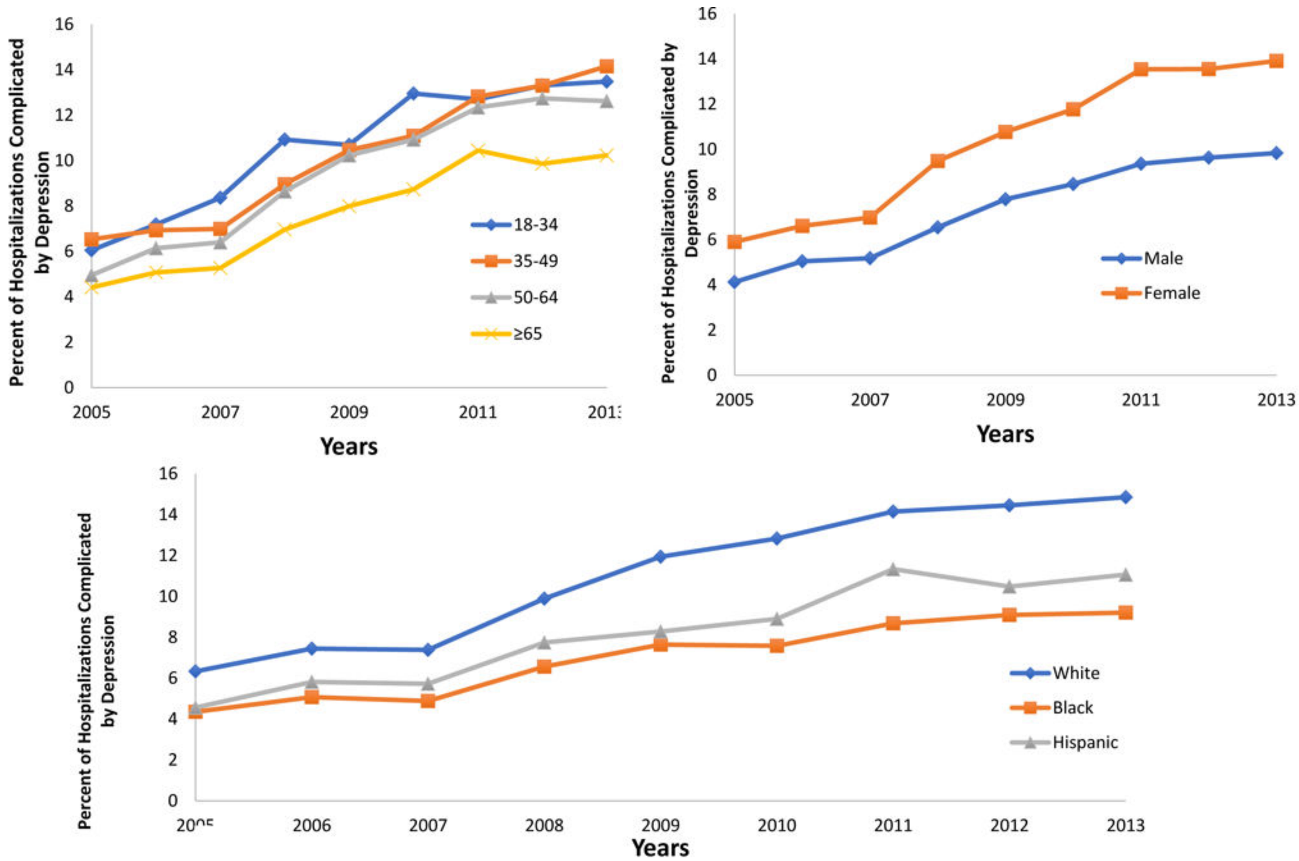


Figure 2.

Temporal trends in Hospitalizations of hemodialysis patients with depression. Hospitalizations in patients with depression and hemodialysis are increasing from 2005 to 2013.



(a) While hospitalizations for depression and hemodialysis increased in all age groups, age group ≥65 years had the lowest proportion throughout. (b) Females had high proportion of hospitalizations with depression and hemodialysis than males. The trend was similar. (c) Whites had the highest proportion of hospitalizations with depression and hemodialysis. The trends were similar.

Figure 3.

Temporal trends in hospitalizations of hemodialysis patients with depression stratified by (a) Age (b) Gender and (c) Race.

