Cardiac CT and Coronary CTA: Early Medicare Claims Analysis of National and Regional Utilization and Coverage

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Purpose: The aim of this study was to assess trends in utilization and Medicare coverage of cardiac CT and coronary CT angiography (CCTA).

Methods: Medicare claims for cardiac CT and CCTA were identified for the first 3 complete years for which Current Procedural Terminology® tracking codes existed (2006-2008). The frequencies of billed and denied services were extracted on national and regional bases, along with reporting physician specialty and site of service.

Results: Total annual claims for cardiac CT and CCTA services for Medicare fee-for-service beneficiaries increased from 58,124 to 95,269 (+64%) between 2006 and 2008. The overall percentage of denied claims decreased from 34% to 21% (20,014 of 58,124 to 20,062 of 95,269, P < .001), with the highest denial rate for calcium scoring studies (declining from 82% to 61%) and the lowest rate for CCTA (29% to 14%). Annual overall regional denial rates ranged from 8.9% to 80.6%. Of all 254,672 base services, 138,136 claims (54%) were submitted by cardiologists, 90,767 (36%) by radiologists, and 13,445 (5%) by others. In 12,324 cases (5%), provider specialty was undetermined. Two-thirds (67%) of services were reported in the office setting (170,511), followed by the outpatient hospital (64,008 [25%]), inpatient hospital (15,922 [6%]), ER (1,577 [1%]), and all other (2,654 [1%]) settings.

Conclusion: Most cardiac CT and CCTA services are reported by cardiologists and most takes place in private office and outpatient hospital settings. During the first 3 years of Current Procedural Terminology tracking codes, the utilization of cardiac CT and CCTA by Medicare fee-for-service beneficiaries increased by 64%. Despite perceptions that new technology tracking codes are rarely payable, a large majority of all examinations are reimbursed by Medicare. Coverage varies regionally but overall has improved, setting the stage for expanded patient access.

Key Words: Radiology and radiologists, cardiology and cardiologists, Medicare utilization and coverage, cardiac CT, cardiac CT angiography, socioeconomic trends

J Am Coll Radiol 2011;8:549-555. Copyright © 2011 American College of Radiology

INTRODUCTION

Cardiac CT and coronary CT angiography (CCTA) have emerged over the past decade as valuable tools in the assessment of coronary artery disease. Coronary calcium scoring was the first validated cardiac CT application in widespread clinical use and has been demonstrated to further risk-stratify asymptomatic patients at intermediate risk by traditional criteria [1-6]. Further improvements in technology have allowed the development of angiographic techniques, and CCTA has now gained broad acceptance in a variety of clinical scenarios.

In a number of settings, barriers to physician payment have been shown to impede patient access to medical services [7-12]. Medical imaging in general [13] and new technology in particular [14-16] have faced ever increasing hurdles for coverage, and that convergence has targeted cardiac CT and CCTA. Although several Medicare contractors initially covered these services for a number
of indications, CMS recently attempted to implement a national noncoverage determination policy. In response to intense educational and advocacy efforts by numerous cardiology and radiology organizations, this proposal was eventually withdrawn, and coverage decisions for cardiac CT and CCTA remain at the discretion of local Medicare carriers [17,18].

Since the assignment of dedicated Category III Current Procedural Terminology® (CPT®) codes for these procedures, the utilization of both cardiac CT and CCTA has seemingly increased, and, although variable, successful provider reimbursement has anecdotally improved. However, we are aware of no formal validation of those impressions. Accordingly, the purpose of this analysis was to assess early national and regional trends in utilization and Medicare coverage of cardiac CT and CCTA.

**METHODS**

This study was performed using methodology similar to that previously described for other medical imaging procedure analyses [19-22]. Annual Medicare Physician Supplier Procedure Summary (PSPS) master files from 2006 through 2008 were acquired from CMS. These files aggregate Part B Medicare fee-for-service billing claims filed by physicians and other providers. Those summary claims data are classified by codes for procedure, reporting physician specialty, place of service, and region and include numbers of procedures billed and denied. These files are compiled for public use, without individual patient, physician, diagnosis, or other encounter-specific information, and their analysis is thus exempt from institutional review board oversight.

