Comparison of Trends, Mortality, and Readmissions After Insertion of Left Ventricular Assist Devices in Patients <65 Years Vs ≥65 Years

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Left ventricular assist devices (LVADs) use in treatment of stage D heart failure (HF) has evolved and expanded in the past decade. There is paucity of data on LVAD utilization in patients with age ≥65 years with multiple co-morbidities. We aimed to investigate utilization trends, outcomes, and rates and predictors of readmissions in patients receiving LVADs with age ≥65 years (AO) and comparing them with patient age <65 years (AY). We analyzed hospitalization data from the Nationwide Inpatient Sample from 2007 to 2015 to evaluate LVAD utilization trends and outcomes between the 2 patient cohorts. We also queried the Nationwide Readmission Database from 2014 to third quarter of 2015 to identify trends and compare etiologies of readmissions. Implants in AO patients increased from 20% (154) of the total LVADs implanted in 2007 to 33.2% (1,215) in 2014 and 31.8% (910) through September 2015 ($p < 0.01$). Over the study period there was a steady and significant increase in the mean Elixhauser scores in elderly patients who underwent LVAD implantation from 15.4 in 2007 to 24.54 in 2015 ($p < 0.01$). Despite this finding, the mean LOS in the AO cohort decreased from 56.0 days in 2007 to 33.8 days in 2015 ($p < 0.001$). Furthermore, the in-hospital mortality associated with LVAD implantation among the AO group gradually decreased over the study time period (39% in 2007 to 12.2% in 2015, $p < 0.001$). The overall readmission rate was not significantly different between AO versus AY group (28% vs 33%, $p = 0.2$). The most common cause in both groups was gastrointestinal bleed but it was significantly higher in AO group (24.3% vs 11.3%, $p = 0.01$). In conclusion, patients age ≥65 years with multiple co-morbidities are receiving increasing number of LVADs with improved survival outcomes. Their 30-day readmissions are comparable to the younger patients. **(Am J Cardiol 2020;128:16−27)**

End-stage heart failure that is refractory to medical therapy constitutes 5% of total heart failure population but has profound effects on quality of life with dismal survival.[1] Palliative options with or without ionotropic therapies remained the only route for majority of these patients, with only few eligible for orthotropic heart transplant. The advent of durable left ventricular assist devices (LVADs) changed this paradigm after showing drastically improved outcomes, and are now widely accepted therapeutic options for eligible patients.[2−4] Age is important factor in the determining eligibility, as advanced age with associated co-morbidities has shown mitigate the potential benefit offered through these devices.[5] Not surprising, orthotropic heart transplant has remained an unlikely option for older patients,[6] leaving LVAD as the only effective treatment strategy. The International Society of Heart and Lung Transplantation society has a conservative approach with a recommendation for thorough evaluation of patients >60 years to avoid poor outcomes after LVAD implantation.[7] Contrarily, small studies have acceptable survival in older patients and advocating for consideration for LVAD therapy.[8] With the aging population, it is imperative to explore contemporary use and risk-benefits of LVAD therapy in older patients. We thus decided to study the utilization, in-hospital outcomes and readmissions for patients with age ≥65 years who underwent LVAD implantation from multicentric databases, the National Inpatient Sample (NIS) and Nationwide Readmissions Database.

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Methods

Data were obtained from the NIS and NRD maintained by the Agency for Healthcare Research and Quality Healthcare Cost and Utilization Project. Briefly, NIS is a nationally representative administrative database containing discharge data from a 20% stratified sample of US hospitals. Similarly, NRD is compiled from the Healthcare Cost and Utilization Project (HCUP) State Inpatient databases which represents 50% of all US hospitalization containing information about index admission and subsequent all

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readmissions. In both databases, encounter-level information of hospital stays compiled in a uniform format. Numerous quality assurances are conducted by HCUP to verify the accuracy of the data from its participating sites.[9] This study was deemed exempt by the Institutional Review Board due to use of publicly available de-identified databases.

We selected all patients ≥18 years who underwent LVAD implantation from NIS (January 2007 to September 2015) and NRD (January 2014 to August 2015) using International Classification of Diseases, 9th Edition (ICD-9) procedures codes- 37.66. Records undergoing concomitant orthotopic heart transplantation, artificial heart implantation (ICD 9 code-3752) and/or missing age were excluded from all analyses. From the NIS database, a total of 23,171 admissions were identified for the study period, which after exclusion (N = 1,139) yielded a sample size of 22,052 admissions. Similarly, a total of 5,534 admissions were identified from NRD. Overall cohort was stratified into 2 groups based on age (1) AO (age ≥ 65 years) (2) AY (age <65). Within the AO group, we also did subgroup analysis for patients age 65 to 79 years and ≥80 years.

Baseline characteristics including patient demographics (age, gender, race, expected primary payer, and median household income) and co-morbidities (hypertension, diabetes mellitus, obesity, valvular heart disease, peripheral vascular disease, chronic heart disease, chronic lung disease, chronic kidney disease, and chronic liver disease) were assessed. Co-morbidities were mapped by AHRQ-HCUP using billing codes. Elixhauser co-morbidity index was used to quantify the co-morbidity burden for the cohort.[10−12]

Selected outcomes of interest from the index admission compared between groups were (1) incidence of in-hospital mortality and other complications, namely, cardiogenic shock, acute kidney injury (AKI) needing hemodialysis, acute ischemic stroke, gastrointestinal bleeding, vascular complications, infectious complications and respiratory complications and cardiac complications. (2) Annual trends of proportion of LVAD implanted in the patients age >65, (3) etiology, rates, and predictors of 30-day readmission. (4) Utilization outcomes, like length of stay (LOS) was calculated for all patients who survived index admission. Also, total charge for hospitalization was also calculated and reported for each group.

Weighted data was used for all analyses. Baseline demographic, co-morbidities, and hospital characteristics between the 2 groups were to identify significant univariate associations. Dichotomous outcomes were reported as proportions and compared with using Pearson chi-square test to evaluate for univariate associations (Table 2). Inpatient mortality and in-hospital complications were then modeled into complex sample multivariable logistic regression model adjusting for demographics and co-morbidity factors and were reported as adjusted odds ratios. Mean LOS and costs with standard errors were reported and compared using 1-way ANOVA. All data extraction and analyses were done using SPSS (Version 22.0. Armonk, NY). Two-sided p value <0.05 were used for statistical significance.