Table 1

List of International Disease Classification 9 (ICD9) and Clinical Classification Software (CCS) Codes used

Study variable	ICD9 code	Description
Depression	2962, 2963, 3004, 311	Major depressive disorder- single and recurrent episode, dysthymic disorder, Depressive disorder-not elsewhere classified.
End stage Renal Disease	585.6	End Stage Renal Disease
Dialysis procedures	39.95	Hemodialysis
Dialysis diagnosis	V45.11, V45.12, V56.0, V56.1	Hemodialysis
Exclusions		
Acute Kidney Injury	584.5, 584.6, 584.7, 584.8, 584.9	Acute kidney failure with lesion of tubular necrosis, Acute kidney failure with lesion of renal cortical necrosis, Acute kidney failure with lesion of renal medullary [papillary] necrosis, Acute kidney failure with other specified pathological lesion in kidney, Acute kidney failure, unspecified
Peritoneal Dialysis procedures	549.8, V56.2, V56.8, 996.68, V56.32	Peritoneal Dialysis, Fitting and adjustment of peritoneal dialysis catheter, Encounter for other dialysis, Infection and inflammatory reaction due to peritoneal dialysis catheter, Encounter for adequacy testing for peritoneal dialysis
Renal Transplant	V42.0, 996.81, 556.9, 556.1	Kidney transplant status (Kidney replaced by transplant), Kidney transplant (immune or non-immune cause), Other kidney transplantation, Renal autotransplantation
Complications	**CCS code**	**Description**
Implant complications	237	Complication of device; implant or graft
Hypertension	99	Hypertension with complications and secondary hypertension
Congestive heart failure	108	Congestive heart failure; nonhypertensive
Diabetes mellitus	50	Diabetes mellitus with complications
Septicemia	2	Septicemia (except in labor)

Table 2

Sequential adjusted models to explain temporal trends of hospitalizations in hemodialysis patients with depression stratified by top five clinical reasons for admission.

Procedures	Unadjusted Odds Ratio/year (95% CI)	P-Value	Adjusted Odds Ratio/year (95% CI[1]	P-Value	Adjusted Odds Ratio/year (95% CI)	P-Value
Implant complications	1.15 (1.13 - 1.16)	<.0001	1.13 (1.12 - 1.15)	<.0001	1.11 (1.10 - 1.13)[2]	<.0001
Hypertension	1.10 (1.08 - 1.11)	<.0001	1.09 (1.08 - 1.11)	<.0001	1.07 (1.05 - 1.09)[3]	<.0001
Congestive Heart Failure	1.12 (1.10 - 1.13)	<.0001	1.11 (1.09 - 1.13)	<.0001	1.09 (1.07 - 1.11)[4]	<.0001
Septicemia	1.17 (1.15 - 1.19)	<.0001	1.15 (1.13 - 1.17)	<.0001	1.13 (1.11 - 1.15)[5]	<.0001
Diabetes Mellitus	1.14 (1.12 - 1.15)	<.0001	1.12 (1.10 - 1.14)	<.0001	1.10 (1.08 - 1.12)[6]	<.0001

[1] Adjusted for changes in age, sex, and race

[2] Adjusted for changes in age, sex, race, changes in Charlson Comorbidity Index and comorbidities (HIV, septicemia, alcohol abuse, anemia, diabetes, congestive heart failure, hypertension, liver disease, obesity) and procedures (cardiac procedures, endovascular procedures, and mechanical ventilation).

[3] Adjusted for changes in age, sex, race, changes in Charlson Comorbidity Index and comorbidities (HIV, alcohol abuse, septicemia, anemia, diabetes mellitus, congestive heart failure, liver disease, obesity, hyperlipidemia, acute myocardial infarcation, stroke) and cardiac procedures

[4] Adjusted for changes in age, sex, race, changes in Charlson Comorbidity Index and comorbidities (HIV, alcohol abuse, anemia, diabetes mellitus, hypertension, liver disease, obesity, chronic obstructive pulmonary disease, hypothyroidism) and procedures (cardiac and mechanical ventilation).

