

Identification of Hospital Cardiac Services for Acute Myocardial Infarction Using Individual Patient Discharge Data

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Background—The availability of hospital cardiac services may vary between hospitals and influence care processes and outcomes. However, data on available cardiac services are restricted to a limited number of services collected by the American Hospital Association (AHA) annual survey. We developed an alternative method to identify hospital services using individual patient discharge data for acute myocardial infarction (AMI) in the Premier Healthcare Database.

Methods and Results—Thirty-five inpatient cardiac services relevant for AMI care were identified using American Heart Association/American College of Cardiology guidelines. Thirty-one of these services could be defined using patient-level administrative data codes, such as International Classification of Diseases, Ninth Revision, Clinical Modification and Current Procedural Terminology codes. A hospital was classified as providing a service if it had ≥ 5 instances for the service in the Premier database from 2009 to 2011. Using this system, the availability of these services among 432 Premier hospitals ranged from 100% (services such as chest X-ray) to 1.2% (heart transplant service). To measure the accuracy of this method using administrative data, we calculated agreement between the AHA survey and Premier for a subset of 16 services defined by both sources. There was a high percentage of agreement ($\geq 80\%$) for 11 of 16 (68.8%) services, moderate agreement for 3 of 16 (18.8%) services, and low agreement ($\leq 50\%$) for 2 of 16 services (12.5%).

Conclusions—The availability of cardiac services for AMI care varies widely among hospitals. Using individual patient discharge data is a feasible method to identify these cardiac services, particularly for those services pertaining to inpatient care. (*J Am Heart Assoc.* 2016;5:e003680 doi: 10.1161/JAHA.116.003680)

Key Words: cardiovascular disease • health services research • myocardial infarction • population

In cardiovascular disease, the availability and utilization of individual services and procedures, such as percutaneous coronary intervention (PCI) and coronary artery bypass graft

(CABG) surgery, vary widely between facilities.^{1,2} However, a comprehensive assessment of a hospital's available cardiovascular services is presently lacking. Indeed, past assessments of cardiovascular services have been limited to basic surrogate measures, such as case volume, which have been shown to be associated with readmission rates, mortality, and costs.³ Examining the association between specific hospital measures of service capacity, such as the provision of in-hospital procedures and secondary prevention measures, and outcomes is currently difficult, because we do not have methods to comprehensively identify services available at individual hospitals. In recognition of this, the American Heart Association/American College of Cardiology has stated that there is an "urgent need to develop measurement tools for the structure of [acute myocardial infarction] care, describe the reliability and validity of these tools, and link the results of these measurements to clinically relevant outcomes."⁴

The American Hospital Association (AHA) annual survey is a source of national hospital structural characteristics that costs in excess of \$5000 per year to purchase. Each year, over 6200 hospitals in the United States provide information about hospital characteristics and staffing in the AHA survey.⁵ Despite having a broad coverage of US hospitals, it is limited

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Accompanying Tables S1 through S5 are available at <http://jaha.ahajournals.org/content/5/9/e003680/DC1/embed/inline-supplementary-material-1.pdf>

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Received April 11, 2016; accepted July 1, 2016.

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in its ability to fully characterize hospitals, because it is based on self-reported data and only collects a limited range of cardiac services. Furthermore, studies that directly examine the reliability of the AHA annual and information technology (IT) surveys have been limited in quantity and variety of services.^{1,6} A previous study has tested the reliability of the annual survey for identifying PCI services by utilizing individual patient administrative claims data from the Healthcare Cost and Utilization Project (HCUP). This study reported overall strong agreement for PCI capabilities between these 2 sources of data, with a kappa score of 0.70.¹ This finding suggests that individual patient claims data can potentially be used to reliably identify services available at health care facilities. A claims-based method is advantageous, because evidence of billing for a procedure or service is typically a reliable indicator that the service is provided by the facility. Moreover, such a method uses data that are already collected and have the potential to derive a service's utilization rate.

To our knowledge, administrative data have not been used to derive a wide range of acute myocardial infarction (AMI) services that encompass the emergency department (ED), in-hospital, and secondary prevention services. Accordingly, we used individual patient hospital administrative data to determine the availability of a comprehensive range of cardiovascular services for the management of AMI among hospitals.

Methods

Data Sources

We derived administrative data from the Premier Healthcare Database, which contains data on more than 585 million cumulative discharges (75 million cumulative hospital inpatient discharges and 510 million outpatient discharges). There are ≈850 hospitals in Premier's research database, which vary in geography, bed size, and teaching status. In addition to information available in the standard hospital discharge file, the Premier database contains a date-stamped log of all billed items at the patient level, including diagnostic tests, medications, and therapeutic services. This database has been used in previous studies to determine outcomes (costs, length of stay, mortality, and readmission) and treatment use at hospitals.^{7–10}

In addition, we used data from the 2010 AHA annual survey. This data source is updated annually and contains over 1000 data fields that include self-reported descriptions of hospital organizational structures and services.⁵

Study Design

We included Premier hospitals with at least 25 AMI inpatient cases in a 3-year period (2009–2011). AMI patients were

identified using the International Classification of Diseases, Ninth Revision, Clinical Modification (ICD-9-CM) codes 410.xx, excluding those with 410.x2 (AMI, subsequent episode-of-care), from January 1, 2009 through December 31, 2011.

To identify essential services, we first determined the services required to deliver AMI care by reviewing class I, IIa, and IIb American Heart Association/American College of Cardiology clinical guidelines for ST segment elevated myocardial infarction and Non-ST-elevation acute coronary syndromes.¹¹ Any service that was deemed necessary to provide each guideline recommendation was included in the analysis. The resulting 35 services were then grouped into the following 4 service categories: acute care, diagnostic and procedural care, inpatient management, and secondary prevention. Any prehospital services were excluded from the analysis.

We then determined the percentage of Premier hospitals that provide each service by using a combination of administrative codes contained within the individual patient files recorded in the data: ICD-9-CM, current procedural terminology (CPT), Medicare revenue, and healthcare provider taxonomy codes. In addition, Premier chargemaster data, Premier attending physician specialty, and Premier department codes were included because of their specific use in the Premier database and opportunity to use additional codes outside of what is traditionally available through Medicare claims data. We used multiple sources of codes to maximize the possibility that services could be identified using these administrative data. Specifically, we defined each cardiac service using 1 or more of the 7 coding systems depending on the service. The seven coding systems used, their reasons for use, and an example can be found in Table 1. A complete listing of the specific codes used for each service category can be found in Tables S1 through S4.

We considered a hospital as offering a service if it had 5 or more records for that particular service, as defined by the claims codes, during the 3-year study period (2009–2011). We used a threshold of 5 records to minimize the risk of hospitals being attributed a service because of an occasional inadvertent or erroneous documentation. For services that can be provided in both inpatient and outpatient settings, we counted services in both settings to decide the service availability.

Furthermore, we compared the availability of hospital AMI services derived from the administrative data method with the AHA survey. In this subset analysis, we included hospitals captured in both the Premier database and the 2010 AHA survey and used the AMI health services that overlapped between these 2 data sources. Last, to ascertain the relative benefit of Premier specific codes over Medicare codes alone, we repeated our analysis using only codes that are typically

Table 1. Administrative Data Sources and Reasoning for Their Inclusion

Source of Data	Reasoning for Inclusion	Example
ICD-9-CM procedure codes	To identify inpatient procedures	37.22 Left heart cardiac catheterization
CPT codes	To identify outpatient procedures and services	97003 Occupational therapy evaluation
Medicare revenue codes (identifies the location where procedures and services were delivered during the billing episode)	To identify hospital units and departments involved in providing care	0450 Emergency room-general classification
Health care provider taxonomy code set (indicates the provider's specialty)	To identify specialist provider services available at the hospital	208G00000X Thoracic surgery (cardiothoracic vascular surgery)
Premier chargemaster codes* (codes for all hospital procedures, services, supplies, and drugs that are billed during the episode of care)	To identify hospital procedures and services	270270008900000 Catheter arteriogram
Premier attending physician specialty codes*	To identify specialist provider services available at the hospital	4012 CDS
Premier department codes*	To identify hospital departments	450 Emergency room

CDS indicates cardiovascular surgery; CPT, current procedural terminology; ICD-9-CM, International Classification of Diseases, Ninth Revision, Clinical Modification.

*Indicates coding sources specific to the Premier Healthcare Database.

contained in Medicare claims data (ICD-9-CM, CPT, Medicare revenue, and taxonomy codes).

This study and waiver for informed consent was approved by Yale University's Institutional Review Board.

Study Assessment

Availability (frequency) of each service at the included Premier hospitals was calculated by dividing the number of hospitals defined as providing the service by the total number of included Premier hospitals. Additionally, for each individual hospital, we determined the number of available services in each of the 4 service categories (acute care, diagnostic and procedural care, inpatient management, and secondary prevention services).

For the subset analysis between Premier and the AHA survey, we determined the proportion of hospitals that showed agreement between these 2 data sources. This percentage of agreement examined concordant responses and was defined as instances in which both administrative data and the AHA survey identified a hospital as providing a service, in addition to instances in which both sources identified a hospital as not providing the service. We calculated agreement between the AHA survey and all 7 coding systems, as well as agreement between AHA survey and non-Premier codes (ICD-9-CM, CPT, Medicare revenue, and taxonomy codes). When possible, the percentage of agreement was also quantified using the kappa statistic and McNemar's test.

Statistical Analysis

We presented categorical data as frequencies and percentages. Hospitals were identified as having a particular service or not having the service. Percentage agreement was calculated for the subset of services by assessing the percentage of hospitals that had concordant responses through Premier administrative data and the AHA survey out of the total number of hospitals. For services that did not have a zero cell for agreement or disagreement, percentage of agreement was also quantified with Cohen's kappa coefficient, with a kappa statistic of 1.0 indicating perfect agreement. Furthermore, the *P* value for McNemar's test for symmetry was computed to test whether the paired evaluations of a service by administrative data and the AHA survey for hospitals are agreeable. The null hypothesis in the McNemar's test is that the 2 evaluations are agreeable. A significant value ($P < 0.05$) indicates that the AHA survey and Premier's evaluation of a service are statistically different.

Results

Data Sources

After applying our exclusion criteria, we included a total of 432 Premier hospitals for the analysis. Additionally, for the hospital service subset analysis between Premier and AHA, we had a hospital sample size that ranged from 345 to 370 hospitals, depending on the service.

Table 2. AMI Services and Sources Used for Their Definition

Service Recommended for AMI Care	Source of Administrative Data						
	ICD-9-CM Codes	CPT Codes	Medicare Revenue Codes	Taxonomy Codes	Premier Chargemaster Codes	Premier Attending Physician Specialty Codes	Premier Department Codes
Acute care							
Cardiac biomarkers					X		
Chest pain unit		X	X		X		
Dedicated emergency department			X				X
Emergency department specialist				X		X	
Pathology services			X				
Thrombolysis					X		
Diagnostic and procedural care							
Cardiac nuclear perfusion imaging		X			X		
Chest X-ray	X	X			X		
CABG	X	X			X		
Coronary CT angiogram		X			X		
Diagnostic coronary angiography	X	X			X		
EP ablation	X	X			X		
EP testing	X	X			X		
Exercise stress testing	X	X			X		
General CT	X	X			X		
PCI	X	X			X		
PPM/AICD implantation	X	X			X		
Stress echocardiography		X			X		
Transthoracic echocardiography	X	X			X		
Primary PCI	Could not be identified using administrative data						
Inpatient management							
Coronary care unit			X	X	X		
Coronary step-down unit			X		X		
Inpatient cardiac surgical service				X		X	
Inpatient cardiology service				X		X	
Intensive care unit	X	X	X		X		
Inpatient internal medicine service				X		X	
Transplant unit	X	X	X		X		
Secondary prevention							
Inpatient cardiac rehabilitation (phase I)	X		X		X		
Outpatient cardiac rehabilitation (phase II or III)		X	X		X		
Pharmacist		X	X		X		
Physiotherapy/occupational therapy	X	X			X		
Social worker	X	X			X		
Inpatient heart failure services	Could not be identified using administrative data						
Outpatient heart failure services	Could not be identified using administrative data						
Readmissions prevention program	Could not be identified using administrative data						

ACID indicates automatic implantable cardioverter defibrillator; AMI, acute myocardial infarction; CABG, coronary artery bypass grafting; CPT, Current Procedural Terminology; CT, computed tomography; EF, electrophysiology; ICD-9-CM, International Classification of Diseases, Ninth Revision, Clinical Modification; PCI, percutaneous coronary intervention; PPM, permanent pacemaker.

Study Design

Of the 35 originally defined cardiac services necessary for AMI care, 31 could be defined using the administrative data sources (Table 2). The 4 services, and their respective categories, that could not be defined using our coding sources were as follows: primary PCI (diagnostic and procedural care); inpatient heart failure services (secondary prevention); outpatient heart failure services (secondary prevention); and readmissions prevention programs (secondary prevention). A subset of 16 services could be compared between the AHA survey and the Premier database.

