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Nursing Home Utilization following Implantable Cardioverter-Defibrillator Implantation in Older Patients: Results from the NCDR

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Abstract

Background—This study evaluated the incidence and characteristics of nursing home (NH) use following ICD implantation.

Design—Cohort study

Setting—Medicare patients in the NCDR - ICD Registry.

Participants—192,483 patients > 65 years receiving ICDs between January 1, 2006 – March 31, 2010.h

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Measurements—Proportion of ICD recipients discharged to NHs directly after device placement; cumulative incidence of long-term NH admission, and factors associated both with immediate discharge to a NH and time to long-term NH admission.

Results—Over 4 years, 40.6% of the cohort had died and 35,939 (18.7%) patients experienced at least 1 NH admission, including 4.0% directly discharged to NH following ICD implantation and 2.8% admitted to long-term NH care during follow-up. The cumulative incidence of long-term NH admission, accounting for the competing risk of death, was 1.7% at 1 year, 3.8% at 3 years, and 4.6% at 4 years. A total of 20.1% of patients admitted to NH died in that setting. Factors most strongly associated with direct NH discharge and time to long-term NH care, respectively, included older age (adjusted odds ratio (AOR) 2.09 (95% confidence interval (CI) 2.01 – 2.17) per 10 year increment; and adjusted hazard ratio (AHR) 1.88 (95% CI 1.80–1.97, respectively); dementia (AOR 2.60, (95% CI 2.25–3.01); and AHR 2.50 (95% CI 2.14 – 2.93)); and Medicare Part A claim for NH stay in prior 6 months (AOR 3.96 95% CI 3.70 – 4.25); and AHR 2.88 (95% CI 2.65 – 3.14).

Conclusion—Nearly 1 in 5 patients are admitted to NHs over a median of 1.6 years of follow-up after ICD implantation. Understanding these outcomes may help inform the clinical care of these patients.

Introduction

Patients aged 65 are frequent recipients of implantable cardioverter-defibrillators (ICDs), accounting for more than half of the >100,000 implants performed in the United States annually.^{1,2} Converging trends in demographics and cardiovascular disease are expected to increase the number of older patients eligible for these devices dramatically over the next several decades.³ Thus, there is a growing interest in characterizing outcomes of particular relevance to this group to better inform clinical decision-making, realistic expectations, and health care utilization needs.^{3–5}

One important facet of care for older cardiac patients is the need for either short or long-term nursing home (NH) care, neither of which have been explored in ICD recipients. Prior work has shown a rise in short-term NH utilization among older heart failure patients over the past decade, with associated increased risks for rehospitalization and death.⁶ Admission to a NH for long-term care is a transition that implies more permanent cognitive and/or functional disability and loss in independence, outcomes that are of particular concern to older patients. At the same time, NHs must be prepared to manage the specific care needs of older ICD patients, including resources for device monitoring and deactivation, should that become appropriate.

To date, no study has described the need for or timing of NH care among older patients relative to ICD implantation. Thus, the goals of this study were to describe the incidence and characteristics of NH use in a large, nationally-representative sample of older patients following ICD implantation.

Methods

Data Sources

This study analyzed data from the National Cardiovascular Data Registry (NCDR[®]) ICD Registry[™], which was established in 2005 in concert with the Centers for Medicare and Medicaid Services (CMS) expansion of coverage for primary prevention ICD implantation. While the original goal was to enroll Medicare beneficiaries receiving ICDs for primary prevention of sudden cardiac death,⁷ the majority of the >1500 participating hospitals enter data for all ICD recipients regardless of insurance status or indication.^{2, 8} Participating sites are trained on data collection including the use of standardized definitions and submitted data are subject to audit for errors and completeness. A separate NCDR audit program conducts hospital chart reviews and blinded data abstractions for additional quality control. There are annual audits of 25 randomly selected sites. The most recent report of data quality for the ICD registry found an average 91.2% accuracy rate.”⁹

ICD registry data from January 1, 2006 through March 31, 2010 was combined with Medicare Part A and B Fee-for-service (FFS) ICD claims and enrollment files from January 1, 2006 – June 30, 2010. Patient linkage was done using a previously established algorithm using the following indirect identifiers, without reference to social security numbers or Medicare health insurance claim numbers: age, sex, admission date or procedure date, and hospital Medicare provider number to achieve a 63% match rate.¹⁰ Death dates were derived from CMS enrollment database. To ascertain nursing home (NH) utilization among ICD recipients, we further linked data from the ICD registry with two additional sources. First, we used Part A FFS Skilled Nursing Facility (SNF) claims linked using beneficiary ID’s obtained through the above linkage of the NCDR with CMS Medicare ICD claims.