Results

Between January 2007 and September 2015, a total of 23,171 LVADs were implanted. Of the 23, 171 LVADs implanted, 1,139 patients were excluded from the study due to incomplete records on age, transplant, and artificial heart implantations. Of the remaining 22,052, 15,418 (70%) patients were in <65 years and 6,633 (30%) were ≥65 years (Figure 1). Over the study period there has been a consistent increase in the number of LVAD implantations each year with an increase from 769 in 2007 to 2865 in 2015 through September. Age stratified analysis revealed increased LVAD implantations in the age group ≥65 years between 2007 and 2015, with only 20% (154) of the total LVADs implanted being in this age group in 2007 compared with 1,215 (33.2%) in 2014 and 910 (31.8%) through September 2015 ($p < 0.01$). Similar trends were observed when LVAD implantations when adjusted for all annual admissions. (Figure 2)

Mean age of patients in the AY and AO groups was 50.2 ± 0.09 and 70.2 ± 0.05 ($p < 0.001$) years, respectively. AO

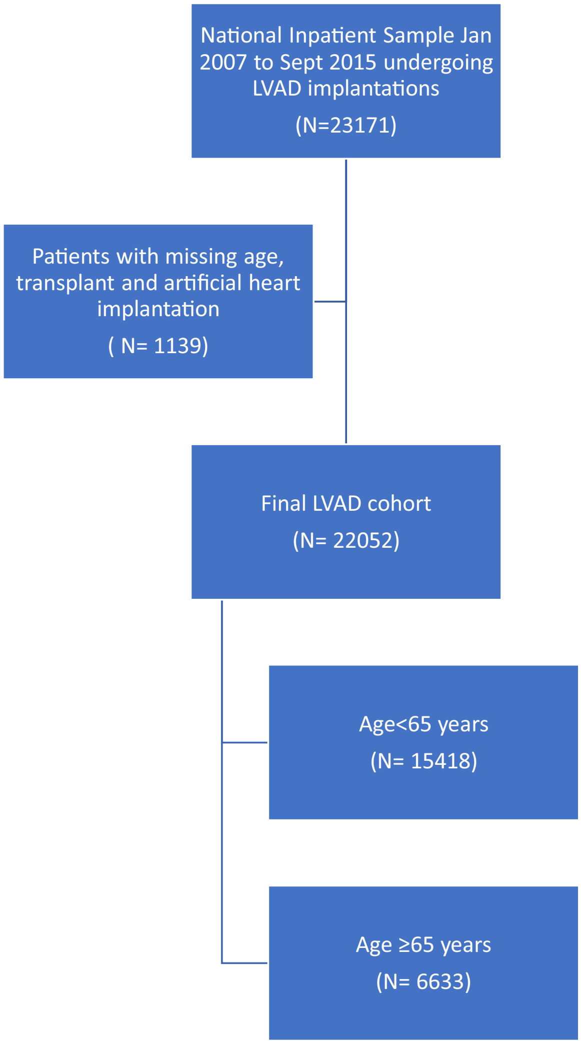

Figure 1. Schematic representation of the study selection and design strategy from National Inpatient Sample. LVAD = left ventricular assist device.

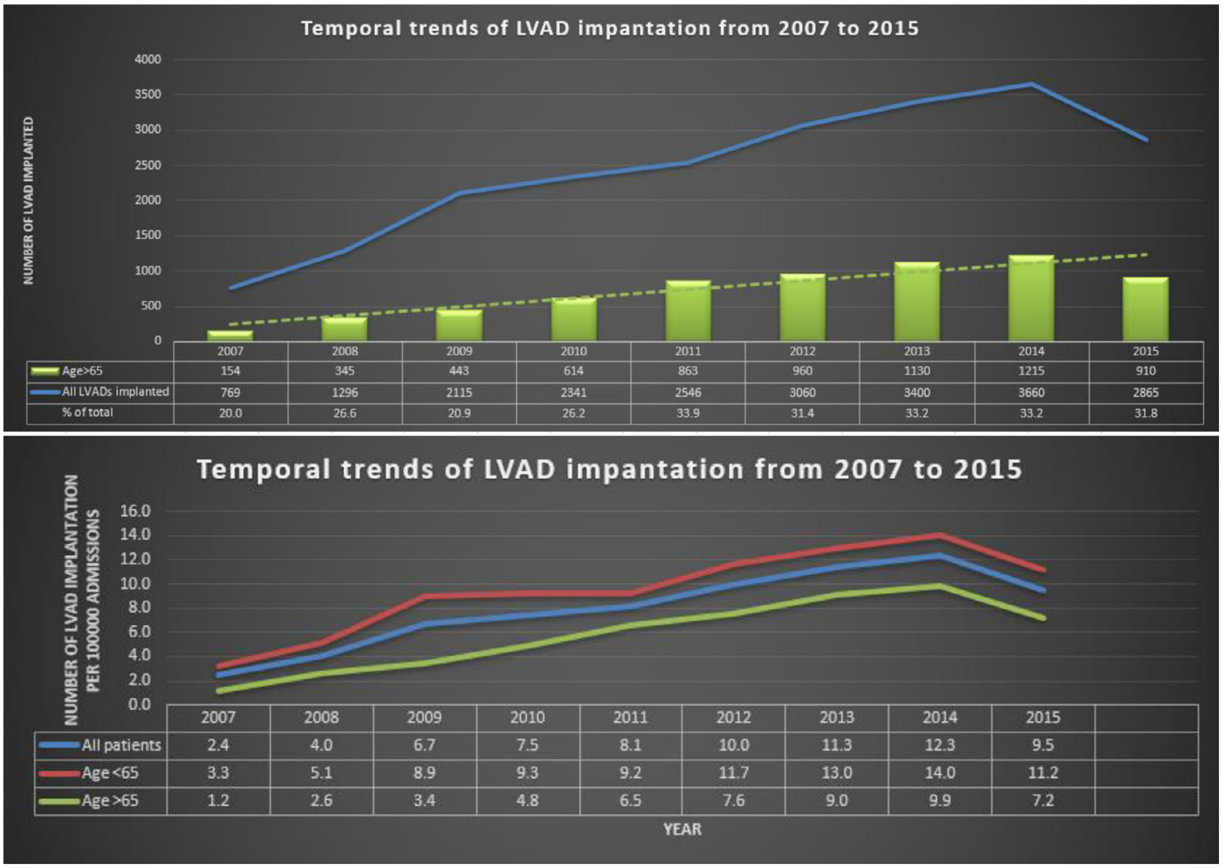

Figure 2. . *(A)* Temporal trends of Left ventricular assist device implantation from 2007 to 2015. LVAD = left ventricular assist device. *(B)* Temporal trends of Left ventricular assist device implantation per 100,000 admissions from 2007 to 2015. LVAD = left ventricular assist device.