Study Assessment

The availability of the 31 services among the Premier hospitals varied between 100% (for services such as chest X-ray) to 1.2% (transplant unit; Figure 1). For the analysis of agreement between the AHA survey and administrative data sources, a high percentage of agreement ($\geq 80\%$) was noted for 11 of 16 (68.8%) services (Table 3). Moderate agreement was noted for 3 of 16 services (18.8%), and low agreement ($< 50\%$) was noted for 2 of 16 (12.5%) services. All acute care and diagnostic and procedural services had a high degree of agreement between administrative data and the AHA survey. The 2 low-agreement services were physiotherapy/occupational therapy (41.4%) and presence of a social worker (6.7%), both of which were classified as secondary prevention services.

For 9 of 16 services, the more-common type of disagreement stemmed from hospitals identified as having the service on the AHA survey, but not through administrative data (yes on AHA survey/no based on administrative data), compared to hospitals identified as having the service through administrative data but not the AHA survey (no on AHA survey/yes using administrative data; Table 3).

We examined each hospital's proportion of available services according to the 4 service categories (Figure 2). Across the 432 hospitals included in the analysis, the total number of available services ranged from 6 to 29 (of the 31 total services). The number of acute care services remained relatively stable across all hospitals. The proportion of inpatient management and secondary prevention services increased slightly as the number of total services increased for hospitals. The most significant contributor to the gradient in the number of services available at individual hospitals was attributed to diagnostic and procedural services (range, 1–13).

Agreement of Administrative Data With the AHA Survey

Cohen's kappa coefficient could be calculated for 10 of the 16 services and ranged from -0.01 to 0.88 (Table 3). Of the 6

services that did not have a kappa coefficient calculated, 5 of the services had a high degree of agreement ($> 94.8\%$), and 1 service (physiotherapy/occupational therapy) had a low degree of agreement (41.4%). The P value for McNemar's test for symmetry could be determined for 11 of the services and was statistically significant at $P < 0.05$ for 9 of these services (Table 3). Even though this indicates statistical disagreement between the sources for those services, coupled with the results with the kappa coefficient and percentage agreement, we see that, in practice, there is relatively good agreement.

When services were defined using codes typically found in Medicare claims alone, excluding Premier specific codes, we found that agreement remained the same for some services, but agreement sensitivity decreased for 7 of 16 services (Table S5). Additionally, when we examined agreement by AMI discharge volume (≤ 400 AMI discharges from 2009 to 2011 vs > 400 discharges), we did not find statistically significant differences in agreement between smaller- and larger-volume hospitals (data not shown).

Discussion

In this study, we show that for a majority of the services, discharge data can be a reasonable proxy for direct survey. We found a high degree of agreement ($\geq 80\%$) between administrative data and the AHA survey for many services, but also identified some services for which there was common discord. Nevertheless, the method using administrative data is a feasible way to profile most inpatient hospital cardiac services among hospitals and detect variation in service availability between hospitals. The ability to use administrative data is valuable, because it is accessible, can capture a wide range of services, is nationally representative data, and can be used to calculate service utilization rates in hospitals.

In previous studies, the Premier Healthcare Database has been used to identify utilization rates of individual health services, such as patterns of intensive care unit utilization among heart failure patients¹² and computed tomography (CT) angiogram and perfusion utilization among acute ischemic stroke patients.¹³ Additionally, Concannon et al.¹ used claims data from the HCUP's Inpatient Database to identify PCI services at hospitals and compare claims-based utilization rates with those of the AHA survey. In contrast to these previous studies, we extended the current literature by developing a systematic method to comprehensively identify a wide range of cardiac health services using administrative data. To our knowledge, no previous studies have classified a comprehensive set of services for AMI care using this approach. Our study also found a higher degree of agreement for PCI when compared with the results from Concannon et al.¹ ($\kappa = 0.88$ vs 0.70).

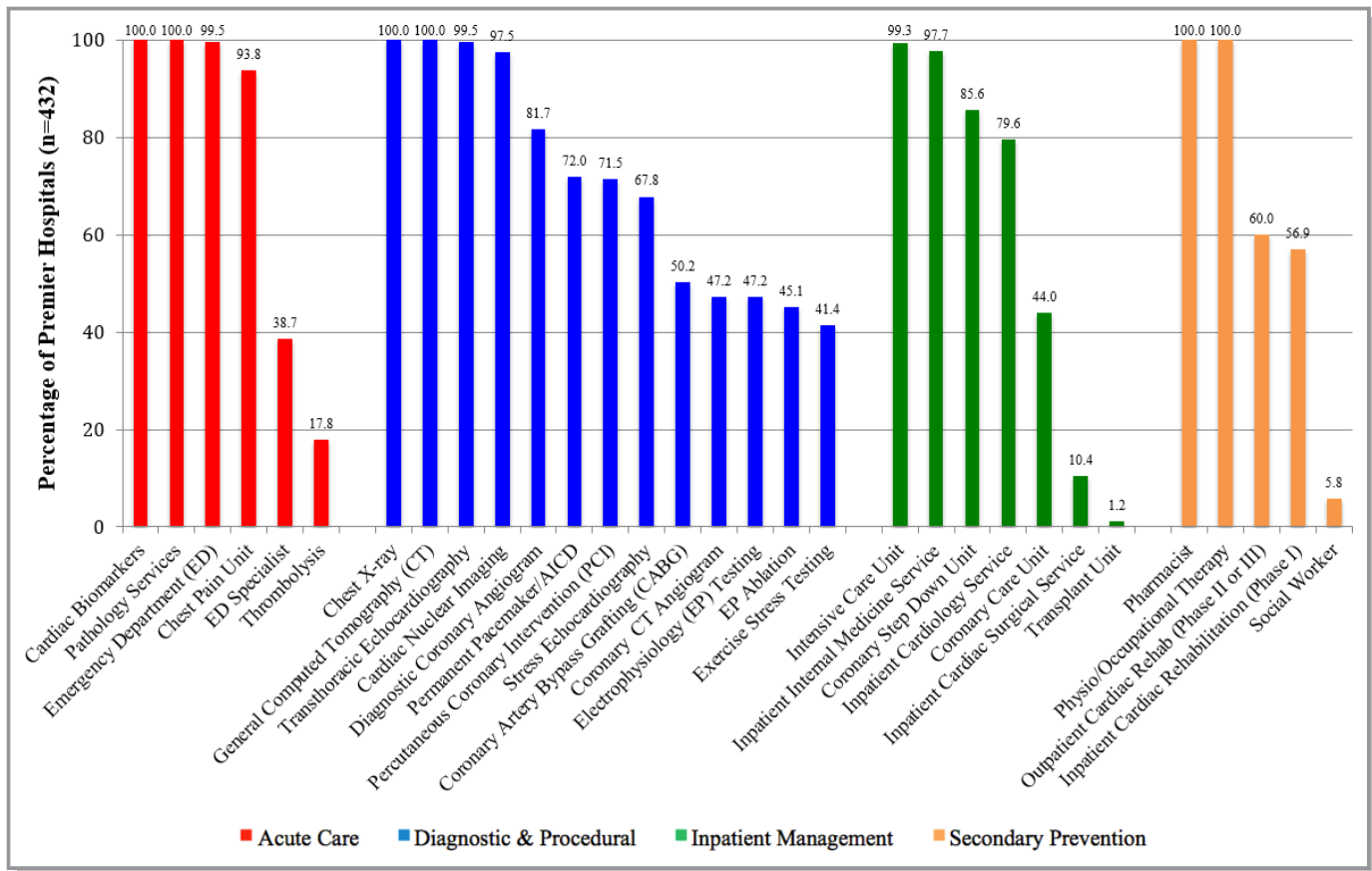


Figure 1. Availability of cardiac services among Premier hospitals identified using administrative data. Thirty-one cardiac services, which were divided into 4 categories (acute care, diagnostic and procedural care, inpatient management, and secondary prevention), were able to be defined using administrative data. Of the 432 Premier hospitals included in the analysis, the availability of services in hospitals ranged from 100% for several services to 1.2% for transplant units.

Furthermore, the method that we developed can be potentially extended to other conditions and databases.

The AHA survey is the most widely used and is currently one of the only nationally representative sources of hospital infrastructure data. However, it has several limitations. Although it is relied upon by health care systems nationwide as the source of truth for structural questions about hospitals, data in the survey are self-reported by hospitals, only capture a subset of specialized cardiac services (eg, cardiac intensive care, cardiac surgery, cardiac electrophysiology, magnetic resonance imaging, and CT scanner), are costly to purchase, and are not validated.

Although we found an overall high degree of agreement between administrative data and the AHA survey, agreement was not consistent across all services. It is possible that available services in the AHA survey are over-reported by hospitals. Additionally, we defined service availability as hospitals with ≥ 5 service codes during our time period. Thus, if hospitals have the capacity for the service, but a low utilization rate, they would be incorrectly classified as not providing the service. Finally, differences between the AHA

survey’s definition for data elements, the interpretation of survey questions by the hospital personnel completing the survey, and our method using administrative data could explain our discordances. For example, social work services had a low degree of agreement (6.7%), which may be attributed to a different definition and interpretation from the AHA survey (includes counseling for social, emotional, and environmental problems), compared to the health and behavior therapy services we were able to utilize from administrative data.

Our findings indicate that administrative data can be used for identifying the availability of services at hospitals. This method gives us the ability to identify cardiovascular services at hospitals, which can drive further research to explore the relationship between structures, outcomes, and processes. We designed our study to use data from the Premier Healthcare Database instead of Medicare claims data because they have extra information outside of more traditionally used ICD-9-CM and CPT codes found in Medicare data. These additional codes available in Premier include the Premier chargemaster, attending physician specialty, and department codes. Our finding that agreement sensitivity decreases for 7

Table 3. Percentage of Agreement and Disagreement Between Premier Administrative Data and AHA Annual Survey

Services Recommended for AMI Care	N (Hospitals With AHA Survey Data)	% Agree or Disagree				% Agreement	Cohen's Kappa (95% CI)	McNemar's Test for Symmetry P Value*
		Agree: Yes on AHA Survey/Yes on Administrative Data (%)	Disagree: Yes on AHA Survey/No on Administrative Data (%)	Disagree: No on AHA Survey/Yes on Administrative Data (%)	Agree: No on AHA Survey/No on Administrative Data (%)			
Acute care								
Dedicated ED	345	99.7	0.3	0.0	0.0	99.7	N/A	N/A
Diagnostic and procedural								
Cardiac nuclear perfusion imaging	345	94.8	5.2	0.0	0.0	94.8	N/A	N/A
General CT	345	98.8	0.3	0.9	0.0	98.8	N/A	0.32
Diagnostic coronary angiography	345	76.5	2.0	2.0	19.4	95.9	0.88 (0.82, 0.94)	1.00
PCI	345	64.6	0.9	4.3	30.1	94.8	0.88 (0.83, 0.93)	0.01
EP testing	345	40.6	15.4	1.7	42.3	82.9	0.66 (0.59, 0.74)	<0.01
Inpatient management								
Coronary care unit	345	34.8	20.6	7.5	37.1	71.9	0.45 (0.36, 0.54)	<0.01
Inpatient cardiac surgical service	345	6.4	45.5	0.3	47.8	54.2	0.11 (0.06, 0.16)	<0.01
Inpatient cardiology service	345	68.4	14.2	5.8	11.6	80.0	0.42 (0.30, 0.53)	<0.01
Intensive care unit	345	97.4	0.3	2.0	0.3	97.7	0.19 (−0.14, 0.52)	<0.01
Inpatient internal medicine service	320	88.1	1.9	9.1	0.9	89.1	0.11 (−0.40, 0.25)	<0.01
Transplant unit	345	0.0	2.6	0.0	97.4	97.4	N/A	N/A
Secondary prevention								
Inpatient cardiac rehabilitation (phase 1)	345	51.0	25.8	1.7	21.4	72.5	0.43 (0.25, 0.52)	<0.01
Pharmacist	370	98.6	0.0	1.4	0.0	98.6	N/A	N/A
Physiotherapy/Occupational therapy	345	41.4	0.0	58.6	0.0	41.4	N/A	N/A
Social worker	345	3.8	92.8	0.6	2.9	6.7	−0.01 (−0.03, 0.01)	<0.01

CT indicates computed tomography; ED, emergency department; EP, electrophysiology; PCI, percutaneous coronary intervention.

*Statistically significant at $P < 0.05$. AHA indicates American Hospital Association; AMI, acute myocardial infarction.

of 16 services when only non-Premier codes were used indicates that supplementing more widely available coding sources with Premier codes may help the accuracy of identifying some cardiac services.