Second, we linked these ICD registry entries to nationwide Minimum Data Set (MDS) version 2.0 assessments completed from January 1, 2004 to June 30, 2010. The MDS is a comprehensive, standardized resident assessment instrument federally mandated for use in all licensed US NHs. Full MDS assessments are completed at the time of NH admission, with major health status changes, and annually; abbreviated MDS assessments are done quarterly. The MDS has nearly 400 data elements, including demographic data, cognitive status, and functional status.¹¹

The Yale University Human Investigation Committee and Institutional Review Boards at Beth Israel Deaconess Medical Center and Hebrew SeniorLife Institute for Aging Research approved the conduct of this study.

Study Population

Patients ≥ 65 years who had ICDs inserted between from January 1, 2006 through March 31, 2010 were eligible (Figure 1). Patients who were not fee-for service Medicare patients were excluded. Patients who resided in a NH > 90 days prior to device placement were also excluded. The first entry into the ICD registry was considered the index procedure for analytic purposes for those patients with multiple entries during the study period.

Patient Characteristics

Patient characteristics at the time of device insertion were derived from ICD Registry™ Data Collection Form v1.08 unless otherwise stated. Demographic variables included age, sex, and race (white, black, or other). Clinical information included cardiac conditions, non-cardiac conditions, diagnostic studies, and procedural details. Cardiac comorbidities, as documented in the standard ICD registry form, included: congestive heart failure, functional status (New York Heart Association class I–IV), atrial fibrillation/flutter, nonischemic cardiomyopathy, any ischemic heart disease, prior ICD implantation, and cerebrovascular disease. We recorded type of device (single chamber, dual chamber, or biventricular) and whether the device was for primary or secondary prevention according to ICD registry definitions. In the ICD Registry, “primary prevention” indicates that the patient has not previously experienced sustained ventricular tachycardia, ventricular fibrillation, or resuscitated cardiac arrest. Patients with prior ICDs who have experienced these events are subsequently coded as “secondary prevention” at the time of replacement.

Non-cardiac comorbidities identified from the ICD registry form included chronic lung disease and diabetes. In addition, we hypothesized that dementia and cancer would be associated with NH utilization. As these diagnoses are not included in the ICD registry, these were obtained from ICD-9 codes on the Medicare claim associated with the index procedure. To construct the cancer and dementia variables we used a modified version of the Hierarchical Condition Categories¹² employed by the CMS 30 day mortality and readmissions measures.¹³ In addition, Medicare claims data were used to determine whether subjects had a NH stay covered by Medicare Part A in the six months prior to the index ICD procedure.

From the ICD registry form we also ascertained the most recent estimates of left ventricular ejection fraction (%) and glomerular filtration rate (GFR) (ml/min), calculated using the Modification of Diet in Renal Disease Study Group (MDRD) Study formula.¹⁴

For the subset of patients admitted to NHs, we identified the following variables from their admission MDS assessment: functional status (Activity of Daily Living scale; range 0–28, higher score indicates greater disability),¹⁵ and cognitive status (Cognitive Performance Scale; range, 0–6; 0=intact, 1=borderline intact, 2=mild impairment, 3=moderate impairment, 4=moderately severe impairment, 5=severe impairment, and 6=very severe impairment with total dependence for eating).¹⁶ Lastly, we noted the presence of do-not-resuscitate (DNR) and do-not-hospitalize (DNH) orders at the time of admission to NH.