The PSPS data files include claims for all beneficiaries in Medicare’s traditional fee-for-service program. Medicare currently insures individuals aged ≥65 years, some disabled individuals aged <65 years, and persons of all ages with end-stage renal disease. Between 2006 and 2008, Medicare fee-for-service enrollment was approximately 33 million [23], making its public-use claims data set the largest available for national physician service analysis.

CPT codes 0144T through 0150T were implemented in 2006 to describe cardiac CT and CCTA examinations during the entire period of this study [24]. Alphanumeric Category III CPT tracking codes such as these are assigned to report new and emerging technologies [25]. The PSPS data files for these codes (Table 1) were specifically targeted for evaluation. Because add-on code 0151T (for cardiac functional evaluation) is always reported in conjunction with one of these base codes, claims for this code were excluded from our analysis to avoid double counting. Only professional component and global service claims were examined (ie, technical-only claims were excluded) to similarly avoid double counting of services.

Claims for bundled services (nominally the result of incorrect CPT coding) are administratively denied and excluded by CMS in its PSPS claims data. Denials in the PSPS files therefore refer to those claims which have been disallowed because of coverage or medical necessity determinations. Using the annual number of submissions and denials, denial rates could be calculated. National changes in denial rates were evaluated for statistical significance using Pearson’s χ² test.

Geographic analysis of cardiac CT and CCTA denials was performed by CMS region. Regional codes are assigned to the established CMS regional offices: Boston, New York, Philadelphia, Atlanta, Chicago, Dallas, Kansas City (Missouri), Denver, San Francisco, and Seattle. These 10 regions include all states and United States territories. An additional code, for “Travelers Railroad,” also exists but applies to only a small number of Medicare beneficiaries classified by nongeographic miscellaneous criteria (such as railroad workers).

Physicians are identified within the PSPS files with self-designated specialty codes. Cardiology has its own specialty provider code (06) and for this study was considered a distinct category. Those physicians with codes for diagnostic radiology (30), interventional radiology (94), and nuclear medicine (36) were grouped together as radiologists. All other identifiable specialties were aggregated. For some providers (such as those servicing independent diagnostic testing facilities or employed by multispecialty groups), claims are submitted using a code for the practice type (rather than physician specialty), and thus specialty information could not be extracted. These were grouped in an undetermined category.

The PSPS files also identify procedures by site of service, using a variety of different code groups. Place-of-service information could thus be extracted in a similar fashion, and we specifically targeted the highest volume location codes for physician office (11), outpatient hospital (22), inpatient hospital (21), and hospital emerg-

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**Table 1.** Base cardiac CT and CCTA category III CPT® codes in effect during the period of analysis (2006-2008)

<table>
<thead>
<tr>
<th>Code</th>
<th>Description</th>
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<tr>
<td>0144T</td>
<td>CT, without contrast, including calcium scoring</td>
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<tr>
<td>0145T</td>
<td>CT, with contrast, for structure and morphology</td>
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<tr>
<td>0146T</td>
<td>CTA, without calcium scoring</td>
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<tr>
<td>0147T</td>
<td>CTA, with calcium scoring</td>
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<tr>
<td>0148T</td>
<td>CT, with contrast, for structure and morphology, and CTA, without calcium scoring</td>
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<tr>
<td>0149T</td>
<td>CT, with contrast, for structure and morphology, and CTA, with calcium scoring</td>
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<tr>
<td>0150T</td>
<td>CT, with contrast, for congenital heart disease</td>
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Note: CCTA  = coronary CT angiography; CTA  = CT angiography.
gency department (23). Other much lower volume sites were aggregated in a single miscellaneous category.

All data and statistical analysis was performed using commercially available database and spreadsheet software (Access 2007 and Excel 2007; Microsoft Corporation, Redmond, Washington).