This study has a few limitations. First, our sources of data could not define primary PCI, inpatient heart failure services, outpatient heart failure services, or readmissions prevention programs. Three of these 4 services were secondary prevention services. Among the secondary prevention services that could

be identified using the data, the agreement between administrative data and the AHA survey was low. However, for other service categories, we had a high degree of agreement between the AHA survey and administrative data. Another limitation is that Premier is a performance improvement database, which means that the results may not be generalizable to all hospitals if medical coding is more accurate at these hospitals that strive to improve quality. Despite this limitation, it is important to note that the Premier Healthcare Database is a large database that

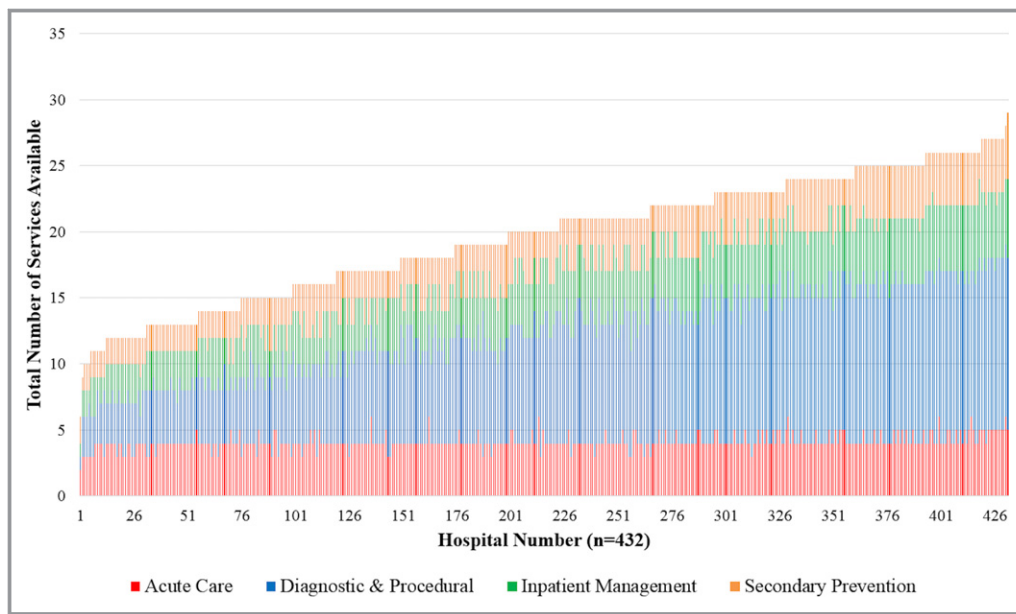


Figure 2. Number of services available in each service category in Premier hospitals. For each of the 432 hospitals, the total number of available services was determined according to the type of service category (acute care, diagnostic and procedural care, inpatient management, and secondary prevention). The total available services ranged from 6 to 29 for each hospital, with diagnostic and procedural care services contributing most significantly to the wide range of available services across hospitals.

includes a wide range of hospitals. Finally, this method does not allow us to discern whether services with low degrees of agreement are attributed to an error in the administrative data or the AHA survey.

In conclusion, this method of using individual administrative discharge data to define hospital services is feasible for a majority of cardiovascular services. This provides the ability for future research to use readily available data to link structural characteristics with processes and outcomes. Future research should test this methodology to see whether this can be extended to hospital services for other diseases.

Conclusion

We developed a method to identify hospital cardiac services using administrative data available in the Premier Healthcare Database. When we compared the availability of services between our administrative data method and data from the AHA survey, we found a high or moderate degree of agreement for 14 of the 16 included services. Our analysis showed that it is feasible to use administrative data to identify AMI services, especially inpatient services.

Sources of Funding

This work was supported by grant DF10-301 from the Patrick and Catherine Weldon Donaghue Medical Research Foundation

in West Hartford, Connecticut, and by grant UL1 RR024139-06S1 from the National Center for Advancing Translational Sciences in Bethesda, Maryland. Dr Krumholz is supported by grant U01 HL105270-05 (Center for Cardiovascular Outcomes Research at Yale University) from the National Heart, Lung and Blood Institute in Bethesda, Maryland. The content is solely the responsibility of the authors and does not necessarily represent the official views of the Donaghue Foundation or the National Institutes of Health.

Disclosures

Drs Krumholz and Li work under contract with the Centers for Medicare & Medicaid Services to develop and maintain performance measures. Dr Krumholz is the recipient of research agreements from Medtronic and from Johnson & Johnson, through Yale University, to develop methods of clinical trial data sharing and chairs a cardiac scientific advisory board for United Healthcare. Dr Ranasinghe is supported by an Early Career Fellowship cofunded by the National Health and Medical Research Council and the National Heart Foundation of Australia.

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SUPPLEMENTAL MATERIAL

Table S1: Codes used to identify acute care services

Service	Source	Code and Description
Cardiac Biomarkers	Premier Chargemaster	300301845120000-TROPONIN QUAL
	Premier Chargemaster	300301844840000-TROPONIN QN
Cardiology in Emergency Department	Taxonomy Code	207RC0000X-Internal Medicine, Cardiovascular Disease
	Taxonomy Code	207RI0011X-Interventional Cardiology
	Premier Admitting	4011-Cardiovascular Diseases (CD)
Chest Pain Unit	CPT	G0378-Hospital observation service, per hour
	CPT	G0379-Direct referral for hospital observation care
	Medicare Revenue	0762-Treatment or observation room-observation room (eff 9/93)
	Premier Chargemaster	760762000050000-OBSERVATION ADDL HR
	Premier Chargemaster	760762000070000-OBSERVATION CCU 12-18 HRS
	Premier Chargemaster	760760992200000-INITIAL OBSERVATION PER DAY HIGH COMPLEXITY
	Premier Chargemaster	760762000040000-OBSERVATION 23 HR PER HR
	Premier Chargemaster	760762000500000-OBSERVATION 1ST HR
	Premier Chargemaster	760762000020000-OBSERVATION 23 HR 16-24
	Premier Chargemaster	760760992190000-INITIAL OBSERVATION PER DAY MODERATE COMPLEXITY
	Premier Chargemaster	760762000100000-OBSERVATION CCU PER HR
	Premier Chargemaster	760762000090000-OBSERVATION CCU FLAT RATE
	Premier Chargemaster	760762000030000-OBSERVATION 23 HR 8-16
	Premier Chargemaster	760762000080000-OBSERVATION CCU 7-11 HRS
	Premier Chargemaster	760762000060000-OBSERVATION CCU 0-6 HRS
	Premier Chargemaster	760760992180000-INITIAL OBSERVATION PER DAY LOW COMPLEXITY
Premier Chargemaster	760762000010000-OBSERVATION 23 HR 0-8	
Dedicated Emergency Department	Medicare Revenue	0450-Emergency room- general classification
	Medicare Revenue	0451-Emergency Room: EM/EMTALA
	Medicare Revenue	0452-Emergency Room: ER/Beyond EMTALA
	Medicare Revenue	0456-Emergency Room: Urgent care
	Medicare Revenue	0459-Emergency Room: Other emergency room
	Medicare Revenue	0961 -Professional fees- emergency room
	Premier Department codex	450-Emergency Room
Emergency Department Specialist	Taxonomy Code	207P00000X-Emergency Medicine
	Taxonomy Code	207PE0004X-Emergency Medicine, Emergency Medical Services
	Premier Admitting	4028-Emergency Medicine (EM)
Pathology	Medicare Revenue	0305-Laboratory- hematology
	Medicare Revenue	0310-Laboratory pathological- general classification
Thrombolysis	Premier Chargemaster	480480929770000-THROMBOLYSIS CORONARY IV INFUSION
Primary Percutaneous Coronary Intervention	<i>Could not be identified using administrative data</i>	

Table S2: Codes used to identify diagnostic and procedural services

Service	Source	Code and Description
Cardiac Nuclear Perfusion	CPT	78451-Myocardial perfusion imaging, tomographic (SPECT) (including attenuation correction, qualitative or quantitative wall motion, ejection fraction by first pass or gated technique, additional quantification, when performed); single study, at rest and or stress (exercise or pharmacologic)
	CPT	78452-Myocardial perfusion imaging, tomographic (SPECT) (including attenuation correction, qualitative or quantitative wall motion, ejection fraction by first pass or gated technique, additional quantification, when performed); multiple studies, at rest and/or stress (exercise or pharmacologic) and/or redistribution and/or rest reinjection
	CPT	78453-Myocardial perfusion imaging, planar (including qualitative or quantitative wall motion, ejection fraction by first pass or gated technique, additional quantification, when performed); single study, at rest or stress (exercise or pharmacologic)
	CPT	78454-Myocardial perfusion imaging, planar (including qualitative or quantitative wall motion, ejection fraction by first pass or gated technique, additional quantification, when performed); multiple studies, at rest and/or stress (exercise or pharmacologic) and/or redistribution and/or rest reinjection
	CPT	78466-Myocardial imaging, infarct avid, planar; qualitative or quantitative
	CPT	78468-Myocardial imaging, infarct avid, planar; with ejection fraction by first pass technique
	CPT	78469-Myocardial imaging, infarct avid, planar; tomographic SPECT with or without quantification
	CPT	78472-Cardiac blood pool imaging, gated equilibrium; planar, single study at rest or stress (exercise and/or pharmacologic), wall motion study plus ejection fraction, with or without additional quantitative processing
	CPT	78473-Cardiac blood pool imaging, gated equilibrium; multiple studies, wall motion study plus ejection fraction, at rest and stress (exercise and/or pharmacologic), with or without additional quantification
	CPT	78481-Cardiac blood pool imaging (planar), first pass technique; single study, at rest or with stress (exercise and/or pharmacologic), wall motion study plus ejection fraction, with or without quantification
	CPT	78483-Cardiac blood pool imaging (planar), first pass technique; multiple studies, at rest and with stress (exercise and/or pharmacologic), wall motion study plus ejection fraction, with or without quantification
	CPT	78494-Cardiac blood pool imaging, gated equilibrium,

		SPECT, at rest, wall motion study plus ejection fraction, with or without quantitative processing
	CPT	78496-Cardiac blood pool imaging, gated equilibrium, single study, at rest, with right ventricular ejection fraction by first pass technique
	Premier Chargemaster	340340784510000-NM MYOCARD PERF SINGL SPECT W/WALL ,EF,REST/STRESS
	Premier Chargemaster	340340784520000-NM MYOCARD PERF MULTI SPECT W/WALL ,EF,REST/STRESS
	Premier Chargemaster	340340784530000-NM MYOCARD PERF SINGL PLANR W/WALL ,EF,REST/STRESS
	Premier Chargemaster	340340784540000-NM MYOCARD PERF MULTI PLANR W/WALL ,EF,REST/STRESS
	Premier Chargemaster	340341784140000-NM CARDIOVASCULAR HEMODYNAMICS
	Premier Chargemaster	340341784600000-NM MYOCARD PERF SINGLE
	Premier Chargemaster	340341784610000-NM MYOCARD PERF MULTI
	Premier Chargemaster	340341784640000-NM MYOCARD PERF SINGLE SPECT
	Premier Chargemaster	340341784650000-NM MYOCARD PERF MULTI SPECT
	Premier Chargemaster	340341784660000-NM MYOCARD INFARCT
	Premier Chargemaster	340341784680000-NM MYOCARD INFARCT W/EJECTION FRACTION 1ST PASS
	Premier Chargemaster	340341784690000-NM MYOCARD INFARCT SPECT
	Premier Chargemaster	340341784720000-NM CARDIAC BLOOD POOL SINGLE
	Premier Chargemaster	340341784730000-NM CARDIAC BLOOD POOL MULTI
	Premier Chargemaster	340341784780000-NM MYOCARD PERF WALL MOTION
	Premier Chargemaster	340341784800000-NM MYOCARD PERF EJECTION FRACTION
	Premier Chargemaster	340341784810000-NM CARDIAC 1ST PASS SINGLE
	Premier Chargemaster	340341784830000-NM CARDIAC 1ST PASS MULTI
	Premier Chargemaster	340341784940000-NM MUGA AT REST W/SPECT
	Premier Chargemaster	340341784960000-NM MUGA SINGLE W/RIGHT VENTRICULAR EF BY 1ST PASS
Chest X-Ray	ICD-9-CM	87.44-Routine chest x-ray, so described
	ICD-9-CM	87.49-Other chest x-ray
	CPT	71010-Radiologic examination, chest; single view, frontal
	CPT	71015-Radiologic examination, chest; stereo, frontal
	CPT	71020-Radiologic examination, chest, 2 views, frontal and lateral;
	CPT	71021-Radiologic examination, chest, 2 views, frontal and lateral; with apical lordotic procedure
	CPT	71022-Radiologic examination, chest, 2 views, frontal and lateral; with oblique projections
	CPT	71023-Radiologic examination, chest, 2 views, frontal and lateral; with fluoroscopy