group had more men and predominantly Caucasian. Patients in the AO group also had a higher prevalence of hypertension, diabetes mellitus, chronic pulmonary diseases, coronary artery disease, peripheral vascular disease, chronic kidney disease, and coagulopathy. The younger cohort had higher prevalence of alcohol abuse, drug abuse, smoking, chronic liver disease, and valvular heart disease. A comprehensive list of baseline characteristics in included in Table 1. Mean Elixhauser score was significantly higher in AO group as compared with AY group (24.1 vs 22.4, p < 0.001). Over the study period there was a steady and significant increase in the mean Elixhauser scores in AO patients receiving LVAD implantation from 15.4 in 2007 to 24.54 in 2015 (p < 0.01; Figure 3).

There was a significant decrease in LOS during index hospitalization post VAD implantation among all patients during the study period. The mean LOS in the AO cohort decreased from 56.07 days in 2007 to 33.86 days in 2015 (p < 0.001; Figure 4). The mortality during index hospitalization during the study period was significantly higher among the AO cohort (16.7% vs 13.1%, p < 0.001) as compared with AY. (Table 2) However, the in-hospital mortality associated with LVAD implantation among the AO group demonstrated a gradual but consistent decrease over the study time period (39% in 2007 to 12.2% in 2015, p < 0.001; Figure 5). Within the AO cohort, mortality was significantly higher among those >80 years than compared with those between 65 and 79 years (27.4% vs 16.7%, p < 0.001; Table 3)

AO patients were more likely to have gastrointestinal bleeding (6.7% vs 4.4%, p < 0.001) during their index hospitalization but no significant increase in their LOS (34.6 vs 35 days, p = 0.33). Annual trends in other complications including AKI, AKI needing hemodialysis, acute stroke, infectious complications, respiratory complications, and vascular complications between the 2 cohorts were as shown in Figure 6.

Multivariate stepwise logistic regression analysis was performed which showed age (≥65), female gender, diabetes mellitus, chronic liver disease, chronic pulmonary disease, peripheral vascular diseases, AKI, obesity, acute ischemic stroke, infectious complications, cardiac complications, gastrointestinal bleeding, and vascular complications as independent predictors for in-hospital mortality in patients ≥65 years who received LVAD implantation. (Supplemental Table 1) Hypertension, smoking, and respiratory complications were not predictors of in-hospital mortality in this cohort.

Out of 5,534 patients underwent LVAD implantation between January 2014 and August 2015, 505 (32.9%) in AO group had at-least one readmission post implantation within 30 days and 80 (5.2%) has more than one (Figure 7). Baseline characteristics of the patients requiring readmission within 30 days in both cohorts are summarized in Table 4.

Table 1
Patient characteristics of patients <65 and ≥65 years age from National Inpatient Sample January 2007 to September 2015

Variables	Age (years)		p Value
	<65	≥65	
Number of hospitalizations			
Unweighted (%)	3136 (69.9%)	1346 (30.1%)	
Weighted (%)	15418 (69.9%)	6633 (30.1%)	
Age (in years)	50.2(±0.09)	70.2(±0.05)	<0.001
Men	73.9%	83.6%	<0.001
White	58.9%	78.3%	
Black	28.1%	10.1%	
Hispanic	6.3%	5.5%	
Asian or Pacific Islander	2.0%	1.3%	
Native American	0.4%	0.3%	
Other	4.3%	4.6%	
Median household income percentile			<0.001
0-25	28.8%	20.1%	
26-50	25.8%	22.1%	
51-70	24.3%	29.5%	
76-100	21.1%	28.3%	
Primary payer			<0.001
Medicare	30.5%	83.7%	
Medicaid	16.4%	0.8%	
Private insurance	47.9%	13.5%	
Self-pay	1.7%	0.8%	
Other	3.4%	1.0%	
Type of admission			<0.001
Elective	30.3%	37.3%	
Non-elective	69.7%	62.7%	
Weekend admission	68.4%	31.6%	0.058
Hospital characteristics			
Teaching status			<0.001
Rural	0.1%	0.3%	
Urban non-teaching	2.1%	4.3%	
Urban teaching	97.7%	95.4%	
Bed-size			<0.001
Small	1.0%	1.6%	
Medium	8.3%	10.6%	
Large	90.7%	87.9%	
Region of Hospital			<0.001
Northeast	19.8%	22.7%	
Midwest	29.1%	26.1%	
South	25.6%	32.0%	
West	14.5%	19.2%	
Disposition			<0.001
Home	28.2%	18.7%	
Short-term hospital	2.1%	1.6%	
Transfer to skilled nursing facility/intermediate care facility	16.5%	32.1%	
Home health services	40.2%	30.8%	
Comorbidities			
Alcohol abuse	3.0%	1.0%	<0.001
Drug abuse	3.1%	0.3%	<0.001
Rheumatological/Collagen vascular disease	1.1%	1.0%	0.29
Hypertension	40.3%	47.0%	<0.001
Diabetes mellitus	30.1%	37.0%	<0.001
Obesity	18.1%	8.5%	<0.001
Chronic pulmonary disease	16.5%	20.9%	<0.001
Chronic liver disease	4.0%	2.7%	<0.001
Coronary artery disease	31.8%	54.1%	<0.001
Valvular heart disease	0.2%	0.1%	0.04
Prior ICD placement	26.1%	26.7%	0.41
Peripheral vascular disease	6.7%	13.0%	<0.001
Chronic kidney disease/ESRD	35.0%	47.0%	<0.001
Anemia	21.8%	20.9%	0.13

(*continued*)

Table 1 (***Continued***)

Variables	Age (years)		p Value
	<65	≥65	
Coagulopathy	36.4%	39.6%	<0.001
Smoking	20.4%	17.1%	<0.001
Weight loss	24.2%	30.3%	<0.001
Comorbidity scores			
Mean Elixhauser score	22.4	24.1	<0.001

