Emergency Room and Inpatient Use After Cardiac Pacemaker Implantation

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Although studies have demonstrated health benefits, there is limited evidence on utilization and cost changes associated with cardiac pacemaker implantation from national community samples. The aim of this study was to quantify changes in emergency room (ER) and hospital inpatient use and in Medicare payments per beneficiary/year after pacemaker implantation. Outcomes for pacemaker recipients after and before implantation and between pacemaker recipients and controls were compared using propensity score matching. Data came from Health and Retirement Study interviews merged with Medicare claims. Sample subjects were aged ≥68 years with diagnosed conduction disorders or cardiac dysrhythmias in the previous 3 years. Outcome measures were (1) ER visits, inpatient admissions and days, and Medicare payments for ER and inpatient care in the after period for the pacemaker versus control groups, defined per beneficiary/year, (2) difference in differences in the same 5 outcome variables, and (3) binary variables for whether or not utilization or payments were lower in the after versus before periods for the pacemaker versus control groups. In conclusion, most pacemaker recipients improved, as measured by reductions in use and payments in the after versus before period, and there were reductions in ER visits and hospital admissions for conditions commonly leading to pacemaker implantation. © 2013 Elsevier Inc. All rights reserved. (Am J Cardiol 2013;111:563−568)

Cardiac pacemakers have existed for decades, but their use is increasing[1] and will increase further because of population aging and other factors. Most pacemaker recipients are ≥65 years of age.[1,2] Although studies have demonstrated health benefits,[3] there is very limited empirical evidence on utilization and cost changes associated with pacemaker receipt. There are studies of pacemaker outcomes using data from randomized controlled trials, but longitudinal evidence from national community samples is lacking. In this study, we used a national sample of elderly patients merged with Medicare claims to assess changes in emergency room (ER) and hospital inpatient use and in payments per beneficiary/year for such services after pacemaker receipt.

Methods

Data came from the Health and Retirement Study (HRS), a longitudinal survey of subjects aged 51 to 61 years in 1992 and their spouses or partners of any age, with older and younger cohorts added subsequently.[4] The HRS has been conducted in even-numbered years since 1992. The HRS elicits information on personal health, physical and cognitive function, income, and other topics. Merged with HRS data, Medicare claims provided information on diagnoses, utilization, and Medicare payments for services beneficiaries received. We used HRS interview data to match pacemaker recipients with controls. Our sample consisted of patients diagnosed with conduction disorders (International Classification of Diseases, Ninth Revision, Clinical Modification [ICD-9-CM] code 426) and cardiac dysrhythmias (ICD-9-CM code 427), recorded as primary or secondary diagnoses during a 3-year look-back period. Given the look-back period length, all sample subjects were ≥68 years of age.

Pacemaker implantation procedures were for the implantation of cardiac resynchronization pacemaker devices without mention of defibrillation, total system (Current Procedural Terminology, 4th Edition, code 0050), or implantation of pacemaker systems (single, dual, biventricular with leads) in patients without preexisting pacemakers or leads (Healthcare Common Procedure Coding System codes 33206, 33207, and 33208). The observational period was from 1996 to 2004, during which 434 sample patients received pacemakers. The HRS provided data on health and functional status, demographic characteristics, and earnings and income. HRS data were obtained periodically, while claims were reported daily. Thus, we split dates of service on Medicare claims into discrete time periods to match claims with HRS interview years. For the pacemaker sample, a period consisted of claims with pacemaker implantation dates 6 months before to 6 months after the HRS interview year. For example, we matched pacemaker implantations occurring from July 1, 1997, to June 30, 1999, with 1998 HRS data and implantations from July 1, 1999, to June 30, 2001, with 2000 HRS data.

We observed utilization and Medicare payments, the study outcomes, before and after pacemaker implantation, for

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Table 1
Mean values and standardized differences before and after matching