	CPT	71030-Radiologic examination, chest, complete, minimum of 4 views;
	CPT	71034-Radiologic examination, chest, complete, minimum of 4 views; with fluoroscopy
	CPT	71035-Radiologic examination, chest, special views (eg, lateral decubitus, Bucky studies)
	Premier Chargemaster	320324710100000-XR CHEST 1 VIEW
	Premier Chargemaster	320324710100001-XR CHEST 1 VIEW PA
	Premier Chargemaster	320324710100002-XR CHEST 1 VIEW PORTABLE
	Premier Chargemaster	320324710100004-XR CHEST 1 VIEW AP
	Premier Chargemaster	320324710100005-XR CHEST LORDOTIC 1 VIEW
	Premier Chargemaster	320324710150000-XR CHEST STEREO
	Premier Chargemaster	320324710200000-XR CHEST 2 VIEWS
	Premier Chargemaster	320324710200002-XR CHEST OBLIQUE 2 VIEWS
	Premier Chargemaster	320324710200003-XR CHEST FLAT & UPRIGHT
	Premier Chargemaster	320324710200004-XR CHEST 2 VIEWS PORTABLE
	Premier Chargemaster	320324710210000-XR CHEST 2 VIEWS W/APICAL LORDOTIC
	Premier Chargemaster	320324710220000-XR CHEST W/OBLIQUES
	Premier Chargemaster	320324710300000-XR CHEST COMPLETE 4+ VIEWS
	Premier Chargemaster	320324710350000-XR CHEST SPECIAL VIEWS
	Premier Chargemaster	970972710100000-PF XR CHEST 1 VIEW
	Premier Chargemaster	970972710150000-PF XR CHEST STEREO
	Premier Chargemaster	970972710200000-PF XR CHEST 2 VIEWS
	Premier Chargemaster	970972710210000-PF XR CHEST 2 VIEWS W/APICAL LORDOTIC
	Premier Chargemaster	970972710220000-PF XR CHEST W/OBLIQUES
	Premier Chargemaster	970972710300000-PF XR CHEST COMPLETE 4+ VIEWS
	Premier Chargemaster	970972710300000-PF XR CHEST COMPLETE 4+ VIEWS
	Premier Chargemaster	970972710350000-PF XR CHEST SPECIAL VIEWS
	Premier Chargemaster	999999030062007-CHEST XRAY RESULTS DOCUMENT & REVIEW
Coronary Artery Bypass Grafting (CABG)	ICD-9-CM	36.10-Aortocoronary bypass for heart revascularization, not otherwise specified
	ICD-9-CM	36.11-(Aorto)coronary bypass of one coronary artery
	ICD-9-CM	36.12-(Aorto)coronary bypass of two coronary arteries
	ICD-9-CM	36.13-(Aorto)coronary bypass of three coronary arteries
	ICD-9-CM	36.14-(Aorto)coronary bypass of four or more coronary arteries
	ICD-9-CM	36.15-Single internal mammary-coronary artery bypass
	ICD-9-CM	36.16-Double internal mammary-coronary artery bypass
	ICD-9-CM	36.17-Abdominal-coronary artery bypass
	ICD-9-CM	36.19-Other bypass anastomosis for heart revascularization
	CPT	33510-Coronary artery bypass, vein only; single coronary venous graft
CPT	33511-Coronary artery bypass, vein only; 2 coronary venous grafts	

CPT	33512-Coronary artery bypass, vein only; 3 coronary venous grafts
CPT	33513-Coronary artery bypass, vein only; 4 coronary venous grafts
CPT	33514-Coronary artery bypass, vein only; 5 coronary venous grafts
CPT	33516-Coronary artery bypass, vein only; 6 or more coronary venous grafts
CPT	33517-Coronary artery bypass, using venous graft(s) and arterial graft(s); single vein graft
CPT	33518-Coronary artery bypass, using venous graft(s) and arterial graft(s); 2 venous grafts
CPT	33519-Coronary artery bypass, using venous graft(s) and arterial graft(s); 3 venous grafts
CPT	33521-Coronary artery bypass, using venous graft(s) and arterial graft(s); 4 venous grafts
CPT	33522-Coronary artery bypass, using venous graft(s) and arterial graft(s); 5 venous grafts
CPT	33523-Coronary artery bypass, using venous graft(s) and arterial graft(s); 6 or more venous grafts
CPT	33530-Reoperation, coronary artery bypass procedure or valve procedure, more than 1 month after original operation
CPT	33533-Coronary artery bypass, using arterial graft(s); single arterial graft
CPT	33534-Coronary artery bypass, using arterial graft(s); 2 arterial grafts
CPT	33535-Coronary artery bypass, using arterial graft(s); 3 arterial grafts
CPT	33536-Coronary artery bypass, using arterial graft(s); 4 arterial grafts
Premier Chargemaster	360360335720000-ENDARTERECTOMY CORONARY OPEN
Premier Chargemaster	360450335100000-ER CABG VEIN 1 GRAFT
Premier Chargemaster	360450335110000-ER CABG VEIN 2 GRAFTS
Premier Chargemaster	360450335120000-ER CABG VEIN 3 GRAFTS
Premier Chargemaster	360450335130000-ER CABG VEIN 4 GRAFTS
Premier Chargemaster	360450335140000-ER CABG VEIN 5 GRAFTS
Premier Chargemaster	360450335160000-ER CABG VEIN > 6 GRAFTS
Premier Chargemaster	360450335170000-ER CABG ARTERY/VEIN 1 GRAFT
Premier Chargemaster	360450335180000-ER CABG ARTERY/VEIN 2 GRAFTS
Premier Chargemaster	360450335180000-ER CABG ARTERY/VEIN 3 GRAFTS
Premier Chargemaster	360450335180000-ER CABG ARTERY/VEIN 4 GRAFTS
Premier Chargemaster	360450335180000-ER CABG ARTERY/VEIN 5 GRAFTS
Premier Chargemaster	360450335180000-ER CABG ARTERY/VEIN >6 GRAFTS
Premier Chargemaster	360450335300000-ER REOPERATION CORONARY ARTERY BYPASS
Premier Chargemaster	360450335330000-ER CABG ARTERIAL 1 GRAFT
Premier Chargemaster	360450335340000-ER CABG ARTERIAL 2 GRAFTS

	Premier Chargemaster	360450335350000-ER CABG ARTERIAL 3 GRAFTS
	Premier Chargemaster	360450335360000-ER CABG ARTERIAL > 4 GRAFTS
	Premier Chargemaster	970975335100000-PF CABG VEIN 1 GRAFT
	Premier Chargemaster	970975335110000-PF CABG VEIN 2 GRAFTS
	Premier Chargemaster	970975335120000-PF CABG VEIN 3 GRAFTS
	Premier Chargemaster	970975335130000-PF CABG VEIN 4 GRAFTS
	Premier Chargemaster	970975335140000-PF CABG VEIN 5 GRAFTS
	Premier Chargemaster	970975335160000-PF CABG VEIN > 6 GRAFTS
	Premier Chargemaster	970975335170000-PF CABG ARTERY/VEIN 1 GRAFT
	Premier Chargemaster	970975335180000-PF CABG ARTERY/VEIN 2 GRAFTS
	Premier Chargemaster	970975335190000-PF CABG ARTERY/VEIN 3 GRAFTS
	Premier Chargemaster	970975335210000-PF CABG ARTERY/VEIN 4 GRAFTS
	Premier Chargemaster	970975335220000-PF CABG ARTERY/VEIN 5 GRAFTS
	Premier Chargemaster	970975335230000-PF CABG ARTERY/VEIN > 6 GRAFTS
	Premier Chargemaster	970975335300000-PF REOPERATION CORONARY ARTERY BYPASS
	Premier Chargemaster	970975335330000-PF CABG ARTERIAL 1 GRAFT
	Premier Chargemaster	970975335340000-PF CABG ARTERIAL 2 GRAFTS
	Premier Chargemaster	970975335350000-PF CABG ARTERIAL 3 GRAFTS
	Premier Chargemaster	970975335360000-PF CABG ARTERIAL > 4 GRAFTS
	Premier Chargemaster	270270034980000-PACK CABG
	Premier Chargemaster	270270009620000-CATHETER CABG
	Premier Chargemaster	999999041102008-IMA GRAFT PERFORMED PRIMARY ISOLATED CABG
Coronary CT Angiogram	CPT	75574-Computed tomographic angiography, heart, coronary arteries and bypass grafts (when present), with contrast material, including 3D image postprocessing (including evaluation of cardiac structure and morphology, assessment of cardiac function, and evaluation of venous structures, if performed)
	CPT	75572-Computed tomography, heart, with contrast material, for evaluation of cardiac structure and morphology (including 3D image postprocessing, assessment of cardiac function, and evaluation of venous structures, if performed)
	CPT	75573-Computer tomography, heart, with contrast material, for evaluation of cardiac structure and morphology in the setting of congenital heart disease (including 3D image postprocessing, assessment of LV cardiac function, RV structure and function and evaluation of venous structures, if performed)
	Premier Chargemaster	350350001462007-CTA HEART CORONARY ARTERIES ONLY
	Premier Chargemaster	350350001472007-CTA HEART CORONARY ARTERIES & CALCIUM SCORING
	Premier Chargemaster	350350001482007-CTA HEART CORONARY ARTERIES & MORPHOLOGY
	Premier Chargemaster	350350001492007-CTA HEART CORONARIES, MORPH & CALCIUM SCORING

	Premier Chargemaster	350350001512007-CT HEART RVEF/LVEF AND WALL MOTION
	Premier Chargemaster	350350755740000-CTA HEART ARTERIES,GRAFTS,STRUCT/MORPH W/CONTRAST
Diagnostic Coronary Angiography	ICD-9-CM	37.22-Left heart cardiac catheterization
	ICD-9-CM	37.23-Combined right and left heart cardiac catheterization
	ICD-9-CM	88.50-Angiocardiography, not otherwise specified
	ICD-9-CM	88.52-Angiocardiography of right heart structures
	ICD-9-CM	88.53-Angiocardiography of left heart structures
	ICD-9-CM	88.54-Combined right and left heart angiocardiology
	ICD-9-CM	88.55-Coronary arteriography using a single catheter
	ICD-9-CM	88.56-Coronary arteriography using two catheters
	ICD-9-CM	88.57-Other and unspecified coronary arteriography
	CPT	93452-Left heart catheterization including intraprocedural injection(s) for left ventriculography, imaging supervision and interpretation, when performed
	CPT	93453-Combined right and left heart catheterization including intraprocedural injection(s) for left ventriculography, imaging supervision and interpretation, when performed
	CPT	93454-Catheter placement in coronary artery(s) for coronary angiography, including intraprocedural injection(s) for coronary angiography, imaging supervision and interpretation;
	CPT	93455-Catheter placement in coronary artery(s) for coronary angiography, including intraprocedural injection(s) for coronary angiography, imaging supervision and interpretation; with catheter placement(s) in bypass graft(s) (internal mammary, free arterial venous grafts) including intraprocedural injection(s) for bypass graft angiography
	CPT	93456-Catheter placement in coronary artery(s) for coronary angiography, including intraprocedural injection(s) for coronary angiography, imaging supervision and interpretation; with right heart catheterization
	CPT	93457-Catheter placement in coronary artery(s) for coronary angiography, including intraprocedural injection(s) for coronary angiography, imaging supervision and interpretation; with catheter placement(s) in bypass graft(s) (internal mammary, free arterial, venous grafts) including intraprocedural injection(s) for bypass graft angiography and right heart catheterization
CPT	93458-Catheter placement in coronary artery(s) for coronary angiography, including intraprocedural injection(s) for coronary angiography, imaging supervision and interpretation; with left heart catheterization including intraprocedural injection(s) for left ventriculography, when performed	
CPT	93459-Catheter placement in coronary artery(s) for coronary angiography, including intraprocedural	

		injection(s) for coronary angiography, imaging supervision and interpretation; with left heart catheterization including intraprocedural injection(s) for left ventriculography, when performed, catheter placement(s) in bypass graft(s) (internal mammary, free arterial, venous grafts) with bypass graft angiography
CPT		93460-Catheter placement in coronary artery(s) for coronary angiography, including intraprocedural injection(s) for coronary angiography, imaging supervision and interpretation; with right and left heart catheterization including intraprocedural injection(s) for left ventriculography, when performed
CPT		93461-Catheter placement in coronary artery(s) for coronary angiography, including intraprocedural injection(s) for coronary angiography, imaging supervision and interpretation; with right and left heart catheterization including intraprocedural injection(s) for left ventriculography, when performed, catheter placement(s) in bypass graft(s) (internal mammary, free arterial, venous grafts) with bypass graft angiography
CPT		93508-Catheter placement in coronary artery(s), arterial coronary conduit(s), and/or venous coronary bypass graft(s) for coronary angiography without concomitant left heart catheterization
CPT		93510-Left heart catheterization, retrograde, from the brachial artery, axillary artery or femoral artery; percutaneous
CPT		93511-Left heart catheterization, retrograde, from the brachial artery, axillary artery or femoral artery; by cutdown
CPT		93526-Combined right heart catheterization and retrograde left heart catheterization
CPT		93528-Combined right heart catheterization with left ventricular puncture (with or without retrograde left heart catheterization)
CPT		93529-Combined right heart catheterization and left heart catheterization through existing septal opening (with or without retrograde left heart catheterization)
CPT		93555-Imaging supervision, interpretation and report for injection procedure(s) during cardiac catheterization; ventricular and/or atrial angiography
CPT		93556-Imaging supervision, interpretation and report for injection procedure(s) during cardiac catheterization; pulmonary angiography, aortography, and/or selective coronary angiography including venous bypass grafts and arterial conduits
Premier Chargemaster		270270008850000-CATHETER ANGIOGRAM
Premier Chargemaster		270270008860000-CATHETER ANGIOGRAM 7FR 110CM
Premier Chargemaster		270270008870000-CATHETER ANGIOGRAM 7FR