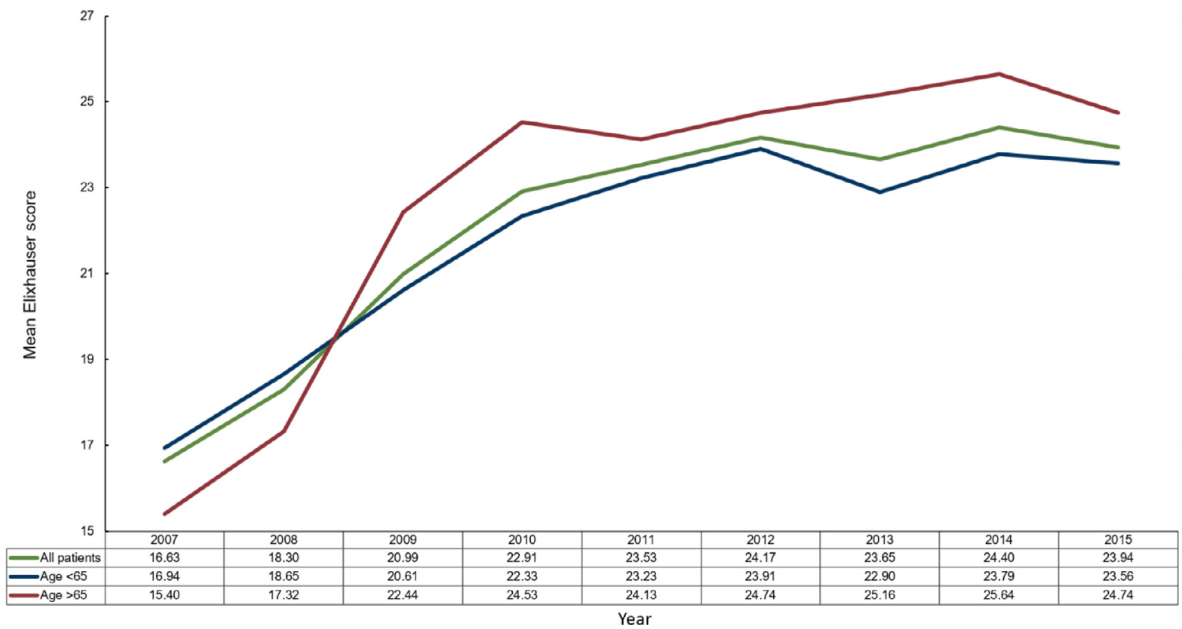

Figure 3. Trend of mean Elixhauser score for overall population and according to age cutoff.

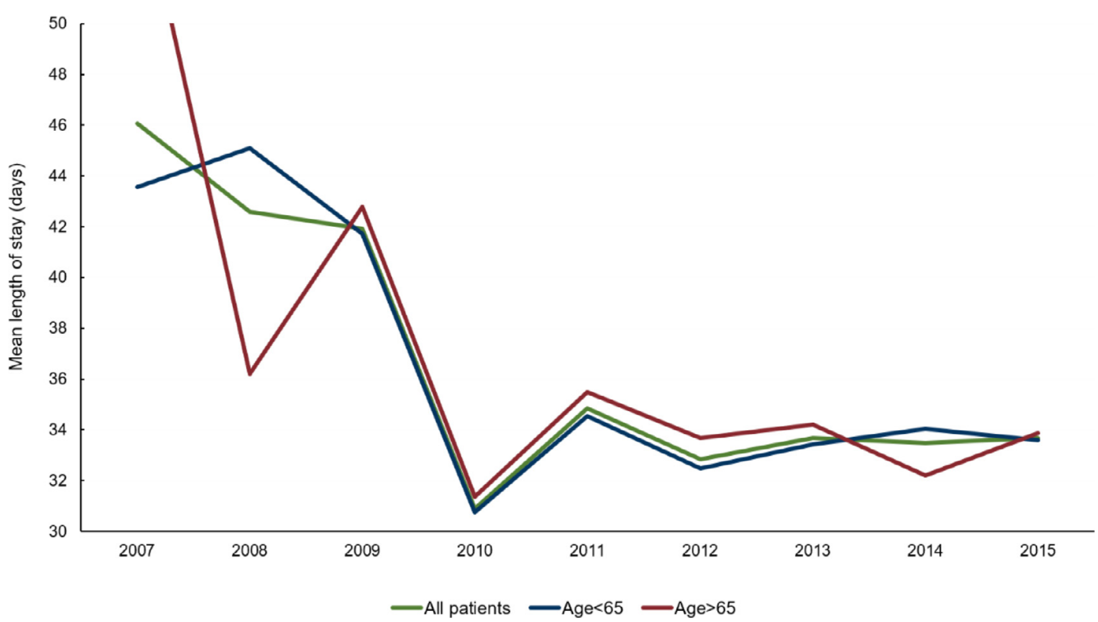

Figure 4. Trends of mean length of stay for left ventricular assist device implantation for overall population and according to age cutoff.

Table 2
Comparison of in-hospital outcomes for patients <65 years compared with ≥65 years

Variables	Age (years)		p Value
	<65	≥65	
In-hospital mortality	13.1%	16.7%	<0.001
Cardiogenic shock	54.4%	51.3%	<0.001
Acute Kidney Injury	55.7%	57.0%	0.08
Acute Kidney Injury needing hemodialysis	6.6%	6.3%	0.45
Acute Ischemic Stroke	4.5%	4.4%	0.73
Gastrointestinal bleeding	4.4%	6.7%	<0.001
Vascular	2.5%	2.3%	0.38
Infectious complication	19.1%	20.1%	0.07
Respiratory complication	5.9%	5.3%	0.04
Cardiac complication	13.8%	13.1%	0.14
Resource utilization			
Length of Stay (days)	35.0(±0.2)	34.6(±0.3)	0.33
Cost of hospitalization (US dollars)	777141 (±3911)	805461(±6306)	<0.001