Nursing home utilization

Admissions to NHs and associated discharged dates following ICD placement were ascertained both from Medicare claims and MDS data. Using both MDS assessment data and the Medicare Part A data, a patient history file was constructed to determine NH admissions and discharges. This file utilized all records (MDS, Medicare Part A NH and inpatient claims) together to determine and adjudicate dates of nursing home admissions and discharges. Nursing home stays were identified using both the MDS or Part A NH admission claims (in rare instances the NH stay was identified only by one source). Patients were

considered to be directly admitted to the NH immediately following their index hospitalization for ICD implantation when the hospital discharge date (as ascertained from Medicare claims) was equal to, or one day prior to, the NH admission date.

All NHs admissions were identified and classified as either a short or long-stay using a cut-off of 90 days.¹⁷ We recognized that patients commonly are transferred from NHs to hospitals and back to the NH again. For these transitions, we allowed for hospital admissions from NHs to account for a cumulative “gap” of 10 days before considering a separate NH admission to have occurred.

Statistical Analysis

All demographic data, clinical information, and procedural variables were described using frequencies for categorical variables. Means (standard deviations (SDs)) and medians (1st and 3rd quartile) were used for continuous variables.

The first analyses focused on calculating the proportion of patients admitted to the NH directly from the hospital post-ICD insertion. We then identified factors associated with this outcome using logistic regression. First, independent variables potentially associated with NH admission were selected from the dataset *a priori* based on the literature¹⁸ and clinical judgment. Candidate independent variables included: age (per 10 years), female sex, race (white vs nonwhite), congestive heart failure, New York Heart Association Class (using Class I as reference), history of atrial fibrillation/flutter, ischemic heart disease, cerebrovascular disease, replacement ICD, cardiac resynchronization (CRT) vs non-CRT device, chronic lung disease, diabetes, dementia, history of cancer, Medicare Part A claim for NH admission in prior 6 months, left ventricular ejection fraction category (<20% and 20–39% vs 40 as reference), glomerular filtration rate (per 10 unit increment). Unadjusted analyses examined the association between each individual independent variable and the outcome. All variables with an unadjusted association with NH admission having $p < 0.2$ were entered into a multivariable model. Using a purposeful selection method,^{19, 20} we sequentially dropped non-significant variables from the model checking their impact on the model to ensure no confounding of estimates existed. After all non-significant variables were dropped from the model, each variable was re-entered back into the model to again ensure its non-significance and lack of confounding on other estimates. Odds ratios (ORs) and 95% confidence intervals (CIs) were generated from these analyses using imputed data sets (described below).

The next analysis examined time from ICD implant to long-term NH admission and identified factors associated with this outcome using proportional sub-distribution hazards regression. The outcome was defined as the number of days between ICD implant to first NH admission for which the length of stay was > 90 days. Subjects who were never admitted to long-term NH care or were disenrolled from Medicare fee-for-service were censored at the end of follow-up or time of disenrollment. Cumulative incidence for the time to long-term NH admission was calculated accounting for the competing risk of death using a proportional sub-distribution hazards model.²¹ Independent variables were selected using the same criteria as described for the prior analysis. Unadjusted analyses examined the association between each individual independent variable and time to long-term NH

admission. Univariate associations at $P < 0.2$ were entered into the initial multivariable model. The same purposeful selection method described above was employed to select the final model. Adjusted hazard ratios (AHRs) and 95% CIs were calculated from the final model using imputed data.

Prior to modeling either outcome, missing data for each independent variable was iteratively imputed using the Fully Conditional Specification method of multiple imputation to create 10 imputed datasets.²² Point estimates (odds ratios and hazard ratios, respectively) and 95% CIs were generated from these analyses using the average of the estimates across 10 imputed datasets. Statistical inference was made based on the averaged aggregate estimates and standard errors using standard pooling rules for multiply imputed data.²³

All analyses were performed using SAS v9.4 (SAS Institute, Cary, NC).