		90CM
	Premier Chargemaster	270270008880000-CATHETER ANGIOGRAM 8FR 110CM
	Premier Chargemaster	270270008900000-CATHETER ARTERIOGRAM
	Premier Chargemaster	270270009630000-CATHETER CARDIAC DIAGNOSTIC
	Premier Chargemaster	480480934540000-CATH PLACEMENT FOR CORONARY ANGIOGRAM
	Premier Chargemaster	480481000170000-CATH LEFT HEART W/LVA
	Premier Chargemaster	480481000180000-CATH LEFT HEART W/LVA & CA
	Premier Chargemaster	480481000190000-CATH LEFT HEART W/LVA CA & AO
	Premier Chargemaster	480481000200000-CATH LEFT HEART W/LVA CA & BG
	Premier Chargemaster	480481000210000-CATH LEFT HEART W/LVA CA BG & AO
	Premier Chargemaster	480481935080000-CATH PLACE FOR CORONARY ANGIO W/O LEFT HEART CATH
Electrophysiology (EP) Ablation	ICD-9-CM	37.34-Excision or destruction of other lesion or tissue of heart, endovascular approach
	CPT	93650-Intracardiac catheter ablation of atrioventricular node function, atrioventricular conduction for creation of complete heart block, with or without temporary pacemaker placement
	CPT	93651-Intracardiac catheter ablation of arrhythmogenic focus; for treatment of supraventricular tachycardia by ablation of fast or slow atrioventricular pathways, accessory atrioventricular connections or other atrial foci, singly or in combination
	CPT	93652-Intracardiac catheter ablation of arrhythmogenic focus; for treatment of ventricular tachycardia
	CPT	93660-Evaluation of cardiovascular function with tilt table evaluation, with continuous ECG monitoring and intermittent blood pressure monitoring, with or without pharmacological intervention
	CPT	93662-Intracardiac echocardiography during therapeutic/diagnostic intervention, including imaging supervision and interpretation
	Premier Chargemaster	480480936510000-ABLATION SVT
	Premier Chargemaster	480480936500000-ABLATION AV
	Premier Chargemaster	480480936520000-ABLATION VT
EP Testing	ICD-9-CM	37.26-Catheter based invasive electrophysiologic testing
	ICD-9-CM	37.27-Cardiac mapping
	CPT	93600-Bundle of His recording
	CPT	93602-Intra-arterial recording
	CPT	93603-Right ventricular recording
	CPT	93609-Intraventricular and/or intra-arterial mapping of tachycardia site(s) with catheter manipulation to record from multiple sites to identify origin of tachycardia
	CPT	93610-Intra-arterial pacing

	CPT	93612-Intraventricular pacing
	CPT	93613-Intracardiac electrophysiologic 3-dimensional mapping
	CPT	93615-Esophageal recording of atrial electrogram with or without ventricular electrogram(s)
	CPT	93616-with pacing
	CPT	93618-Induction of arrhythmia by electrical pacing
	CPT	93619-Comprehensive electrophysiologic evaluation with right atrial pacing and recording, right ventricular pacing and recording, His bundle recording, including insertion and repositioning of multiple electrode catheters, without induction or attempted induction of arrhythmia
	CPT	93620-Comprehensive electrophysiologic evaluation including insertion and repositioning of multiple electrode catheters with induction or attempted induction of arrhythmia; with right atrial pacing and recording, right ventricular pacing and recording, His bundle recording
	CPT	93621-Comprehensive electrophysiologic evaluation including insertion and repositioning of multiple electrode catheters with induction or attempted induction of arrhythmia; with left atrial pacing and recording from coronary sinus or left atrium
	CPT	93622-Comprehensive electrophysiologic evaluation including insertion and repositioning of multiple electrode catheters with induction or attempted induction of arrhythmia; with left ventricular pacing and recording
	CPT	93623-Programmed stimulation and pacing after intravenous drug infusion
	CPT	93624-Electrophysiologic follow-up study with pacing and recording to test effectiveness of therapy, including induction or attempted induction of arrhythmia
	CPT	93631-Intra-operative epicardial and endocardial pacing and mapping to localize the site of tachycardia or zone of slow conduction for surgical correction
	Premier Chargemaster	48048093620000-EP COMPREHENSIVE W/ARRHYTHMIA
	Premier Chargemaster	480480936070000-LEFT VENTRICULAR RECORDING
	Premier Chargemaster	480480936220000-EP COMPREHENSIVE LEFT VENTRICLE
	Premier Chargemaster	480480936030000-RIGHT VENTRICULAR RECORDING
	Premier Chargemaster	480480936020000-INTRA-ATRIAL RECORDING
	Premier Chargemaster	480480936210000-EP COMPREHENSIVE LEFT ATRIUM
	Premier Chargemaster	480480936120000-INTRAVENTRICULAR PACING
	Premier Chargemaster	480480936130000-EP INTRACARDIAC 3-D MAPPING
	Premier Chargemaster	480480936090000-TACHYCARDIA SITE MAPPING
	Premier Chargemaster	480480936100000-INTRA-ATRIAL PACING
Exercise Stress Testing	ICD-9-CM	89.41-Cardiovascular stress test using treadmill
	ICD-9-CM	89.42-Masters' two-step stress test

	ICD-9-CM	89.43-Cardiovascular stress test using bicycle ergometer
	CPT	93015-Cardiovascular stress test using maximal or submaximal treadmill or bicycle exercise, continuous electrocardiographic monitoring and/or pharmacological stress: with supervision, interpretation and report
	CPT	93016-Cardiovascular stress test using maximal or submaximal treadmill or bicycle exercise, continuous electrocardiographic monitoring and/or pharmacological stress; with supervision, without interpretation and report
	CPT	93017-Cardiovascular stress test using maximal or submaximal treadmill or bicycle exercise, continuous electrocardiographic monitoring and/or pharmacological stress; with tracing only, without interpretation and report
	CPT	93018-Cardiovascular stress test using maximal or submaximal treadmill or bicycle exercise, continuous electrocardiographic monitoring and/or pharmacological stress: with interpretation and report only
	Premier Chargemaster	480482930150000-STRESS TEST COMPLETE W/PF
	Premier Chargemaster	480482930170001-STRESS TEST W/ERGOMETER
	Premier Chargemaster	480482930170003-STRESS TEST TREADMILL
General Computed Tomography (CT)	ICD-9-CM	87.03-Computerized axial tomography of head
	ICD-9-CM	87.04-Other tomography of head
	ICD-9-CM	87.41-Computerized axial tomography of thorax
	ICD-9-CM	87.42-Other Tomography of Thorax
	ICD-9-CM	87.71-Computerized axial tomography of kidney
	ICD-9-CM	88.01-Computerized axial tomography of abdomen
	ICD-9-CM	88.02-Other abdomen tomography
	ICD-9-CM	88.38-Other computerized axial tomography
	CPT	70450-Computed tomography, head or brain; without contrast material
	CPT	70460-Computed tomography, head or brain; with contrast material
	CPT	70470-Computed tomography, head or brain; without contrast material, followed by contrast material(s) and further sections
	CPT	71250-Computed tomography, thorax; without contrast material
	CPT	71260-Computed tomography, thorax; with contrast material(s)
	CPT	71270-Computed tomography, thorax; without contrast material, followed by contrast material(s) and further sections
	CPT	71275-Computed tomographic angiography, chest (noncoronary), with contrast material(s), including noncontrast images, if performed, and image postprocessing
CPT	72192-Computed tomography, pelvis; without contrast material	
CPT	72194-Computed tomography, pelvis; without contrast material, followed by contrast material(s) and further	

	sections
CPT	74150-Computed tomography, abdomen; without contrast material
CPT	74160-Computed tomography, abdomen; with contrast material(s)
CPT	74270-Computed tomography, abdomen; without contrast material, followed by contrast material(s) and further sections
Premier Chargemaster	350352712500000-CT CHEST W/O CONTRAST
Premier Chargemaster	350352712500001-CT CHEST W/O CONTRAST EXTENDED
Premier Chargemaster	350352712600000-CT CHEST W/CONTRAST
Premier Chargemaster	350352712600001-CT CHEST W/CONTRAST EXTENDED
Premier Chargemaster	350352712700000-CT CHEST W/ & W/O CONTRAST
Premier Chargemaster	350352712700001-CT CHEST W/ & W/O CONTRAST EXTENDED
Premier Chargemaster	350352712750000-CTA CHEST (NONCARD) W/ CONTRAST & W/O IF PERFORMED
Premier Chargemaster	350352741600000-CT ABDOMEN W/CONTRAST
Premier Chargemaster	350352741600001-CT ABDOMEN W/CONTRAST EXTENDED
Premier Chargemaster	350352741500000-CT ABDOMEN W/O CONTRAST
Premier Chargemaster	350352741700001-CT ABDOMEN W/ & W/O CONTRAST EXTENDED
Premier Chargemaster	350352741700000-CT ABDOMEN W/ & W/O CONTRAST
Premier Chargemaster	350352741500001-CT ABDOMEN W/O CONTRAST EXTENDED
Premier Chargemaster	350352763800002-CT ABDOMEN W/O CONTRAST LIMITED
Premier Chargemaster	350351704600000-CT HEAD/BRAIN W/CONTRAST
Premier Chargemaster	350351704500001-CT HEAD/BRAIN W/O CONTRAST EXTENDED
Premier Chargemaster	350351704500000-CT HEAD/BRAIN W/O CONTRAST
Premier Chargemaster	350351704700001-CT HEAD/BRAIN W/ & W/O CONTRAST EXTENDED
Premier Chargemaster	350351704600001-CT HEAD/BRAIN W/CONTRAST EXTENDED
Premier Chargemaster	350351704700000-CT HEAD/BRAIN W/ & W/O CONTRAST
Premier Chargemaster	350352741740000-CTA,ABD & PELVIS,W/CONT INCLUDE W/O IMAGES,IF PERF
Premier Chargemaster	350352721910000-CTA PELVIS W/ CONTRAST & W/O IF PERFORMED
Premier Chargemaster	350352741750000-CTA ABDOMEN W/ CONTRAST & W/O IF PERFORMED
Premier Chargemaster	350351704960000-CTA HEAD W/ CONTRAST & W/O IF PERFORMED
Premier Chargemaster	350352721920000-CT PELVIS W/O CONTRAST

	Premier Chargemaster	350352721940001-CT PELVIS W/ & W/O CONTRAST EXTENDED
	Premier Chargemaster	350352721930001-CT PELVIS W/CONTRAST EXTENDED
	Premier Chargemaster	350352721940000-CT PELVIS W/ & W/O CONTRAST
	Premier Chargemaster	350352721930000-CT PELVIS W/CONTRAST
	Premier Chargemaster	350352721920001-CT PELVIS W/O CONTRAST EXTENDED
Percutaneous Coronary Intervention (PCI)	ICD-9-CM	0.66-Percutaneous transluminal coronary angioplasty [PTCA]
	ICD-9-CM	36.06-Insertion of non-drug-eluting coronary artery stent(s)
	ICD-9-CM	36.07-Insertion of drug-eluting coronary artery stent(s)
	CPT	92920-Percutaneous transluminal coronary angioplasty; single major coronary artery or branch
	CPT	92921-Percutaneous transluminal coronary angioplasty; each additional branch of a major coronary artery (List separately in addition to code for primary procedure)
	CPT	92924-Percutaneous transluminal coronary atherectomy, with coronary angioplasty when performed; single major coronary artery or branch
	CPT	92925-Percutaneous transluminal coronary atherectomy, with coronary angioplasty when performed; each additional branch of a major coronary artery (List separately in addition to code for primary procedure)
	CPT	92980-Transcatheter placement of an intracoronary stent(s), percutaneous, with or without other therapeutic intervention, any method; single vessel
	CPT	92981-Transcatheter placement of an intracoronary stent(s), percutaneous, with or without other therapeutic intervention, any method; each additional vessel
	CPT	92982-Percutaneous transluminal coronary balloon angioplasty; single vessel
	CPT	92984-percutaneous transluminal coronary balloon angioplasty; each additional vessel
	CPT	92995-Percutaneous transluminal coronary atherectomy, by mechanical or other method, with or without balloon angioplasty; single vessel
	CPT	92996-Percutaneous transluminal coronary atherectomy, by mechanical or other method, with or without balloon angioplasty; each additional vessel
	Premier Chargemaster	270270008910000-CATHETER ATHERECTOMY (CUTTING BALLOON)
	Premier Chargemaster	270270008970000-CATHETER BALLOON ACE
	Premier Chargemaster	270270008980000-CATHETER BALLOON ACE LONG
	Premier Chargemaster	270270008990000-CATHETER BALLOON ANGIOGRAM
Premier Chargemaster	270270009000000-CATHETER BALLOON ARC	
Premier Chargemaster	270270009010000-CATHETER BALLOON ASSIST	
Premier Chargemaster	270270009020000-CATHETER BALLOON BAILOUT CATH LAB	