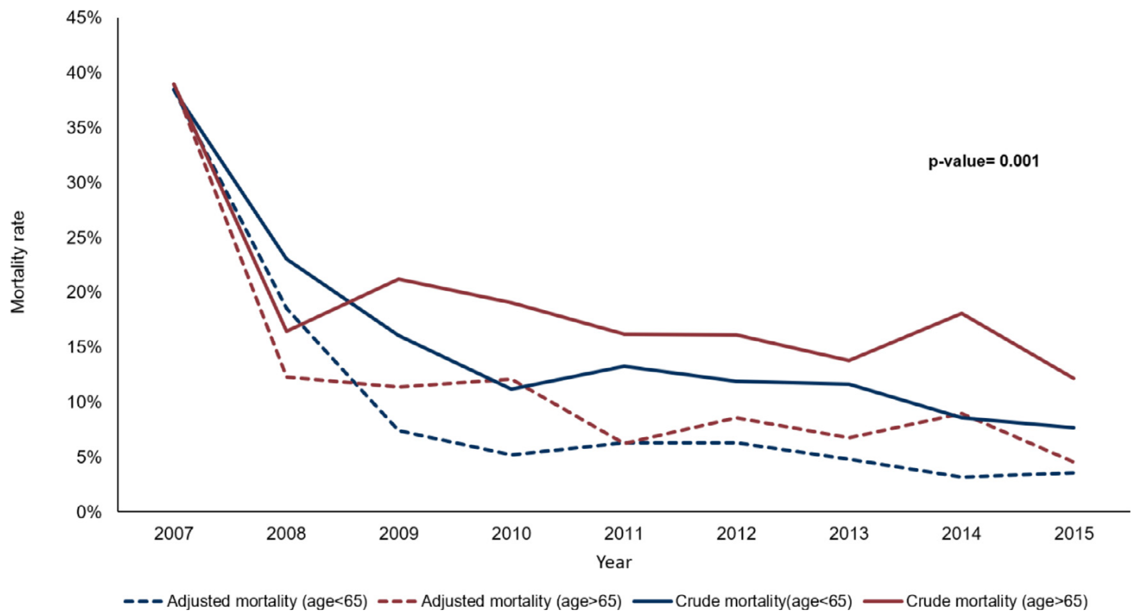

Figure 5. Trends of adjusted and crude mortality of patients according to age cutoff from the National Inpatient Sample database.

The overall readmission rate was not significantly different between AY and AO patients (28% vs 33%, p = 0.2; Figure 8) There was no significant difference in mortality during readmission between the cohorts but the LOS during readmission was significantly longer in AO group (Table 5). There was no difference in readmission rate between in very elderly age >80 years compared age 65 to 79 years (33.1 vs 23.3%; p = 0.28), but in-hospital mortality during the readmission was significantly higher in the former (2.95% vs 0%; p = 0.00002).

The single most common cause in both the groups was GI bleed but it was significantly higher in AO group compared with the nonelderly group (24.3% vs 11.3%, p = 0.01; Figure 9) Although not statistically significant decompensated heart failure was also more common in AO population compared with AY patients (12.1% vs 11.6%, p = 0.89). Other causes of readmission among were AO were LVAD-related complications (10.2%), cardiac arrhythmias (7%), and coagulopathy (6.1%). No predictors of 30-day readmissions reached statistical

Table 3
Subgroup analysis according to the age

Outcomes	Age 65-79 years (N = 6470)	Age >80years (N = 164)	p Value
Died	16.7%	27.4%	<0.001
Length of Stay	34.7 (0.3)	31.6(2.3)	0.19
Cost of Hospitalization	805285(±6300)	812490(±58001)	0.86
Mean Elixhauser score	24.1	22.8	0.057

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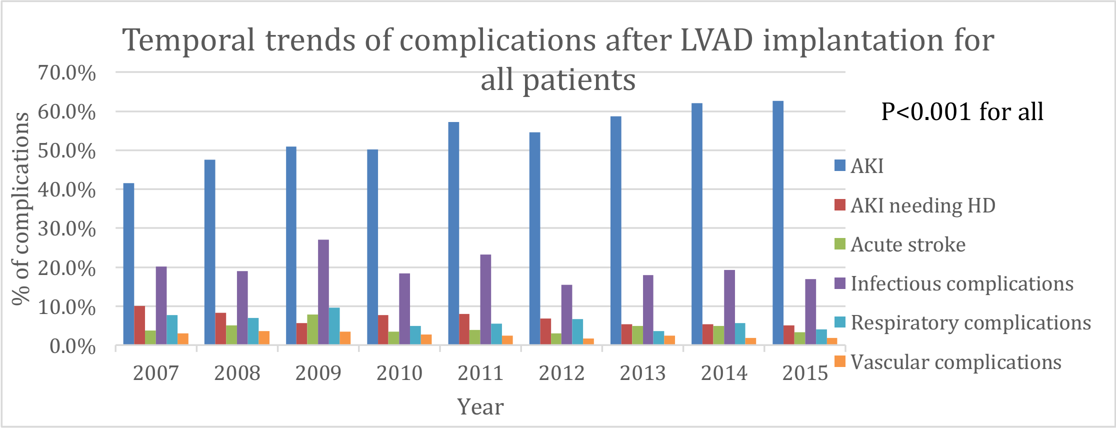

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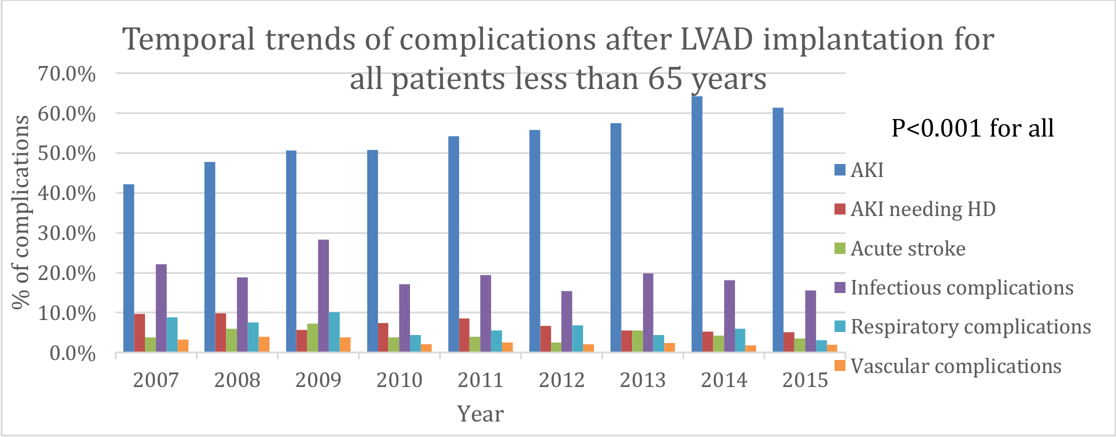