Results

Baseline Characteristics

Among the 516,147 patients entered into the ICD Registry during the study period, 312,801 were eligible for probabilistic matching after exclusions for age < 65 , discharge date outside of the study period, duplicates, or missing hospital information (Figure 1). Probabilistic matching to Medicare data identified 195,593 patients, from which an additional 3,110 (1.6%) patients were excluded due a long-term NH admission prior to ICD implantation. This yielded a final cohort of 192,483 ICD recipients. Comparisons between matched and non-matched patients according to demographic and clinical characteristics showed no significant differences. The median follow-up for final analytic cohort was 1.6 years (25% – 75% interquartile range, 288 days – 2.6 years). During the 4.5 year follow-up period, 43,424 (22.6%) deaths were observed. At one and four years after device placement, 10.3% and 40.6% of the cohort had died, respectively.

In the analytic cohort, the mean age was 75.4 ± 6.4 years, 25.5% were female, and 89.6% were white (Table 1). Prevalent cardiovascular conditions included congestive heart failure (80.0%), particularly NYHA Class II (34.5%) and III (50%). A total of 46.7% received CRT devices, and 29.5% had received a prior ICD of any type. Among non-cardiac conditions, 1.0% had a prior diagnosis of dementia while only 1.2% carried a diagnosis of cancer. At total of 3.8% of patients had had an admission to a NH in the 6 months prior to the index procedure.

Overall NH utilization

Overall, 35,939 (18.7%) patients experienced at least 1 NH admission following ICD implantation. The median length of stay for all NH admissions was 23 days (12 – 47 days, 1st and 3rd quartile). Among patients admitted to NH, 66.7% (23,971/35,939) experienced one NH admission, 21.1% (7583/35,939) had 2 NH admissions, and 12.2% (4385/35,939) 3 NH admissions during the follow-up period. This yielded a total of 55,017 separate NH admissions observed in the study period, of which 50,616 (92%) originated as an inpatient hospital stay. Of these NH admissions, 5403/50,616 (10.7%) ultimately became long-term NH stays.

A total of 20.1% of patients (7218/35,939) admitted to NH ultimately died in that setting. In addition, 34.5% (2,396/35,939) of the patients admitted to NH had at least 1 hospital admission during an NH admission. Among patients with at least 1 NH admission, the median number of NH days per year was 25 days (25th–75th: 9 – 71 days).

Direct NH admission post-ICD insertion

A total of 7,768 (4.0%) of patients were admitted directly to a NH upon discharge from hospital post ICD-insertion. The median length of stay for these admissions was 21 days (25% – 75% IQR, 12 – 37 days). After multivariable adjustment, the following baseline factors were most strongly associated with an increased likelihood of discharge directly to NH (Table 2): Medicare part A claim for NH admission in prior 6 months (adjusted OR (AOR) 3.96, 95% CI 3.70 – 4.25), class IV heart failure (AOR 3.09 versus Class I referent, 95% CI 2.75 – 3.48), dementia (AOR 2.60, 95% CI 2.25 – 3.01), and increasing age (AOR 2.09 per 10 year increment, 95% CI 2.01 – 2.17).

Long-term NH Utilization

A total of 5,379 (2.8%) patients were admitted to a NH for long-term care following ICD implantation, with a median time of 296 days (25th–75th: 84 days – 1.7 years) after the procedure. Most of these admissions (4,512/5379, 83.9%) began as a Part A hospital admission. The cumulative incidence of long-term NH admission, accounting for the competing risk of death, was 1.7% at 1 year, 3.8% at 3 years, and 4.6% at 4 years (Figure 2). Unadjusted and adjusted associations between baseline characteristics and time to first long-term NH admission are shown in Table 3. After adjustment, the following baseline factors were most strongly associated with a shorter time to long-term NH admission: Medicare Part A claim for a NH admission in the 6 months prior to device placement (AHR 2.88, 95% confidence interval (CI) 2.65–3.14), dementia (AHR 2.50, 95% CI 2.14 – 2.93), age (AHR 1.88 per 10 year increment, 95% CI 1.80 – 1.97), female sex (AHR 1.52, 95% CI 1.43–1.62), and diabetes (AHR 1.42, 95% CI 1.35–1.50).