Premier Chargemaster	270270009030000-CATHETER BALLOON BANDIT
Premier Chargemaster	270270009050000-CATHETER BALLOON COBRA
Premier Chargemaster	270270009070000-CATHETER BALLOON DILATION CARDIAC
Premier Chargemaster	270270009120000-CATHETER BALLOON ELIPSE
Premier Chargemaster	270270009150000-CATHETER BALLOON EVERGREEN
Premier Chargemaster	270270009180000-CATHETER BALLOON GRAFT ACE
Premier Chargemaster	270270009190000-CATHETER BALLOON GRUNTZIG
Premier Chargemaster	270270009220000-CATHETER BALLOON MEDITECH
Premier Chargemaster	270270009230000-CATHETER BALLOON MILLENIA
Premier Chargemaster	270270009240000-CATHETER BALLOON MONGOOSE
Premier Chargemaster	270270009260000-CATHETER BALLOON NC RANGER
Premier Chargemaster	270270009300000-CATHETER BALLOON PERC
Premier Chargemaster	270270009310000-CATHETER BALLOON PMC
Premier Chargemaster	270270009320000-CATHETER BALLOON PREDATOR
Premier Chargemaster	270270009330000-CATHETER BALLOON PRISM
Premier Chargemaster	270270009340000-CATHETER BALLOON PROBE
Premier Chargemaster	270270009350000-CATHETER BALLOON PTCA
Premier Chargemaster	270270009360000-CATHETER BALLOON RALLY
Premier Chargemaster	270270009370000-CATHETER BALLOON RANGER
Premier Chargemaster	270270009390000-CATHETER BALLOON RX COMET
Premier Chargemaster	270270009400000-CATHETER BALLOON RX COMET VP
Premier Chargemaster	270270009410000-CATHETER BALLOON SAVVY
Premier Chargemaster	270270009420000-CATHETER BALLOON SLALOM
Premier Chargemaster	270270009430000-CATHETER BALLOON SURPASS
Premier Chargemaster	270270009440000-CATHETER BALLOON THOR
Premier Chargemaster	270270009450000-CATHETER BALLOON TITAN
Premier Chargemaster	270270009460000-CATHETER BALLOON TITAN MEGA
Premier Chargemaster	270270009470000-CATHETER BALLOON TRAKSTAR
Premier Chargemaster	270270009480000-CATHETER BALLOON TRAPPER
Premier Chargemaster	270270009490000-CATHETER BALLOON TX 2000
Premier Chargemaster	270270009500000-CATHETER BALLOON ULTRA THICK
Premier Chargemaster	270270009520000-CATHETER BALLOON VALOR
Premier Chargemaster	270270009530000-CATHETER BALLOON VALVULOPLASTY
Premier Chargemaster	270270010980000-CATHETER GUIDING PTCA
Premier Chargemaster	270270015340000-CONNECTOR PTCA
Premier Chargemaster	270270026270000-GUIDEWIRE PTCA
Premier Chargemaster	270270026280000-GUIDEWIRE PTCA STEERABLE
Premier Chargemaster	270270028380000-INTRODUCER PTCA
Premier Chargemaster	270270028400000-INTRODUCER STENT SET
Premier Chargemaster	270270031150000-KIT PTCA
Premier Chargemaster	270270031160000-KIT PTCA GUIDEWIRE
Premier Chargemaster	270270035010000-PACK CATHETERIZATION LAB

	Premier Chargemaster	270270045670000-STENT CORONARY
	Premier Chargemaster	270270045750000-STENT INTRACORONARY
	Premier Chargemaster	270270095120000-CATHETER BALLOON DISPATCH
	Premier Chargemaster	270270095140000-CATHETER BALLOON LIFESTREAM
	Premier Chargemaster	270270095150000-CATHETER BALLOON MAGNUM
	Premier Chargemaster	270270101030000-CATHETER BALLOON UT 8MMX3
	Premier Chargemaster	270270101040000-CATHETER BALLOON BANDIT 3.75 NC
	Premier Chargemaster	270270101050000-CATHETER BALLOON 2.5
	Premier Chargemaster	270270101060000-CATHETER BALLOON 2.5M
	Premier Chargemaster	270270101070000-CATHETER BALLOON 3.0M
	Premier Chargemaster	270270101080000-CATHETER BALLOON 3.5MM
	Premier Chargemaster	270270101090000-CATHETER BALLOON 4MX2CM
	Premier Chargemaster	270270101100000-CATHETER BALLOON 5FR 4X10
	Premier Chargemaster	270270101110000-CATHETER BALLOON 5FR
	Premier Chargemaster	270270101120000-CATHETER BALLOON 6MM
	Premier Chargemaster	270270101130000-CATHETER BALLOON 6X2
	Premier Chargemaster	270270101140000-CATHETER BALLOON 6X4
	Premier Chargemaster	270270101150000-CATHETER BALLOON 7X4
	Premier Chargemaster	270270101160000-CATHETER BALLOON 8FR
	Premier Chargemaster	270270101170000-CATHETER BALLOON BMX 10X4
	Premier Chargemaster	270270110060000-STENT DRUG ELUTING
	Premier Chargemaster	270270110170000-STENT CORDIS CYPHER DRUG ELUTING
	Premier Chargemaster	270270110190000-STENT TAXUS EXPRESS PACLITAXEL-ELUTING
	Premier Chargemaster	270270111670000-STENT MEDTRONIC ENDEAVOR
	Premier Chargemaster	270270112010000-STENT CORONARY WITH DELIVERY SYSTEM
	Premier Chargemaster	480480000320000-PTCA W/STENT EACH ADDL VESSEL
	Premier Chargemaster	480480000330000-PTCA W/STENT SINGLE VESSEL
	Premier Chargemaster	480480000340000-PTCA W/SUPPLIES
	Premier Chargemaster	480480929730000-PERCUTANEOUS TRANSLUMINAL CORONARY THROMBECTOMY
	Premier Chargemaster	480480929800000-STENT PLACEMENT SINGLE VESSEL
	Premier Chargemaster	480480929810000-STENT PLACEMENT EACH ADDL VESSEL
	Premier Chargemaster	480480929820000-PTCA SINGLE VESSEL
	Premier Chargemaster	480480929840000-PTCA EACH ADDL VESSEL
Permanent Pacemaker (PPM)/ Automatic Implantable Cardioverter Defibrillator	ICD-9-CM	00.50-Implantation of cardiac resynchronization pacemaker without mention of defibrillation, total system (CRT-P)
	ICD-9-CM	00.51-Implantation of cardiac resynchronization defibrillator, total system (CRT-D)
	ICD-9-CM	00.52-Implantation of replacement of transvenous lead (electrode) into left ventricular coronary venous system
	ICD-9-CM	00.53-Implantation or replacement of cardiac

(AICD) Implantation		resynchronization pacemaker pulse generator only (CRT-P)
	ICD-9-CM	00.54-Implantation or replacement of cardiac resynchronization defibrillator pulse generator device only (CRT-D)
	ICD-9-CM	37.80-Insertion of permanent pacemaker, initial or replacement, type of device not specified
	ICD-9-CM	37.85-Replacement of any type pacemaker device with single-chamber device, not specified as rate responsive
	ICD-9-CM	37.86-Replacement of any type of pacemaker device with single-chamber device, rate responsive
	ICD-9-CM	37.87-Replacement of any type pacemaker device with dual-chamber device
	ICD-9-CM	37.89-Revision or removal of pacemaker device
	CPT	33206-Insertion or replacement of permanent pacemaker with transvenous electrode(s); atrial
	CPT	33207-Insertion or replacement of permanent pacemaker with transvenous electrode(s); ventricular
	CPT	33208-Insertion or replacement of permanent pacemaker with transvenous electrode(s); atrial and ventricular
	CPT	33212-Insertion or replacement of pacemaker pulse generator only; single chamber, atrial or ventricular
	CPT	33213-Insertion or replacement of pacemaker pulse generator only; dual chamber
	CPT	33214-Upgrade of implanted pacemaker system, conversion of single chamber system to dual chamber system (includes removal of previously placed pulse generator, testing of existing lead, insertion of new lead, insertion of new pulse generator)
	CPT	33215-Repositioning of previously implanted transvenous pacemaker or pacing cardioverter-defibrillator (right atrial or right ventricular) electrode
	CPT	33216-Insertion of a single transvenous electrode, permanent pacemaker or cardioverter-defibrillator
	CPT	33217-Insertion of 2 transvenous electrodes, permanent pacemaker or cardioverter-defibrillator
	CPT	33218-Repair of single transvenous electrode for a single chamber, permanent pacemaker or single chamber pacing cardioverter-defibrillator
	CPT	33220-Repair of 2 transvenous electrodes for a dual chamber permanent pacemaker or dual chamber pacing cardioverter-defibrillator
	CPT	33224-Insertion of pacing electrode, cardiac venous system, for left ventricular pacing, with attachment to previously placed pacemaker or pacing cardioverter-defibrillator pulse generator (including revision of pocket, removal, insertion, and/or replacement of generator)
	CPT	33225-Insertion of pacing electrode, cardiac venous system, for left ventricular pacing, at time of insertion of pacing cardioverter-defibrillator or pacemaker pulse generator (including upgrade to dual chamber system)

CPT	33226-Relocation of previously implanted cardiac venous system (left ventricular) electrode (including removal, insertion and/or replacement of generator)
CPT	33240-Insertion of single or dual chamber pacing cardioverter-defibrillator pulse generator
CPT	33249-Insertion or repositioning of electrode lead(s) for single or dual chamber pacing cardioverter-defibrillator and insertion of pulse generator
Premier Chargemaster	360450332070000-ER INSERTION PACEMAKER VENTRICULAR
Premier Chargemaster	360360332070000-INSERTION PACEMAKER VENTRICULAR
Premier Chargemaster	360490332000000-INSERTION PACEMAKER THORACOTOMY OP
Premier Chargemaster	360490332010000-INSERTION PACEMAKER XYPHOID OP
Premier Chargemaster	360450332080000-ER INSERTION PACEMAKER ATRIAL & VENTRICULAR
Premier Chargemaster	360360332000000-INSERTION PACEMAKER THORACOTOMY
Premier Chargemaster	360450332000000-ER INSERTION PACEMAKER THORACOTOMY
Premier Chargemaster	360360332120000-INSERTION PULSE GENERATOR SINGLE
Premier Chargemaster	360360332310000-INS OF PAC CARDIOVERT-DEFIB PULSE GEN;W/EXIST MULT
Premier Chargemaster	360450332400000-ER INSERTION ICD PULSE GENERATOR
Premier Chargemaster	360360332400000-INSERTION ICD PULSE GENERATOR
Premier Chargemaster	360490332490000-INSERTION ICD LEAD W/PULSE GENERATOR OP
Premier Chargemaster	360360332130000-INSERTION PULSE GENERATOR DUAL
Premier Chargemaster	360450332130000-ER INSERTION PULSE GENERATOR DUAL
Premier Chargemaster	360450332420000-ER REPAIR ICD PULSE GENERATOR
Premier Chargemaster	360360332140000-UPGRADE IMPLANTED PACEMAKER
Premier Chargemaster	360450332140000-ER UPGRADE IMPLANTED PACEMAKER
Premier Chargemaster	360360332010000-INSERTION PACEMAKER XYPHOID
Premier Chargemaster	360490332130000-INSERTION PULSE GENERATOR DUAL OP
Premier Chargemaster	360490332080000-INSERTION PACEMAKER ATRIAL & VENTRICULAR OP
Premier Chargemaster	360360332250000-INSERT PACING ELECT AT SAME TIME INSERT PM