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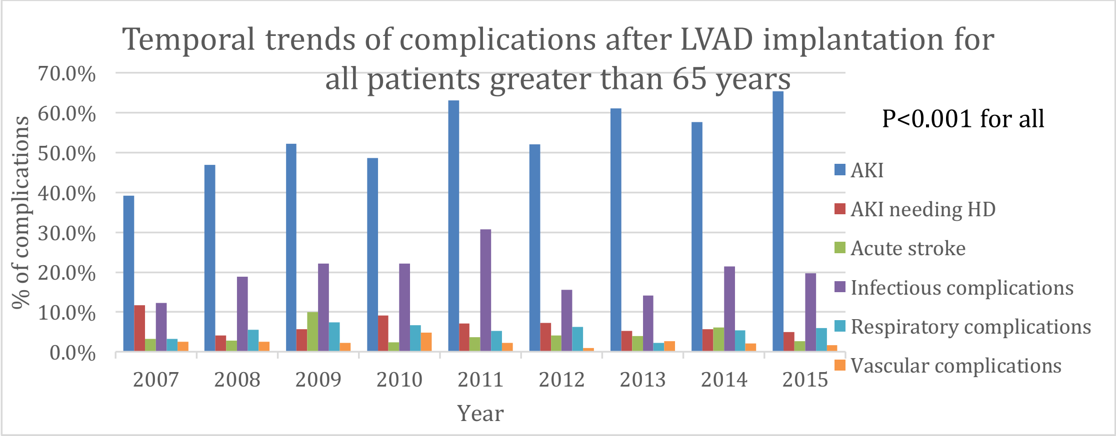


Figure 6. *(A)* Temporal trends of complications during index LVAD implantation for all patients. AKI = acute kidney injury. HD = hemodialysis. *(B)* Temporal trends of complications during index LVAD implantation for patients age <65 years. *(C)* Temporal trends of complications during index LVAD implantation for patients age ≥65 years. AKI = acute kidney injury. HD = hemodialysis.

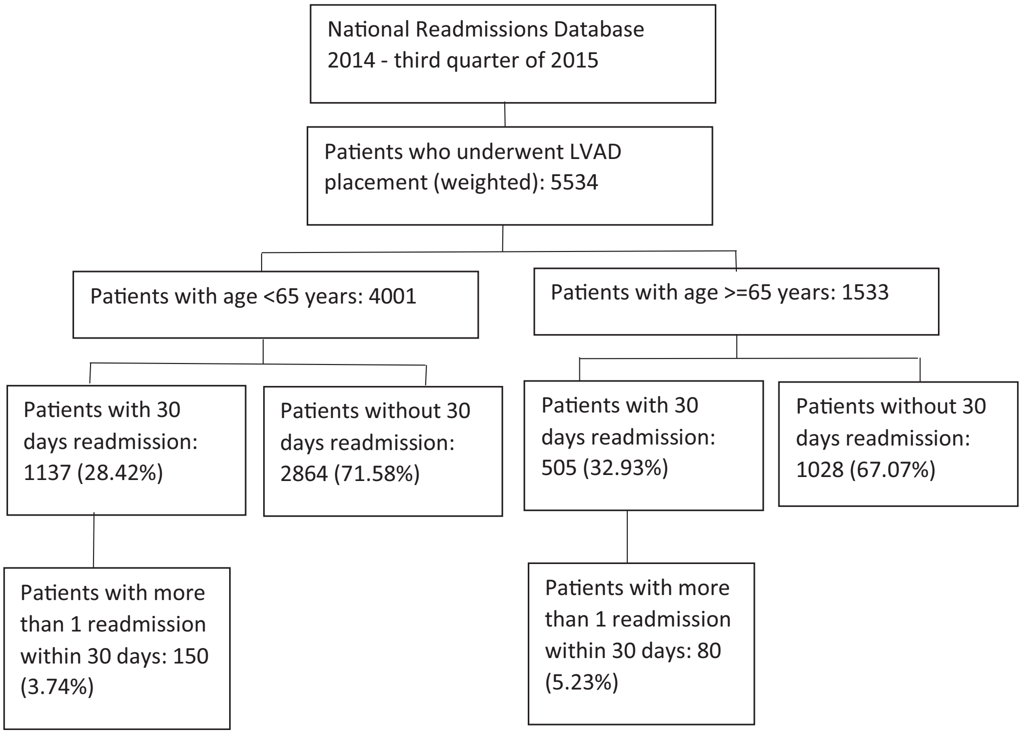


Figure7. Schematic representation of the study selection and design strategy from the National Readmission Database. LVAD = left ventricular assist device.