[5] Adjusted for changes in age, sex, race, changes in Charlson Comorbidity Index and comorbidities (HIV, alcohol abuse, septicemia, diabetes mellitus, congestive heart failure, hypertension, liver disease, obesity, metastatic cancer, chronic obstructive pulmonary disease) and procedures (cardiac procedures and mechanical ventilation)

[6] Adjusted for changes in age, sex, race, changes in Charlson Comorbidity Index and comorbidities (HIV, alcohol abuse, septicemia, anemia, congestive heart failure, hypertension, liver disease, stroke, and peripheral vascular disease) and mechanical ventilation.

Table 3

Baseline Characteristics of Study Population Stratified by Depression in Secondary ESRD population

	ESRD population		
	Without Depression N=4,483,951 (%)	**With Depression N= 464,951 (%)**	**P-Value**
Patient Characteristics			
Age (Years)			
Median (IQR)	62.70 (51.6 - 73.33)	60.47 (49.54 - 70.58)	<.0001
18-34	238,413 (5.32)	30,659 (6.6)	
35-49	678,340 (15.13)	81,076 (17.44)	
50-64	1,451,560 (32.37)	165,618 (35.62)	
≥65	2,115,637 (47.18)	187,598 (40.35)	
Gender(%)			<.0001
Male	2339924(52.18)	200,218 (43.06)	
Female	2,143,778 (47.81)	264,698 (56.93)	
Race(%)			<.0001
White	1,524,945 (34.01)	208,839 (44.92)	
Black	1,472,924 (32.85)	120,994 (26.02)	
Hispanic	635,105 (14.16)	62,517 (13.45)	
Others	295,312 (6.6)	22,893 (4.92)	
Missing	555,665 (12.4)	49,709 (10.7)	
Charlson Comorbidity Index (%)			<.0001
2	807,327 (18)	68,753 (14.8)	
3	1,188,521 (26.51)	110,238 (23.71)	
4	1,251,304 (27.91)	134,058 (28.83)	
>=5	1,236,799 (27.58)	151,902 (32.67)	
Concurrent Diagnosis (%)			
Acquired Immunodeficiency Syndrome	108,816 (2.43)	11,168 (2.4)	0.3
Alcohol Abuse	68,879 (1.54)	10,276 (2.21)	<.0001
Congestive Heart Failure	1,595,653 (35.6)	167,308 (36.98)	<.0001
Chronic Obstructive Pulmonary Disease	705,818 (15.74)	90,742 (19.52)	<.0001
Diabetes Mellitus	2,538,085 (56.6)	286,257 (61.57)	<.0001
Septicemia	684,329 (15.26)	58,397 (12.56)	<.0001
Hypertension	4,174,023 (93.09)	434,159 (93.38)	<.0001
Liver Disease	302,047 (6.74)	32,913 (7.08)	<.0001
Peripheral Vascular Disease	73,913 (16.32)	87,608 (18.84)	<.0001
Mechanical Ventilation	237,919 (5.31)	16,314 (3.51)	<.0001
Anemia Deficiency	2,247,808 (50.13)	278,211(9.4)	<.0001
Obesity	394,172 (8.79)	60,779 (13.07)	<.0001
Cardiac Procedures	202,198 (4.51)	16,217 (3.5)	<.0001

	ESRD population		
	Without Depression N=4,483,951 (%)	With Depression N= 464,951 (%)	P-Value
Endovascular Procedures	201,060 (4.48)	18,503 (3.98)	<.0001
Hypothyroidism	494,652 (11.03)	80707 (17.36)	<.0001
Metastatic Cancer	42,384 (0.95)	34,53 (0.74)	<.0001
Acute Myocardial Infarction	198,558 (4.43)	15,125 (3.25)	<.0001
Stroke	132,922 (2.96)	12,778 (2.75)	<.0001
Hyperlipidemia	1,063,040 (23.71)	157,090 (33.79)	<.0001
Median household income category for patient's zip code[a], n (%)			<.0001
0-25 percentile	1,709,343 (38.13)	161,551 (34.75)	
26-50 percentile	1,084,234 (24.18)	117,453 (25.26)	
51-75 percentile	902,489 (20.13)	103,471 (22.25)	
76-100 percentile	67,3841 (15.03)	72,711 (15.64)	
Hospital Characteristics			
Hospital bed size [b] **(%)**			<.0001
Small	361,731 (8.07)	39,699 (8.54)	
Medium	1,049,033 (23.4)	108,660 (23.37)	
Large	3,044,510 (67.9)	313,718 (67.47)	
Hospital Location [c] **(%)**			<.0001
Rural	283,076 (6.31)	33,015 (7.1)	
Urban non teaching	1876,744 (41.85)	191,904 (41.27)	
Urban teaching	2,295,454 (51.19)	237,158 (51.01)	
Hospital Region (%)			<.0001
Northeast	821,347 (18.32)	76,371 (16.43)	
Midwest or North Central	904,865 (20.18)	117,091 (25.18)	
South	1,864,608 (41.58)	173,664 (37.35)	
West	856,140 (19.09)	93,242 (20.05)	
Disposition (%)			<.0001
Home	2,497,136 (55.69)	232,645 (50.04)	
Discharge against medical advice	81,159 (1.81)	8,092 (1.74)	
Discharge to Specialized care	1,717,769 (38.31)	212,540 (45.71)	
Died	183,161 (4.08)	11,213 (2.41)	
Primary Payer (%)			<.0001
Medicare/Medicaid	3,924,002 (87.51)	411,536 (88.51)	
Private	424,052 (9.46)	42,110 (9.06)	
Uninsured/Self pay	128,792 (2.87)	10,150 (2.18)	