	Premier Chargemaster	360450332120000-ER INSERTION PULSE GENERATOR SINGLE
	Premier Chargemaster	360360332490000-INSERTION ICD LEAD W/PULSE GENERATOR
	Premier Chargemaster	360360332210000-INS PCMKR PULSE GENERATOR; W/EXISTING MULT LEADS
	Premier Chargemaster	360450332470000-ER INSERTION ICD LEAD OTHER THAN THORACOTOMY
	Premier Chargemaster	360360332470000-INSERTION ICD LEAD OTHER THAN THORACOTOMY
	Premier Chargemaster	360360332420000-REPAIR ICD PULSE GENERATOR
	Premier Chargemaster	360490332060000-INSERTION PACEMAKER ATRIAL OP
	Premier Chargemaster	360450332490000-ER INSERTION ICD LEAD W/PULSE GENERATOR
	Premier Chargemaster	360360332300000-INS OF PAC CARDIOVERTER-DEFIB PUL GEN;W/EXIST DUAL
	Premier Chargemaster	360360332080000-INSERTION PACEMAKER ATRIAL & VENTRICULAR
	Premier Chargemaster	360490332420000-REPAIR ICD PULSE GENERATOR OP
	Premier Chargemaster	360490332140000-UPGRADE IMPLANTED PACEMAKER OP
	Premier Chargemaster	360490332470000-INSERTION ICD LEAD OTHER THAN THORACOTOMY OP
	Premier Chargemaster	360490332070000-INSERTION PACEMAKER VENTRICULAR OP
	Premier Chargemaster	360490332400000-INSERTION ICD PULSE GENERATOR OP
	Premier Chargemaster	360360332060000-INSERTION PACEMAKER ATRIAL
	Premier Chargemaster	360360332240000-INSERT PACING ELECT W ATTACH PREV IMPL PM
	Premier Chargemaster	360450332100000-ER INSERTION CARDIAC ELECTRODE SINGLE
	Premier Chargemaster	360490332120000-INSERTION PULSE GENERATOR SINGLE OP
	Premier Chargemaster	360450332060000-ER INSERTION PACEMAKER ATRIAL
	Premier Chargemaster	360450332010000-ER INSERTION PACEMAKER XYPHOID
Stress Echocardiography	CPT	93350-Echocardiography, transthoracic, real-time with image documentation (2D), with or without M-mode recording, during rest and cardiovascular stress test using treadmill, bicycle exercise, and/or pharmacologically induced stress, with interpretation and report
	CPT	93351-Echocardiography, transthoracic, real-time with image documentation (2D), includes M-mode recording, when performed, during rest and cardiovascular stress test using treadmill, bicycle exercise, and/or pharmacologically induced stress, with interpretation and report; including

		performance of continuous electrocardiographic monitoring, with physician supervision
	Premier Chargemaster	98098093350000-PF ECHO REST & STRESS W/PF
	Premier Chargemaster	980980933510000-PF ECHO REST & STRESS W/PF & CONTINUED EKG MONITOR
	Premier Chargemaster	48048393350000-ECHO REST & STRESS W/PF
	Premier Chargemaster	480480933510000-ECHO REST & STRESS W/PF & CONTINUOUS EKG MONITOR

Table S3: Codes used to identify inpatient management services

Service	Source	Code and Description
Coronary Care Unit	Medicare Revenue	0210-General classification
	Medicare Revenue	0211-Coronary care- myocardial infraction
	Medicare Revenue	0212-Coronary care-pulmonary care
	Medicare Revenue	0213-Coronary care- heart transplant
	Medicare Revenue	0219-Coronary care- other coronary care
	Premier Chargemaster	110210000010000-R&B CVICU
	Premier Chargemaster	110210000020000-R&B CVICU ISOLATION
	Premier Chargemaster	110210000030000-R&B CICU/CCU (CORONARY CARE)
	Premier Chargemaster	110210000060000-R&B CICU/CCU ISOLATION (CORONARY CARE)
Coronary Step Down Unit	Medicare Revenue	0214-Coronary care- post CCU; redefined as intermediate CCU
	Premier Chargemaster	110214000030000-R&B STEP DOWN CVICU ISOLATION
	Premier Chargemaster	110101000130000-R&B STEP DOWN ALL INCLUSIVE
	Premier Chargemaster	110141000530000-R&B TELEMETRY DELUXE
	Premier Chargemaster	110164000580000-R&B TCU ISOLATION
	Premier Chargemaster	110214000480000-R&B STEP DOWN CVICU DELUXE
	Premier Chargemaster	110214000020000-R&B STEP DOWN CVICU SEMI PRIVATE
	Premier Chargemaster	110214000140000-R&B STEP DOWN CVICU PRIVATE
	Premier Chargemaster	110214000010000-R&B STEP DOWN CICU/CCU SEMI PRIVATE
	Premier Chargemaster	110120000390000-R&B TCU SEMI PRIVATE
	Premier Chargemaster	110151000020000-R&B TELEMETRY WARD
	Premier Chargemaster	110101000050000-R&B TCU ALL INCLUSIVE
	Premier Chargemaster	110214000620000-R&B STEP DOWN CICU/CCU PRIVATE
	Premier Chargemaster	110214000100000-R&B STEP DOWN CICU/CCU ISOLATION
	Premier Chargemaster	110206000330000-R&B STEPDOWN ISOLATION
	Premier Chargemaster	110206000050000-R&B STEP DOWN MICU SEMI PRIVATE
	Premier Chargemaster	110150000010000-R&B TCU WARD
	Premier Chargemaster	110206000052000-R&B STEP DOWN MICU ISOLATION

	Premier Chargemaster	110110000380000-R&B TCU PRIVATE
	Premier Chargemaster	110121000330000-R&B TELEMETRY SEMI PRIVATE
	Premier Chargemaster	110206000310000-R&B STEP DOWN SEMI PRIVATE
	Premier Chargemaster	110101000060000-R&B TELEMETRY ALL INCLUSIVE
	Premier Chargemaster	110206000500000-R&B STEP DOWN MICU DELUXE
	Premier Chargemaster	110111000320000-R&B TELEMETRY PRIVATE
	Premier Chargemaster	110206000010000-R&B STEP DOWN DELUXE
	Premier Chargemaster	110206000030000-R&B STEP DOWN MICU PRIVATE
	Premier Chargemaster	110206000300000-R&B STEP DOWN PRIVATE
	Premier Chargemaster	110214000490000-R&B STEP DOWN CICU/CCU DELUXE
	Premier Chargemaster	110164000590000-R&B TELEMETRY ISOLATION
	Premier Chargemaster	110140000520000-R&B TCU DELUXE
Inpatient Cardiac Surgical Service	Taxonomy Code	208G00000X-Thoracic Surgery (Cardiothoracic Vascular Surgery)
	Premier Admitting	4012-Cardiovascular Surgery (CDS)
Inpatient Cardiology Service	Taxonomy Code	207RC0000X-Internal Medicine, Cardiovascular Disease
	Taxonomy Code	207RC0001X-Clinical Cardiac Electrophysiology
	Taxonomy Code	207RI0011X-Interventional Cardiology
	Premier Admitting	4010-Cardiac Electrophysiology (ICE)
	Premier Admitting	4011-Cardiovascular Diseases (CD)
Intensive Care Unit	ICD-9-CM	93.90-Non-invasive mechanical ventilation
	ICD-9-CM	96.70-Continuous invasive mechanical ventilation of unspecified duration
	ICD-9-CM	96.71-Continuous invasive mechanical ventilation for less than 96 consecutive hours
	ICD-9-CM	96.72-Continuous invasive mechanical ventilation for 96 consecutive hours or more
	CPT	94002-Ventilation assist and management, initiation of pressure or volume preset ventilators for assisted or controlled breathing; hospital inpatient/observation, initial day
	CPT	94003-; hospital inpatient/observation, each subsequent day
	CPT	94004-; nursing facility, per day
	CPT	94662-Continuous negative pressure ventilation (CNP), initiation and management
	Medicare Revenue	0200-Intensive care- General classification
	Medicare Revenue	0206-Intensive care- Post ICU
	Medicare Revenue	0209-Intensive care- Other intensive care
	Premier Chargemaster	11020000090000-R&B ICU
	Premier Chargemaster	110200000420000-R&B ICU ISOLATION
	Premier Chargemaster	110202000070000-R&B MICU ISOLATION
	Premier Chargemaster	110202000120000-R&B MICU
Inpatient Internal Medicine Service	Taxonomy Code	207R00000X-Internal Medicine
	Taxonomy Code	208M00000X-Hospitalist
	Premier Admitting	4046-Hospitalist (HOS)
	Premier Admitting	4050-Internal Medicine (IM)
Transplant Unit	ICD-9-CM	33.60-Combined heart-lung transplantation
	ICD-9-CM	37.51-Heart transplantation

	CPT	33933-Backbench standard preparation of cadaver donor heart/lung allograft prior to transplantation, including dissection of allograft from surrounding soft tissues to prepare aorta, superior vena cava, inferior vena cava, and trachea for implantation
	CPT	33935-Heart-lung transplant with recipient cardiectomy-pneumonectomy
	CPT	33944-Backbench standard preparation of cadaver donor heart allograft prior to transplantation, including dissection of allograft from surrounding soft tissues to prepare aorta, superior vena cava, inferior vena cava, pulmonary artery, and left atrium for implantation
	CPT	33945-Heart transplant, with or without recipient cardiectomy
	Medicare Revenue	0213-Coronary care- heart transplant
	Premier Chargemaster	360360339350000-HEART/LUNG TRANSPLANT W/RECIPIENT
	Premier Chargemaster	360490339450000-HEART TRANSPLANT OP
	Premier Chargemaster	360490339350000-HEART/LUNG TRANSPLANT W/RECIPIENT OP
	Premier Chargemaster	360360339450000-HEART TRANSPLANT

Table S4: Codes used to identify secondary prevention services

Service	Source	Code and Description
Inpatient Cardiac Rehabilitation (phase I)	ICD-9-CM	93.36-Cardiac retraining
	Medicare Revenue	0943-Other therapeutic services- cardiac rehabilitation
	Premier Chargemaster	940943000010000-CARDIAC REHAB THERAPY
	Premier Chargemaster	940943937970002-CARDIAC REHAB W/O MONITOR PER SESSION
	Premier Chargemaster	940943937980000-CARDIAC REHAB W/MONITOR PER SESSION
	Premier Chargemaster	940943937980003-CARDIAC REHAB W/MONITOR PER MONTH
	Premier Chargemaster	940943000090000-CARDIAC REHAB EVAL
	Premier Chargemaster	940943937990000-CARDIAC REHAB PROCEDURE UNLISTED
	Premier Chargemaster	940943000030000-CARDIAC REHAB CONSULT
	Premier Chargemaster	940943937980001-CARDIAC REHAB PHASE I PER SESSION
	Premier Chargemaster	940943000020000-CARDIAC REHAB EDUCATION
Outpatient Cardiac Rehabilitation (phase II or III)	CPT	93797-Physician or other qualified health care professional services for outpatient cardiac rehabilitation; without continuous ECG monitoring (per session)
	CPT	93798-Physician or other qualified health care professional services for outpatient cardiac rehabilitation; with continuous ECG monitoring (per session)
	Medicare Revenue	0943-Other therapeutic services- cardiac rehabilitation
	Premier Chargemaster	940943937970001-CARDIAC REHAB PHASE III/MAINT PER MONTH
	Premier Chargemaster	940943937980002-CARDIAC REHAB PHASE II PER SESSION
	Premier Chargemaster	940943937970000-CARDIAC REHAB PHASE III/MAINT PER SESSION
Pharmacist	CPT	99605-Medication therapy management service(s) provided by a pharmacist, individual, face-to-face with patient, with assessment and