RESULTS

Between 2006 and 2008, annual claims for cardiac CT and CCTA services for Medicare fee-for-service beneficiaries increased by 63.9%, from 58,124 to 95,269 (Table 2). During that period, total denials at the national level changed little, from 20,014 to 20,062 (0.2%). With the much larger rise in performed services, this corresponded to a significant decline in national denial rates, from 34.4% to 21.1% (P<.001), as detailed in Table 2.

Denial rates for calcium scoring studies (CPT code 0144T) decreased from 82.2% (4,701 of 5,717) to 60.9% (8,505 of 13,227). Denial rates for CCTA examinations (CPT codes 0146T through 0149T) decreased from 28.7% (14,324 of 49,841) to 14.2% (11,254 of 79,158). Denial rates for other structure and morphology examinations (CPT codes 0145T and 0150T) decreased from 38.5% (989 of 2,566) to 26.1% (753 of 2,884).

Regional denial rates over the 3-year period varied considerably on a year-to-year and region-to-region basis, as illustrated in both Table 3 and Figure 1. Regions with the largest relative declines in denial rates during this initial trackable period were Denver (from 80.6% in 2006 to 21.1% in 2008), San Francisco (57.8% to 24.0%), and Philadelphia (53.1% to 23.3%). When claims were aggregated over all 3 years, the highest overall denial rates were noted in the Philadelphia (36.0%), Seattle (34.1%), Chicago (32.4%), and Denver (31.7%) regions.

On the basis of Medicare claims, cardiologists were the dominant providers of cardiac CT and CCTA services, with volume increasing from 29,490 in 2006 to 52,847 (+79.2%), and reporting a total of 138,136

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<th>Table 2. National annual Medicare fee-for-service cardiac CT and coronary CT angiography submitted and denied claims</th>
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<td>Denial rate*</td>
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*Estimated by dividing denied claims by the total number submitted.

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<th>Table 3. Annual Medicare fee-for-service cardiac CT and coronary CT angiography denied (top rows) and submitted (bottom rows) claims, by CMS region</th>
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<td>Region</td>
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Note: Denial rates for each period are indicated in parentheses.
(54.2%) of all 254,672 services. Services reported by radiologists increased from 22,595 in 2006 to 32,743 in 2008 (+44.9%), for a total of 90,767 (35.6%) of all services. All other identifiable specialty groups together reported 13,445 (5.3%) services. For the 12,324 services (4.8%) performed at multispecialty clinics and independent diagnostic testing facilities, reporting physician specialty could not be determined. Annual specialty group trends are plotted in Figure 2.

The largest growth of cardiac CT and CCTA services was noted in the private office setting, increasing from 37,140 in 2006 to 63,917 in 2008 (+26,777 [+72.1%]). These services represented 67.0% of all such services (170,511 of 254,672). Services in the outpatient hospital setting increased 6,147 (16,778 to 22,925 [+36.6%]) and represented 25.1% of all services. Inpatient hospital services grew from 3,344 to 6,873 (+3,529 [+106%]) and represented 6.3% of all services. A total of 1,577 and 2,654 services were performed in the ER and all other settings combined, respectively, and represented only 0.6% and 1.0% of all services. Annual changes in site of service are graphed in Figure 3.

Overall national denial rates were 19.4% (33,060 of 170,511) in the office, 33.1% in the outpatient hospital (21,195 of 64,008), 29.1% in the inpatient hospital (4,631 of 15,922), and 19.8% in the emergency department (313 of 1,577) settings.

Of the 170,511 services performed in private offices, 108,663 (63.7%) were reported by cardiologists, 42,256 (24.2%) by radiologists, and 10,483 (6.1%) by other specialists (10,109 undetermined). Of 64,008 services performed in the outpatient hospital setting, 23,334 (36.5%) were reported by cardiologists, 38,267 (59.8%) by radiologists, and 2,295 (3.6%) by other specialists (112 undetermined). Of 15,922 services performed in the inpatient hospital setting, 5,534 (34.8%) were reported by cardiologists, 9,750 (61.2%) by radiologists, and 505 (3.2%) by other specialists (133 undetermined). And of 1,577 services performed in the hospital emergency department setting, 366 (23.2%) were performed by cardiologists, 1,176 (74.5%) by radiologists, and 34 (2.2%) by other specialists (1 undetermined). Specialty percentage distributions by sites of service are plotted in Figure 4.