Characteristics at time of NH admission

Based on MDS assessments upon NH admission, patients directly admitted to NHs post-procedure had mean ADL score of 15.3 ± 5.5 , and the following CPS scores: 0 (intact), 53.7%; 1 (borderline intact), 14.5%; 2 (mild impairment), 14.0%; and > 3 or higher (at least moderate impairment), 11.6%. Upon admission for a long-stay, patients had a mean ADL score of 16.9 ± 5.9 and the following CPS scores: 0 (intact), 29.2%; 1 (borderline intact), 15.8%; 2 (mild impairment), 19.9%; and > 3 or higher (at least moderate impairment), 30.5%. For those directly admitted to NH from their ICD implant, the baseline MDS assessment noted DNR orders in 16.1% and DNH orders in 0.7% of patients. Upon first long-term NH stay, 34.5% were noted to be DNR and 1.4% DNH.

Discussion

This nationwide study describes short-term and long-term NH utilization among older patients following ICD placement. Overall, close to one in five (18.7%) of patients experienced at least one NH admission at a median follow-up of 1.6 years, including direct

admission to NH from the index procedure for 4.0% of patients. Additionally, after accounting for the competing risk of death, 4.6% of patients were admitted to long-term NH care over the observation period. Admitting NHs should be prepared to manage the specific needs of these patients, including device monitoring and having protocols for deactivations. We also identified patients' baseline characteristics present at the time of device placement associated with a greater risk of both short and long-term NH admission, most notably, older age, a diagnosis of dementia, and recent prior NH stay. These findings may help providers identify older patients who may have greater care needs post implantation, and help patients and families plan for that care.

Recent years have seen NHs provide care to a growing number of older adults with increasingly complex health care needs. NHs care for nearly 3 million individuals annually, including 1.5 million frail elderly requiring long-term care, and a growing proportion of seriously ill patients admitted for post-acute care.^{24, 25} Among cardiac patients, Bueno et al found an increase in heart failure discharges among Medicare beneficiaries to NH from 13% to nearly 20% in the decade up to 2006.⁶ Allen et al. found similar rates of discharge to NH (24.1%) following heart failure hospitalization among older adults, with a NH admission independently associated with short-term mortality and rehospitalization.²⁶ These data support our findings that nearly 1 in 5 older patients with an ICD will experience at least 1 NH admission in the years immediately following device implantation, with worse heart failure associated with a greater likelihood of this outcome. Thus, NHs should be prepared for the needs of ICD patients. This readiness may include protocols to respond to clinical events such as shocks as well as familiarity with remote monitoring systems to avoid unnecessary office visits or hospitalizations

At the same time, NHs have evolved into common sites of end-of-life care, with 45% of US Medicare beneficiaries who died in 2009 experiencing a NH stay in the last 90 days of life, with 28% dying in that setting.²⁷ Similarly, in our cohort, 20% of patients admitted to NH ultimately died there. This finding, coupled with the known high incidences of mortality and hospice utilization among older patients with ICDs,²⁸ support the need for NHs to be prepared to manage ICDs at the end-of-life. Specifically, NHs should have policies and procedures in place to ensure timely deactivation of ICDs when patients or their proxies request it.

Our multivariable analysis identified patient-level factors common to both direct NH admission and time to long-term NH admission following ICD implantation. In particular, while dementia and prior Medicare Part A claim for a recent NH admission were relatively rare in the cohort prior to ICD implantation (1.0% and 3.8%, respectively), these were strongly associated with future NH needs. These factors may assist in identifying ICD patients for whom more proactive care coordination may be fruitful. For example, providing patients and families with realistic expectations for post-procedure recovery, including possible NH admission, may improve their understanding of the experience of receiving an ICD. Including NH admissions as a possible outcome following ICD implantation may also motivate completion of advance directives. In addition, while we found functional status to be broadly similar upon direct admission to NH versus admission to long-term NH care, cognitive function was starkly worse for the latter, with 30% versus 11% of patients

considered to have at least moderate impairment. Cognitive decline may therefore also serve as an especially important marker of subsequent loss of independence and need for institutionalization among ICD recipients, and further reinforce careful goal-directed decision-making regarding device implantation and replacement. Similarly, the relatively high proportions of patients admitted either directly to NH or at any time to long-term care with DNR orders (16.1% and 34.5%, respectively) provide snapshots of the ways in which goals of care may evolve in the course of living with an ICD, and emphasize the importance of making patients and clinicians aware of ICD deactivation options and eventual palliative care needs.