Frequencies (%) in the columns may not sum to 100% since there might be missing data

Abbreviations: IQR: Inter Quartile range; AIDS: Acquired Immunodeficiency Syndrome;

[a]This represents a quartile classification of the estimated median household income of residents in the patient's ZIP Code. These values are derived from ZIP Code-demographic data obtained from Claritas. The quartiles are identified by values of 1 to 4, indicating the poorest to wealthiest populations.

[b]Bed size categories are based on hospital beds, and are specific to the hospital's location and teaching status. Bed size assesses the number of short-term acute beds in a hospital. Hospital information was obtained from the AHA Annual Survey of Hospitals.

[c]The hospital's teaching status was obtained from the AHA Annual Survey of Hospitals. A hospital is considered to be a teaching hospital if it has an AMA-approved residency program, is a member of the Council of Teaching Hospitals (COTH) or has a ratio of full-time equivalent interns and residents to beds of .25 or higher. Non-metropolitan hospitals were not split according to teaching status, because rural teaching hospitals were rare. The metropolitan categorization is a simplified adaptation of the 2003 version of the Urban Influence Codes (UIC) and includes both large and small metropolitan areas.

Table 4

Adjusted estimates of (a) mortality and (b) discharge to specialized care for HD patients with depression stratified by top 5 clinical reasons for admissions.

Procedures	Unadjusted Odds Ratio (95% Confidence Interval)	P-Value	Adjusted Odds Ratio (95% Confidence Interval)[1]	P-Value
Implant complications	0.72 (0.62 - 0.84)	<.0001	0.73 (0.63 - 0.85)	<.0001
Hypertension	0.84 (0.66 - 1.07)	0.1636	0.90 (0.70 - 1.14)	0.361
Congestive Heart Failure	0.64 (0.51 - 0.79)	<.0001	0.68 (0.55 - 0.84)	0.0005
Septicemia	0.60 (0.55 - 0.66)	<.0001	0.63 (0.57- 0.70)	<.0001
Diabetes Mellitus	0.53 (0.39 - 0.71)	<.0001	0.63 (0.46 - 0.86)	0.0035

Procedures	Unadjusted Odds Ratio (95% Confidence Interval)	P-Value	Adjusted Odds Ratio (95% Confidence Interval)[1]	P-Value
Implant complications	1.58 (1.49 - 1.67)	<.0001	1.66 (1.57 - 1.76)	<.0001
Hypertension	1.69 (1.57 - 1.82)	<.0001	1.84 (1.70 - 2.00)	<.0001
Congestive Heart Failure	1.57 (1.46 - 1.68)	<.0001	1.66 (1.54 - 1.78)	<.0001
Septicemia	1.21 (1.13 - 1.29)	<.0001	1.30 (1.21 - 1.40)	<.0001
Diabetes Mellitus	1.16 (1.02 - 1.25)	<.0001	1.42 (1.31 - 1.53)	<.0001

[1]Adjusted for changes in age, sex, race, Hospital Location, Primary Payer type, Hospital Bed size, Hospital Location, Zip code Income, Charlson Comorbidity Index