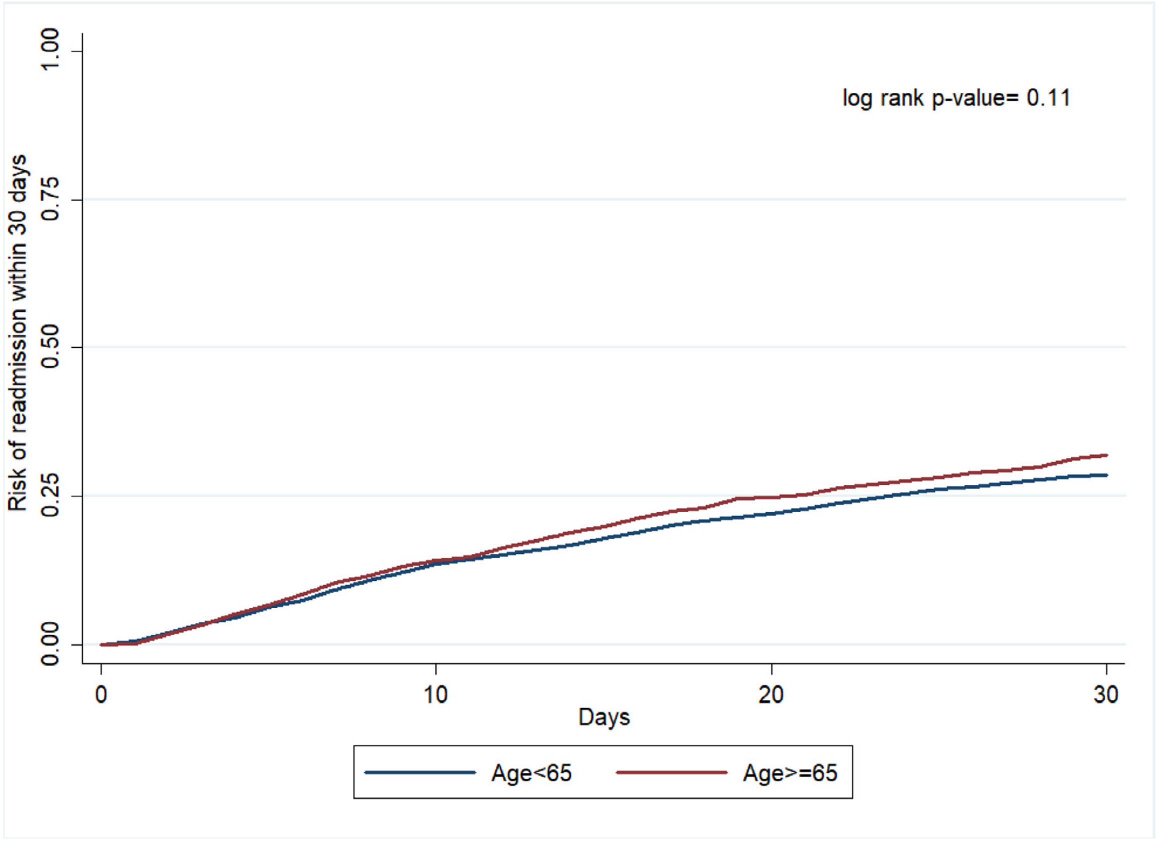


Figure 8. Risk of 30-day readmission after LVAD implantation according to the age cutoff from the National Readmission Database.

Table 4
Patient characteristics of patients <65 and ≥65 years age from National Readmissions Database (January 2014 to August 2015)

Patient characteristics	Age (years)		p value
	<65	≥65 years	
Number of hospitalizations			
Unweighted	1768 (70.89%)	726 (29.11%)	
Weighted	4001 (72.29%)	1533 (27.71%)	
Men	76.38%	82.84%	0.002
Median household income percentile			
0-25	29.55%	18.56%	<0.001
26-50	27.63%	24.88%	0.35
51-70	23.16%	28.59%	0.006
76-100	19.66%	27.97%	<0.001
Primary payer			
Medicare	31.99%	83.33%	<0.001
Medicaid	15.43%	1.18%	<0.001
Private insurance	47.92%	13.46%	<0.001
Self-pay	0.86%	0.45%	0.32
Other	3.79%	1.57%	0.003
Type of admission			
Elective	28.45%	41.39%	<0.001
Non-elective	71.55%	58.60%	<0.001
Weekend admission	14.42%	12.30%	0.46
Hospital characteristics			
Teaching status			
Teaching	99.19%	99.18%	0.15
Non-teaching	0.81%	1.82%	0.15
Bed-size			
Small	1.49%	1.63%	0.67
Medium	6.60%	8.93%	0.06
Large	91.91%	89.44%	0.06
Comorbidities			
Hypertension	57.69%	68.06%	<0.001
Dyslipidemia	37.49%	51.23%	<0.001
Diabetes mellitus	32.49%	39.09%	0.003
Obesity	21.64%	8.67%	<0.001
Chronic pulmonary disease	56.77%	64.53%	0.001
Chronic liver disease	16.54%	11.14%	0.004
Coronary artery disease	34.56%	55.19%	<0.001
Valvular heart disease	43.47%	49.92%	0.005
Prior ICD placement	35.55%	35.21%	0.88
Peripheral vascular disease	6.47%	10.82%	0.008
Chronic kidney disease/ESRD	47.83%	63.38%	<0.001
Coagulopathy	2.55%	2.02%	0.40
Smoking	24.27%	22.26%	0.33
Comorbidity scores			
Mean Elixhauser score	23.37±8.76	25.49±8.29	<0.001
Complications during index admission			
Gastrointestinal bleeding	4.84%	8.12%	0.003
Vascular	7.39%	6.49%	0.54
Infection	12.52%	9.01%	0.01
Respiratory complication	15.49%	21.06%	0016
Cardiac complication	14.09%	12.87%	0.52

significance in AO cohort and the same is true for the young cohort.

Discussion

There are multiple he key findings of our study, which need to be emphasized. During the study period, (1) there was a significant increase in LVAD implantations in older patients with increase in co-morbidity burden, (2) index-admission mortality was higher in older patients, especially among those >80 years (3) and continued to decrease during the study period despite an increase in co-morbidity burden (4) age was not a predictor of 30-day readmissions, and (e) gastrointestinal bleeding as the leading cause of readmission in both groups.

In older patients, men are more likely to undergo LVAD implantation than women during our study period. This can be partly explained by the natural history of disease as studies have shown that the lifetime risk for development of heart failure with reduced ejection fraction is higher in men

Table 5
Readmission rate and outcomes (weighted data) from National readmission database

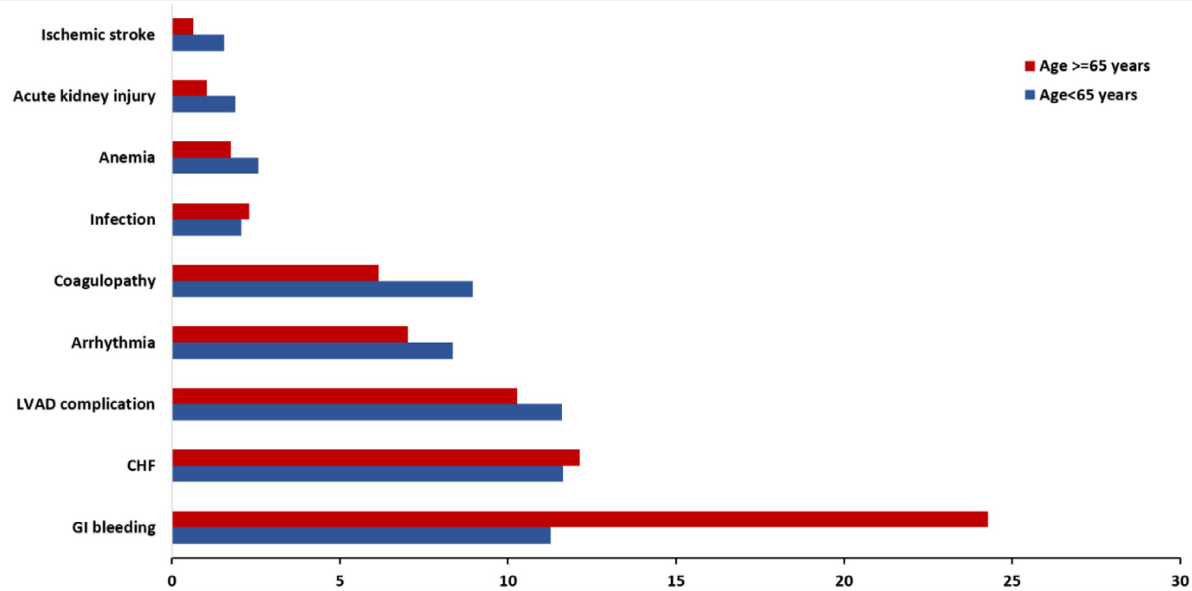
Variables	Age (years)		p Value
	<65	≥65years	
Index admission			
Total LAVD implants	4001 (72.29%)	1533 (27.71%)	
30-day readmissions	1137 (28.42%)	505 (32.93%)	0.20
More than 1 admission in 30 days	150 (3.74%)	80 (5.23%)	0.14
Readmission			
In hospital mortality	33 (2.90%)	15 (2.91%)	0.99
Length of stay (days)	9.34±11.61	11.48±14.29	0.02