Our study design includes several potential limitations. Only ICD recipients in the ICD Registry who were matched to fee-for-service Medicare claims were eligible for our analyses, and thus our findings may not extend simply to patients who are younger or those in managed care plans. Though our probabilistic match strategy showed similar patient characteristics between matched and unmatched subjects, it is possible that residual differences remain between these groups. Our data sources could not supply some covariates such as appropriate ICD therapies or device programming, and we were not able to identify exact reasons for NH admissions or causes of death. In addition, nursing home utilization trends may have changed since the follow-up period, although the persistent high prevalence of older patients with multiple comorbidities among ICD recipients suggests that, if anything, NH use may have actually increased since this time.

In summary, a substantial portion of ICD recipients subsequently experience NH admission, including both direct discharges to NH from their original procedure and long-term NH admission in the years that follow. NHs should therefore be prepared to care for patients with ICDs, including possible end-of-life needs such as ICD deactivation. In addition, our study demonstrates the importance of understanding patients' clinical trajectories and goals of care following ICD implantation, particularly the evolution of cognitive impairment, in order to ensure thoughtful clinical management across multiple sites of care.

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Conflict of Interest

The following disclosures are noted:

Elements of Financial/Personal Conflicts	Daniel Kramer		Matthew Reynolds		Sharon-Lise Normand		Craig Parzynski	
	Yes	No	Yes	No	Yes	No	Yes	No
Employment or Affiliation		x		x		x		x
Grants/Funds	x			x	X			x
	NIH				FDA			
Honoraria		x		x		x		x
Speaker Forum		x		x		x		x
Consultant		x	x			x		x
			Medtronic					
Stocks		x		x		x		x
Royalties		x		x		x		x
Expert Testimony		x		x		x		x
Board Member		x		x		x		x
Patents		x		x		x		x
Personal Relationship		x		x		x		x

Elements of Financial/Personal Conflicts	John Spertus		Vince Mor		Susan Mitchell	
	Yes	No	Yes	No	Yes	No
Employment or Affiliation		x		x		x
Grants/Funds	x			x	X	
	ACC				NIH	
Honoraria				x		x
Speaker Forum	x	x		x		x
Consultant	x	x		x		x
Stocks	x	x		x		x
Royalties	x	x		x		x
Expert Testimony	x	x		x		x
Board Member	x	x		x		x
Patents	x	x		x		x
Personal Relationship	x	x		x		x

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Figure 1.
Derivation of Study Cohort

Figure 2.
Cumulative incidence (solid line) with 95% confidence intervals (dashed lines) of long-term nursing home admission following implantable cardioverter-defibrillator implantation.

Table 1

Baseline characteristics of study cohort at time of implantable cardioverter-defibrillator implantation overall and according to disposition to home versus nursing home after the index procedure.