Variable	Before Matching			After Matching		
	Pacemaker	Control	Standardized Difference	Pacemaker	Control	Standardized Difference
Black	0.10	0.12	−3.95	0.11	0.13	−6.50
Hispanic	0.07	0.05	7.25	0.06	0.07	−3.15
Female	0.45	0.56	−20.9	0.47	0.40	14.3
Married	0.54	0.51	4.55	0.53	0.57	−7.91
Age 75−84 yrs	0.50	0.42	16.5	0.50	0.49	0.52
Age ≥85 yrs	0.22	0.20	6.37	0.22	0.23	−2.52
Education 12 yrs	0.27	0.32	−11.5	0.28	0.27	1.77
Education 13−15 yrs	0.15	0.16	−3.55	0.16	0.15	1.45
Education ≥16 yrs	0.17	0.15	3.49	0.17	0.18	−4.16
Fair/poor health	0.46	0.44	3.38	0.45	0.49	−7.36
Body mass index	0.19	0.17	4.14	0.18	0.22	−9.24
Number of limitations of activities of daily living (0−5)	0.26	0.32	−12.7	0.27	0.26	2.38
Number of limitations of instrumental activities of daily (0−2)	0.20	0.24	−10.6	0.21	0.18	5.95
Number of mobility limitations (0−9)	0.84	0.85	−4.01	0.83	0.84	−4.23
Heart failure	0.28	0.18	24.3	0.25	0.30	−10.6
Coronary artery disease	0.03	0.06	−11.4	0.04	0.04	−1.37
Diabetes mellitus	0.15	0.13	8.35	0.15	0.14	2.25
Bradycardia	0.41	0.02	108.1	0.35	0.32	7.21
Earned $5,000 to <$50,000	0.06	0.05	2.37	0.05	0.08	−10.6
Earned ≥$50,000	0.01	0.01	−5.16	0.00	0.00	0.00
Income $5,000 to <$50,000	0.82	0.81	1.56	0.81	0.79	4.56
Income $50,000 to <$100,000	0.12	0.12	−1.16	0.12	0.15	−6.90
Income ≥$100,000	0.05	0.05	3.53	0.05	0.05	1.19
ER visits/beneficiary/year	1.80	0.80	50.9	1.70	1.87	−5.59
ER payments/beneficiary/year (×1,000)	9.98	2.22	69.4	9.19	9.36	−0.89
Number of inpatient admissions	1.43	0.49	76.6	1.35	1.35	−0.30
Number of inpatient days	10.3	3.39	60.3	9.74	9.37	2.17
Inpatient payments/1,000	18.0	4.44	74.9	17.2	18.0	−2.70
Year	6.68	5.83	29.6	6.57	6.89	−11.1
n	434	13,602		381	381	

Results listed are from analysis of the number of inpatient admissions except for the number of ER visits, ER payments, inpatient days, and inpatient payments. Entries for visits, payments, and hospital use are defined per beneficiary/year and are for the year before implantation (pacemaker recipients) or the reference date (controls).

beneficiaries receiving pacemakers. Having a control group allowed us to account for changes independent of pacemaker implantation, such as regression toward the mean in utilization or payments. If subjects experience unusually high or low utilization in a year, there may be convergence toward the mean value for the group subsequently. Control groups consisted of beneficiaries with diagnoses of conduction disorders or cardiac dysrhythmias. Initially, we selected all beneficiaries with these diagnoses from 1996 to 2004 claims (n = 13,602). Controls entered the study on the basis of the first claim with the study diagnoses from 1996 to 2004. The date of this claim was the "reference date" from which look-back and look-forward data were calculated.

We compared changes in the utilization of ER and inpatient care and Medicare payments between a period 1 year before pacemaker implantation and, for controls, a 1-year period immediately before the reference date and for a year after a 6-month period after pacemaker placement or the reference date (controls). The 6-month gap from implantation to follow-up allowed adjustments to be made after implantation (e.g., to device settings and medications). Outcome measures defined per beneficiary/year were ER visits,

inpatient admissions and days, and Medicare payments for ER and inpatient care.

Although the analysis sample used a common set of diagnoses, pacemaker recipients may differ on characteristics unobservable to researchers. To reduce selection bias in assigning subjects to the intervention, we used propensity score matching (PSM) to obtain a control group to compare utilization and Medicare payments after pacemaker placement.[5,6]

To implement PSM, we first performed logit analysis to predict the probability a beneficiary received a pacemaker. Using the predicted probability, we matched a beneficiary actually receiving a pacemaker to his or her nearest match among controls. We then measured utilization and payment outcome differences for pacemaker recipients versus controls. We used nearest neighbor matching with a caliper of 0.02, with PSMATCH2 from Stata version 11 (StataCorp LP, College Station, Texas). Observation pairs were dropped if differences in values exceeded this amount. Standardized differences were calculated for the matched sample. A general criterion for adequate matching is that standardized differences for the covariates used for matching not exceed 10%.[7−9]