compared with women.[13] Another study showed age and male gender to be independent risk factors for the development of heart failure with reduced ejection fraction .[14]

Our analysis showed a significant decrease in mortality during index hospitalization in the older cohort over the study period. Other smaller single-center studies have also shown improved short- and long-term outcomes in patient >65 years after LVAD implantations.[8,15−17] One could attribute the improved outcomes to better selection of older patients with higher baseline functional capacity as well as fewer co-morbidities and preimplant risk factors for death. However, a simultaneously increase in the mean Elixhauser scores argues to the contrary. Other possibility could be the selection of patients with better INTERMACS class for intervention early in the trajectory of disease. Our study period also coincided with the approval of 2 CF-LVAD namely, HeartMate II for BT in 2008 and DT in 2010, and Heartware HVAD for BT in 2012. We believe that improved LVAD technology, with advent of continuous flow pumps, have contributed to improved outcomes as evident by the largest decrement in mortality between 2007 and 2008. Furthermore, better selection of patients early in the disease course and more comprehensive multidisciplinary perioperative medical care have resulted in better outcomes in older patients.

It is worth noting that age was found to be an independent predictor of in-hospital mortality which is in line with other studies that had similar findings.[18,19] However, improved mortality rates over the course of years does give hope that this can be changed with advances in technology, improved surgical methods and multidisciplinary care. In our study we found female gender to be a predictor of in-hospital mortality as it has been noted to be a preimplant risk factor for death with an early hazard ratio of 1.47 ($p < 0.0001$) in analysis of the INTERMACS registry as well.[18]

Patients in older group had higher prevalence of CKD but it was not a predictor of in-hospital mortality in our study cohort which is in line with INTERMACS report[18] showing elevated creatinine as predictor of mortality in late



	GI bleeding	CHF	LVAD complication	Arrhythmia	Coagulopathy	Infection	Anemia	Acute kidney injury	Ischemic stroke
Age >=65 years	24.28	12.14	10.27	7.02	6.15	2.3	1.76	1.03	0.63
Age<65 years	11.27	11.62	11.61	8.35	8.96	2.06	2.56	1.88	1.55
p-value	0.01	0.89	0.64	0.54	0.21	0.83	0.49	0.36	0.22

Figure 9. Cause of readmission for patients according to the age cutoff from the National Readmission Database. CHF = congestive heart failure. LVAD = left ventricular assist device. GI = gastrointestinal bleeding.

phase (3 months after implant) and constant phase hazard (84 months after implant) but not during the early phase. Age >60 years and estimated glomerular filtration rate <55 mL/min per 1.73 m^2 has been shown to predict mortality at 1 year after implant.[19]

Readmission analysis from NRD was also performed as heart failure accounts for more than 1 million admissions per year in the United States.[20] Our study demonstrated no difference in rates of 30-day readmissions post-LVAD implantation according to dichotomous age groups. This is an encouraging finding especially in conjunction with increased utilization of LVADs older patients as well as improved survival during index hospitalization.

Leading cause of 30-day readmissions in older patients was gastrointestinal bleeding. LVAD patients are at risk for arteriovenous malformations, acquired von Willebrand factor deficiency, and subsequent GI bleeding which is further exacerbated in the setting of concurrent anticoagulation with Coumadin and antiplatelet agents. These risks may be further exacerbated by advanced age. This should improve in the future with the advent of newer devices like Heartmate 3, which has been effective at reducing the incidence of pump thrombosis and a small study[21] has shown that lower INR targets can be effectively used to lower incidence of GI bleed without an increase in thrombotic events. Another study[22] showed that octreotide can be used as secondary prophylaxis to prevent further episodes of GI bleed.

There are several important limitations to our analysis. This is a retrospective analysis of registry data with the limitations inherent to such analyses. Although errors in ICD-9 coding and documentation are limited in this database, nondifferential misclassification bias cannot be completely excluded. NIS database is limited to single hospitalizations and does not contain information on long-term outcomes and out-of-hospital mortality cannot be drawn from our analysis. We could not classify the patients by INTERMACS class at implant due to limitations of the database but the use of CCI gave an indication into the co-morbidities of our study cohort. Analysis of NRD is limited to a given calendar year and analysis of 30-day readmissions for discharges in December each year was not possible. NRD revisit variables does not track a patient across the states which could make the readmission rate artificially low.

Our analysis of the NIS and NRD databases confirms that the number of LVAD implants in elderly patients (age ≥ 65 years) has increased significantly between 2007 and 2015. More patients with advanced age and multiple comorbidities are receiving LVAD implantation with improved survival outcomes. A significant gender difference in LVAD utilization persists among this advanced age group favoring men across all 8 years of the study period and needs further investigation to account for these differences as mentioned earlier. Our study also found that the rates of 30-day readmissions among elderly patients are comparable to those among patients <65 years old; GI bleed was noted to be the leading cause of 30-day readmissions among the elderly.

Disclosures

The authors have no conflicts of interest to disclose.

Supplementary materials

Supplementary material associated with this article can be found in the online version at https://doi.org/10.1016/j.amjcard.2020.04.033.

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