<i>Demographics</i>	Total Population 192,483 No. (%)	Discharged Home 184,715 No. (%)	Discharged to Nursing Home 7,768 No. (%)
Age at implant (years, mean $\pm$ SD)	75.4 $\pm$ 6.4	75.3 $\pm$ 6.3	78.1 $\pm$ 6.3
Female sex	49,156 (25.5)	46,294 (25.1)	2,862 (36.8)
Race			
White	172,236 (89.6)	165,424 (89.7)	6,812 (87.9)
Nonwhite	20,026 (10.4)	19,089 (10.3)	937 (12.1)
<i>Cardiovascular Comorbidities</i>			
Congestive Heart Failure	153,929 (80.0)	147,440 (79.8)	6,489 (83.5)
New York Heart Association Class			
Class I	22,045 (11.5)	21,389 (11.6)	656 (8.5)
Class II	66,239 (34.5)	64,338 (34.9)	1,901 (24.5)
Class III	96,055 (50.0)	91,721 (49.7)	4,334 (55.9)
Class IV	7,885 (4.1)	7,019 (3.8)	866 (11.2)
History of atrial fibrillation/flutter	81,248 (42.2)	77,127 (41.8)	4,121 (53.1)
Ischemic heart disease	141,314 (73.4)	135,547 (73.4)	5,767 (74.3)
Cerebrovascular disease	33,808 (17.6)	31,892 (17.3)	1,916 (24.7)
Previous implantable cardioverter-defibrillator	56,849 (29.5)	56,144 (30.4)	705 (9.1)
Cardiac resynchronization therapy device	89,677 (46.7)	86,256 (46.8)	3,421 (44.1)
<i>Noncardiac Comorbidities</i>			
Chronic Lung Disease	46,225 (24.0)	43,732 (23.7)	2,493 (32.1)
Diabetes	71,688 (37.3)	68,047 (36.8)	3,641 (46.9)
Dementia	1,921 (1.0)	1,675 (0.9)	246 (3.2)
Cancer	3,277 (1.7)	3,040 (1.65)	237 (3.1)
Skilled Nursing Facility claim in prior 6 months	7,305 (3.8)	6,059 (3.3)	1,246 (16.0)
<i>Diagnostic Studies</i>			
Left Ventricular Ejection Fraction			

<i>Demographics</i>	Total Population 192,483 No. (%)	Discharged Home 184,715 No. (%)	Discharged to Nursing Home 7,768 No. (%)
<20	21,769 (12.0)	20,577 (11.8)	1,192 (15.9)
20–<40	136,679 (75.4)	131,334 (75.6)	5,345 (71.2)
40	22,862 (12.6)	21,888 (12.6)	974 (13)
Missing	11,173 (5.8)	10,916 (5.9)	257 (3.3)
Glomerular filtration rate (mean ± SD)	55.8 ± 21.5	56 ± 21.2	52.1 ± 25.7

Table 2

Unadjusted and adjusted associations between baseline characteristics and direct admission to nursing home following ICD implantation. P values for associations are two-sided.

Variable	Unadjusted Odds Ratio (95% confidence interval)	P value	Adjusted Odds Ratio (95% confidence interval)	P value
Age at implant (years, mean $\pm$ SD)	1.96 (1.89 – 2.03)	<.0001	2.09 (2.01 – 2.17)	<.0001
Female sex	1.74 (1.66 – 1.83)	<.0001	1.64 (1.56 – 1.72)	<.0001
Race (White vs Nonwhite reference)	0.84 (0.78 – 0.90)	<.0001	0.87 (0.81 – 0.93)	<.001
<i>Cardiovascular Comorbidities</i>				
Congestive Heart Failure	1.28 (1.21 – 1.36)	<.0001	NS	-
New York Heart Association Class				
Class I (reference)	1.0		1.0	
Class II	0.97 (0.88 – 1.06)	0.44	0.90 (0.82 – 0.99)	0.03
Class III	1.54(1.42–1.68)	<.0001	1.37(1.25–1.50)	<.0001
Class IV	4.03(3.63–4.47)	<.0001	3.09(2.75–3.48)	<.0001
History of atrial fibrillation/flutter	1.58(1.51–1.65)	<.0001	1.49(1.42–1.56)	<.0001
Ischemic heart disease	1.05(0.99–1.10)	0.08	1.09(1.03–1.16)	<.01
Cerebrovascular disease	1.57(1.49–1.65)	<.0001	1.33(1.26–1.41)	<.0001
Previous implantable cardioverter-defibrillator	0.23(0.21–0.25)	<.0001	0.22(0.21–0.24)	<.0001
Cardiac resynchronization therapy device	0.90(0.86–0.94)	<.0001	0.71(0.67–0.75)	<.0001
<i>Noncardiac Comorbidities</i>				
Chronic Lung Disease	1.52(1.45–1.60)	<.0001	1.40(1.33–1.48)	<.0001
Diabetes	1.51(1.45–1.58)	<.0001	1.54(1.47–1.61)	<.0001
Dementia	3.57(3.12–4.09)	<.0001	2.60(2.25–3.01)	<.0001
History of Cancer	1.88(1.64–2.15)	<.0001	1.70(1.48–1.96)	<.0001
Skilled Nursing Facility claim in prior 6 months	5.63(5.27–6.02)	<.0001	3.96(3.7–4.25)	<.0001
<i>Diagnostic Studies</i>				
Left Ventricular Ejection Fraction				