![Fig 1. Total number of 3-year Medicare fee-for-service claims for cardiac CT and CCTA (in parentheses), with denial rates over time (2006–2008), by CMS geographic region.](image1)

![Fig 2. Annual cardiac CT and CCTA Medicare fee-for-service claims, by reporting specialty.](image2)

![Fig 3. Annual cardiac CT and CCTA Medicare fee-for-service claims, by site of service.](image3)

![Fig 4. Percentage of total services reported by specialty group, by major sites of service.](image4)
DISCUSSION
Cardiac CT and CCTA utilization has grown rapidly throughout the country, likely the result of both an increasing number of validation studies and rapid technical advances. CCTA, in particular, has become a focus of major clinical interest, with some suggesting a role replacing more expensive studies such as nuclear perfusion imaging and, in select patients, conventional catheter-based coronary angiography [26,27].

The landscape for cardiac CT and CCTA will no doubt continue to evolve as technological advances improve test performance and simultaneously reduce radiation dose. Multiple large comparative effectiveness research trials are now underway to further evaluate the utility of CCTA in settings such as acute chest pain and chronic angina [28-30]. Paralleling these technical advances and clinical initiatives have been the development of stringent training, performance, and appropriateness guidelines by various professional societies [31-33]. Together, these factors have all likely influenced, and will continue to influence, ongoing coverage determinations by Medicare and other payers.

Perception has long existed that new technology Category III CPT tracking codes, which undergo a less rigorous approval and valuation process than traditional established service Category I codes, are often not paid [34,35]. A recent report of early Medicare claims experience with diagnostic CT colonography, however, has demonstrated that some services described by Category III CPT codes are paid more frequently than anticipated [22]. Our analysis suggests the same for Cardiac CT and CCTA. Although Category I CPT codes 75571, 75572, 75573, and 74474 have since been implemented for these procedures [36,37], Medicare coverage was clearly present, and expanding, when cardiac CT and CCTA maintained Category III code status.

The mismatch between payment for cardiac CT and CCTA and the conventional perception that emerging technology is rarely reimbursed is likely related to a number of factors. The aforementioned technical advances, clinical trials, and standards documents have likely been favorably received by the payer community. Also important, but often overlooked, we believe, have been coordinated physician advocacy efforts. Local Medicare contractors are charged with using formal physician carrier advisory committees when enacting and modifying local coverage determination policies [38,39]. That local oversight is intended to ensure that services are available in conformance with regional patterns of care. To provide patient access to appropriate and current services, the ACR and the American College of Cardiology have maintained carrier advisory committees composed of volunteer physicians who interface with local Medicare contractor payer advisory committees [38,39]. Such liaison efforts have been instrumental in expanding the list of payable indications for other emerging technologies such as CT colonography [40].

Similar efforts, involving the ACR, the American College of Cardiology, the Society of Cardiovascular Computed Tomography, the North American Society for Cardiovascular Imaging, the American Society of Nuclear Cardiology, and other cardiac imaging stakeholders, have advocated expanded coverage for appropriate cardiac CT and CCTA procedures. We believe that such coordinated local advocacy activities and their resulting expansion of coverage have contributed to the overall improving denial rates for cardiac CT and CCTA reported herein. The fact that such policies are established regionally, and not nationally, likely explains the dramatic differences in denial rates from region to region over time and highlights the need for ongoing targeted medical director education. Although the reduction in national denial rates from 34% to 21% reflects considerable early acceptance of these modalities, when contrasted with denial rates of just 4% for established CT technologies such as abdominal imaging [22], opportunities clearly exist for further expansion of cardiac CT and CCTA coverage, as supported by ongoing research further defining its appropriate use.