		intervention if provided; initial 15 minutes, new patient
	CPT	99606-; initial 15 minutes, established patient
	CPT	99607-; each additional 15 minutes
	Medicare Revenue	0250-Pharmacy- general classification
	Premier Chargemaster	250250001152006-MEDICATION THERAPY MGMT INIT 1ST 15MIN, NEW
	Premier Chargemaster	250250001172006-MEDICATION THERAPY MGMT EACH ADDL 15 MIN
	Premier Chargemaster	250250001162006-MEDICATION THERAPY MGMT 1ST 15MIN,EST
Physiotherapy/ Occupational Therapy	ICD-9-CM	93.38-Combined physical therapy without mention of the components
	ICD-9-CM	93.39-Other physical therapy
	ICD-9-CM	93.83-Occupational therapy
	ICD-9-CM	93.89-Rehabilitation, not elsewhere classified
	CPT	93668-Peripheral arterial disease (PAD) rehabilitation, per session
	CPT	97001-Physical therapy evaluation
	CPT	97002-Physical therapy re-evaluation
	CPT	97003-Occupational therapy evaluation
	CPT	97004-Occupational therapy re-evaluation
	CPT	97110-Therapeutic procedure, 1 or more areas, each 15 minutes; therapeutic exercises to develop strength and endurance, range of motion and flexibility
	CPT	97112-Therapeutic procedure, 1 or more areas, each 15 minutes; neuromuscular reeducation of movement, balance, coordination, kinesthetic sense, posture, and/or proprioception for sitting and/or standing activities
	CPT	97113-Therapeutic procedure, 1 or more areas, each 15 minutes; aquatic therapy with therapeutic exercises
	CPT	97116-Therapeutic procedure, 1 or more areas, each 15 minutes; gait training (includes stair climbing)
	CPT	97124-Therapeutic procedure, 1 or more areas, each 15 minutes; massage, including effleurage, petrissage, and/or tapotement (stroking, compression, percussion)
	CPT	97140-Manual therapy techniques (eg, mobilization/manipulation, manual lymphatic drainage, manual traction), 1 or more regions, each 15 minutes
	CPT	97150-Therapeutic procedure(s), group (2 or more individuals)
	CPT	97530-Therapeutic activities, direct (one-on-one) patient contact by the provider (use of dynamic activities to improve functional performance), each 15 minutes
	Premier Chargemaster	430430975370002-OT WORK SIMULATION 1 HR
	Premier Chargemaster	430430977500008-OT FUNCTIONAL CAPACITY TEST ADDL HR
	Premier Chargemaster	430430000120000-OT CONFERENCE 20 MIN
	Premier Chargemaster	430430000150000-OT CONFERENCE 1 HR
	Premier Chargemaster	430430975370003-OT WORK CAPACITY ANALYSIS 15 MIN
	Premier Chargemaster	430434970030004-OT EVAL 30 MIN
	Premier Chargemaster	430430000100000-OT CONFERENCE 10 MIN
	Premier Chargemaster	430434970040100-OT RE-EVALUATION
	Premier Chargemaster	430430000170000-OT CONFERENCE FAMILY 15 MIN
	Premier Chargemaster	430434970030000-OT EVAL 15 MIN
Premier Chargemaster	430430000070000-OT CHECK	
Premier Chargemaster	430434970030011-OT EVAL SCREENING 15 MIN	
Premier Chargemaster	430430977990003-OT MISC	
Premier Chargemaster	430430977500004-OT FUNCTIONAL CAPACITY TEST 30 MIN	

Premier Chargemaster	43043000020000-OT IN ROOM VISIT
Premier Chargemaster	430430000160000-OT CONFERENCE DISCHARGE 15 MIN
Premier Chargemaster	430434970030023-OT EVALUATION
Premier Chargemaster	430430000180000-OT EDUCATION 1 HR
Premier Chargemaster	430430977500005-OT FUNCTIONAL CAPACITY TEST 1 HR
Premier Chargemaster	430430977500007-OT FUNCTIONAL CAPACITY TEST 6 HRS
Premier Chargemaster	430434970040000-OT RE-EVAL 15 MIN
Premier Chargemaster	430434970030014-OT EVAL HOME 1 HR
Premier Chargemaster	430430977500006-OT FUNCTIONAL CAPACITY TEST 2 HRS 30 MIN
Premier Chargemaster	430434970030003-OT EVAL 20 MIN
Premier Chargemaster	430430975370006-OT WORK SIMULATION 30 MIN
Premier Chargemaster	430430000110000-OT CONFERENCE 15 MIN
Premier Chargemaster	430430000230000-OT EDUCATION 15 MIN
Premier Chargemaster	430434970030005-OT EVAL 45 MIN
Premier Chargemaster	430430000050000-OT STERILE TECHNIQUE
Premier Chargemaster	430430000080000-OT FOLLOWUP
Premier Chargemaster	430434970030015-OT EVAL ISOKINETIC 15 MIN
Premier Chargemaster	430434970040004-OT RE-EVAL 30 MIN
Premier Chargemaster	430430000220000-OT EDUCATION FAMILY 15 MIN
Premier Chargemaster	430434970030009-OT EVAL HOME 15 MIN
Premier Chargemaster	430430000140000-OT CONFERENCE ADDL 15 MIN
Premier Chargemaster	430433971500004-OT WORK SIMULATION GROUP 1 HR
Premier Chargemaster	430430975370001-OT COMMUNITY REINTEGRATION OUTING 15 MIN
Premier Chargemaster	430430000190000-OT HOME VISIT
Premier Chargemaster	430434970030008-OT EVAL HAND THERAPY 15 MIN
Premier Chargemaster	430430977500001-OT FUNCTIONAL CAPACITY TEST 15 MIN
Premier Chargemaster	430430977500002-OT BTE/WORK SIMULATOR TEST 15 MIN
Premier Chargemaster	430433000250000-OT EDUCATION GROUP 30 MIN
Premier Chargemaster	430434970030002-OT EVAL 10 MIN
Premier Chargemaster	430434970030006-OT EVAL ADDL 15 MIN
Premier Chargemaster	430430000130000-OT CONFERENCE 30 MIN
Premier Chargemaster	430430000240000-OT EDUCATION 30 MIN
Premier Chargemaster	430430975370009-OT COMMUNITY/WORK REINTEGRATION 15 MIN
Premier Chargemaster	430434970030010-OT EVAL PED 15 MIN
Premier Chargemaster	430430975370008-OT WORK CAPACITY ANALYSIS 30 MIN
Premier Chargemaster	430430977500003-OT SPECIAL REPORT 15 MIN
Premier Chargemaster	430434970030001-OT EVAL 1 HR
Premier Chargemaster	430430000090000-OT AIDE/ADDL PERSON
Premier Chargemaster	430430975370005-OT WORK CAPACITY ANALYSIS ADDL 30 MIN
Premier Chargemaster	430430975370004-OT WORK CAPACITY ANALYSIS 1 HR
Premier Chargemaster	430434970030020-OT CONSULT 15 MIN
Premier Chargemaster	430434970030013-OT EVAL WHEELCHAIR 15 MIN
Premier Chargemaster	430434970030012-OT EVAL SENSORY 15 MIN
Premier Chargemaster	430434970030007-OT EVAL DISABILITY 15 MIN
Premier Chargemaster	430433971500005-OT WORK SIMULATION GROUP ADDL 30 MIN
Premier Chargemaster	420420975350000-PT HOME INSTRUCTION/PROGRAM 15 MIN

	Premier Chargemaster	420420000330000-PT CONFERENCE 1 HR
	Premier Chargemaster	420424970010008-PT EVAL PRE OP 15 MIN
	Premier Chargemaster	420420000220000-PT CONFERENCE 20 MIN
	Premier Chargemaster	420420000170000-PT EDUCATION FAMILY 15 MIN
	Premier Chargemaster	420420000240000-PT CONFERENCE DISCHARGE 15 MIN
	Premier Chargemaster	420420000120000-PT EDUCATION PATIENT 15 MIN
	Premier Chargemaster	420420000090000-PT AIDE/ADDL PERSON
	Premier Chargemaster	420420977500001-PT FUNCTIONAL CAPACITY TEST PER HR
	Premier Chargemaster	420424970010003-PT EVAL 30 MIN
	Premier Chargemaster	420420000270000-PT EDUCATION BACK CARE 15 MIN
	Premier Chargemaster	420424970010004-PT EVAL 45 MIN
	Premier Chargemaster	420420000020000-PT STAT FEE
	Premier Chargemaster	420420977990003-PT MISC
	Premier Chargemaster	420420000230000-PT CONFERENCE 45 MIN
	Premier Chargemaster	420424970010016-PT CONSULT 15 MIN
	Premier Chargemaster	420424970010002-PT EVAL 20 MIN
	Premier Chargemaster	420424970010001-PT EVAL 15 MIN
	Premier Chargemaster	420424970010007-PT EVAL ORTHOTIC 15 MIN
	Premier Chargemaster	420420000190000-PT CONFERENCE 10 MIN
	Premier Chargemaster	420424970010100-PT EVALUATION
	Premier Chargemaster	420420000140000-PT EQUIPMENT CHECK 15 MIN
	Premier Chargemaster	420424970010015-PT EVAL 1 HR
	Premier Chargemaster	420420000070000-PT FOLLOWUP
	Premier Chargemaster	420420000100000-PT HOME VISIT
	Premier Chargemaster	420420977500000-PT PERFORMANCE TEST 15 MIN
	Premier Chargemaster	420424970020100-PT RE-EVALUATION
	Premier Chargemaster	420424970010005-PT EVAL HOME 30 MIN
	Premier Chargemaster	420420000300000-PT CONFERENCE 15 MIN
	Premier Chargemaster	420424970010011-PT EVAL WHEELCHAIR 15 MIN
	Premier Chargemaster	420424970020001-PT RE-EVAL 30 MIN
	Premier Chargemaster	420424970010010-PT EVAL TENS 15 MIN
	Premier Chargemaster	420420000210000-PT CONFERENCE 30 MIN
	Premier Chargemaster	420420000180000-PT EDUCATION BACK CARE 1 HR
	Premier Chargemaster	420424970010006-PT EVAL ISOKINETIC 30 MIN
	Premier Chargemaster	420420000250000-PT EDUCATION PATIENT 30 MIN
	Premier Chargemaster	420424970010009-PT EVAL SCREENING 15 MIN
	Premier Chargemaster	420420000110000-PT IN ROOM VISIT
	Premier Chargemaster	420424970020000-PT RE-EVAL 15 MIN
Social Worker	ICD-9-CM	94.33-Behavior therapy
	CPT	96150-Health and behavior assessment (eg, health-focused clinical interview, behavioral observations, psychophysiological monitoring, health-oriented questionnaires), each 15 minutes face-to-face with the patient; initial assessment
	CPT	96151-; re-assessment
	CPT	96152-Health and behavior intervention, each 15 minutes, face-to-face; individual
	CPT	96153-; group (2 or more patients)
	CPT	96154-; family (with the patient present)
	CPT	96155-; family (without the patient present)
	Premier Chargemaster	940940000030000-SOCIAL SERVICES FLAT RATE

	Premier Chargemaster	940940000040000-SOCIAL SERVICES 1 HR
	Premier Chargemaster	580581000050000-HOME HEALTH VISIT SOCIAL WORKER
Inpatient Heart Failure Services	<i>Could not be identified using administrative data</i>	
Outpatient Heart Failure Services	<i>Could not be identified using administrative data</i>	
Readmissions Prevention Program	<i>Could not be identified using administrative data</i>	

Table S5: Percentage agreement and disagreement between administrative data (non-Premier codes) and AHA Annual Survey

Services recommended for AMI care	% Agree or Disagree				% Agreement †	Cohen's Kappa (95% CI)	McNemar's test for symmetry <i>P</i> -value*
	Agree: Yes on AHA survey/ Yes on administrati ve data (%)	Disagree: Yes on AHA survey/ No on administrati ve data (%)	Disagree: No on AHA survey/ Yes on administrati ve data (%)	Agree: No on AHA survey/ No on administrati ve data (%)			
Acute Care							
Dedicated Emergency Department (ED)	99.7	0.3	0.0	0.0	99.7	N/A	N/A
Diagnostic and Procedural							
Cardiac Nuclear Perfusion Imaging	61.7	38.3	0.0	0.0	61.7	N/A	N/A
General Computed Tomography (CT)	70.1	29.0	0.6	0.3	70.4	0.0024 (-0.0289, 0.0336)	<0.0001
Diagnostic Coronary Angiography	76.2	2.3	2.3	19.1	95.4	0.86 (0.80, 0.93)	1.00
Percutaneous Coronary Intervention (PCI)	64.1	1.5	1.5	33.0	97.1	0.94 (0.90, 0.98)	1.00
Electrophysiology (EP) Testing	37.4	18.6	1.7	42.3	79.7	0.60 (0.53, 0.68)	<0.01
Inpatient Management							
Coronary Care Unit	34.8	20.6	7.5	37.1	71.9	0.45 (0.36, 0.54)	<0.01

Inpatient Cardiac Surgical Service	0.0	51.9	0.0	48.1	48.1	N/A	N/A
Inpatient Cardiology Service	0.0	82.6	0.0	17.4	17.4	N/A	N/A
Intensive Care Unit	97.4	0.3	2.0	0.3	97.7	0.22 (-0.19, 0.52)	<0.01
Inpatient Internal Medicine Service	0.0	90.0	0.0	10.0	10.0	N/A	N/A
Transplant Unit	0.0	2.6	0.0	97.4	97.4	N/A	N/A

Secondary Prevention

Inpatient Cardiac Rehabilitation (Phase 1)	0.3	76.5	0.0	23.2	23.5	0.43 (0.25, 0.52)	<0.01
Pharmacist	98.6	0.0	1.4	0.0	98.6	N/A	N/A
Physiotherapy/ Occupational Therapy	21.2	20.3	24.6	33.9	55.1	0.09 (-0.01, 0.19)	0.2283
Social Worker	0.3	96.2	0.0	3.5	3.8	0.0002 (-0.0002, 0.0006)	<0.01

* Statistically significant at $P < 0.05$

† Agreement between AHA survey and non-Premier codes (ICD-9-CM, CPT, Medicare Revenue, Taxonomy)