Variable	Unadjusted Odds Ratio (95% confidence interval)	P value	Adjusted Odds Ratio (95% confidence interval)	P value
<20	1.38(1.26–1.50)	<.0001	1.02(0.93–1.12)	0.67
20–<40	0.96(0.90–1.03)	0.24	0.71(0.66–0.77)	<.0001
40 (reference)	1.0		1.0	
Glomerular filtration rate (mean $\pm$ SD)	0.92(0.90–0.93)	<.0001	0.98(0.97–0.99)	<.001

Table 3

Unadjusted and adjusted associations between baseline characteristics and time to long-term NH enrollment following ICD implantation. All p values are two-sided.

Variable	Unadjusted Hazard Ratio (95% confidence interval)	P value	Adjusted Hazard Ratio (95% confidence interval)*	P value
Age at implant (per 10 year increment))	1.88 (1.80–1.96)	<.0001	1.88 (1.80–1.97)	<.0001
Female sex	1.60 (1.51–1.69)	<.0001	1.52 (1.43–1.62)	<.0001
Race (White vs Nonwhite reference)	0.69 (0.64–0.74)	<.0001	0.68 (0.63–0.73)	<.0001
<i>Cardiovascular Comorbidities</i>				
Congestive Heart Failure	1.26 (1.17–1.35)	<.0001	1.10 (1.01–1.20)	0.02
New York Heart Association Class				
Class I (reference)	1.0		1.0	
Class II	1.05 (0.95–1.15)	0.38	0.94 (0.85–1.05)	0.26
Class III	1.30 (1.18–1.42)	<.0001	1.14 (1.02–1.27)	0.02
Class IV	1.74 (1.51–2.00)	<.0001	1.38 (1.18–1.61)	<.0001
History of atrial fibrillation/flutter	1.27 (1.21–1.34)	<.0001	1.18 (1.12–1.25)	<.0001
Ischemic heart disease	1.09 (1.02–1.16)	<.001	1.09 (1.02–1.16)	<.001
Cerebrovascular disease	1.56 (1.47–1.66)	<.0001	1.37 (1.29–1.46)	<.0001
Previous implantable cardioverter-defibrillator	0.78 (0.73–0.83)	<.0001	0.81 (0.76–0.87)	<.0001
Cardiac resynchronization therapy device	0.92 (0.87–0.97)	<.001	0.77 (0.72–0.82)	<.0001
<i>Noncardiac Comorbidities</i>				
Chronic Lung Disease	1.20 (1.13–1.28)	<.0001	1.16 (1.10 – 1.24)	<.0001
Diabetes	1.40 (1.32–1.48)	<.0001	1.42 (1.35–1.50)	<.0001
Dementia	3.60 (3.09 – 4.18)	<.0001	2.50 (2.14 – 2.93)	<.0001
History of Cancer	0.87 (0.70–1.09)	.96	N/A	-
Skilled Nursing Facility claim in prior 6 months	3.91 (3.61–4.24)	<.0001	2.88 (2.65–3.14)	<.0001
<i>Diagnostic Studies</i>				
Left Ventricular Ejection Fraction				

Variable	Unadjusted Hazard Ratio (95% confidence interval)	P value	Adjusted Hazard Ratio (95% confidence interval)*	P value
<20	1.0	0.07	N/A	-
20–<40	0.92 (0.85–1.00)	0.68		
40	0.91 (0.81–1.01)			
Glomerular filtration rate (per 10 unit increase)	0.92 (0.91–0.94)	<.0001	0.98 (0.97–1.00)	0.02

* Factors with unadjusted hazard ratios with $P < 0.2$ were entered into the adjusted model. History of cancer and left ventricular ejection fraction were the only variables not included in the adjusted model based on this criterion.