Despite recent articles supporting the role of CCTA in the emergency department [28-30], Medicare claims for CCTA in that setting are surprisingly uncommon. It is possible that such advanced cardiac imaging is regularly available on an emergent basis only at selected referral centers (such as those targeted in those series) but not in the more general community hospital setting. This seeming infrequency may as well be the result of PSPS master files incompletely capturing these encounters. If performed as “triple rule out” studies evaluating the coronary, systemic, and pulmonary arterial systems, these studies are accurately reported using CPT codes for both CCTA and noncoronary CT angiography [41]. Because of payers challenges, however, one author has stated that “it may be preferable to bill for the Category I code (71275) and write off the cardiac portion of the exam” [42]. If this is a widely accepted practice, our analysis underestimates the frequency with which CCTA is performed as part of “triple rule out” studies.

The distribution of services by specialty and location demonstrates that cardiologists predominate in the private office setting, whereas radiologists predominate in the hospital setting. The higher percentage of hospital radiology interpretations may be due in part to exclusive contracts which permit only radiologists to bill for interpretations for CT and other advanced imaging services in the hospital setting [43]. The site distribution may also reflect patient preference for outpatient facilities rather than hospital facilities and also a referral bias to direct outpatients to outpatient imaging centers rather than to

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hospital imaging facilities. Levin et al [20] observed a similar
distribution for myocardial perfusion imaging and
invoked financially driven self-referral as a possible
explanation. Our data do not permit us to comment on
self-referral because they include only billing, rather than
referral, information.

Despite the rapid growth of cardiac CT and CCTA
over its first 3 trackable years, these services, however,
are still relatively uncommonly performed. The
95,269 services on approximately 32.5 million Medi-
care fee-for-service beneficiaries in 2008 translate to
only 1 service per 341 enrollees. In comparison,
recent report on myocardial perfusion imaging and
cardiac catheterization in the Medicare population
indicates utilization levels of both well over an order of
magnitude higher [20]. If clinical value can continue
to be demonstrated for cardiac CT and CCTA, further
growth seems quite likely.

Several limitations exist with this analysis. Although
this study, using PSPS files, was based on the largest
single publicly available physician claims database in this
country, Medicare covers only approximately 15% of the
United States population [44], and without a national
all-payer claims database, the experience of the remainder
of the population, most covered by private insurance,
cannot be definitively asserted. We are aware of no
evidence to indicate, however, that the general trends we
report should substantially diverge in the non-Medicare
population.

Because PSPS files include only aggregated claims, the
details of individual patient encounters cannot be ex-
tacted. To that end, we are unable to identify specific
reasons for payment denials, or determine whether such
studies were in conformance with current appropriaten-
ness criteria. Additionally, aggregate claims do not per-
mit separation of originally denied claims from success-
fully resubmitted claims and thus potentially slightly
distort calculated volume and denial rates. As a practical
matter, a successful appeal is included in PSPS data as
two separate claims submissions (ie, one each for the
original and resubmitted bills) and a single denial (ie, that
for the original claim). The number of successful cardiac
CT and CCTA claims resubmissions, unfortunately, is
unknown. Even if resubmission rates were as high as
10%, actual denial rates would change little (from 34.4% to
32.1% in 2006 and 21.1% to 19.4% in 2008). The
overall trends, however, would remain quite similar.

Finally, at least some centers have adopted a team
approach to cardiac CT and CCTA interpretations, in
which cardiologists focus their evaluation on the heart
and great vessels and radiologists evaluate all other non-
cardiac structures (eg, lungs, spine). For CT studies,
however, Medicare permits only a single claim from a
single provider, who is ultimately responsible for the
totality of the service [45]. Aggregated PSPS files do not
permit us to comment on the frequency of such “dual
read” or “overread” arrangements or the specific details of
how these services may be divided.

In conclusion, over the first 3 years for which unique
Medicare physician claims data are available, the utiliza-
tion of cardiac CT and CCTA nationwide has increased.
Cardiologists have submitted the majority of claims, par-
ticularly in the private office setting. Although regional
variation exists, overall payment denial rates have de-
creased, indicating expanded Medicare coverage across
the United States.

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