Comparative Utilization of Cardiac Stress Testing in US Patients with and without Chronic Kidney Disease

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Introduction

- A "nihilistic approach" to coronary artery disease (CAD) in pts with chronic kidney disease (CKD) has previously been reported.

- We have revisited this "truism" in the context of cardiac stress testing in the modern era (2008-12).

Methods

- Data source: 20% Medicare sample (2007-2012)

- We assembled yearly cohorts of Medicare beneficiaries with and without CKD who were alive, aged ≥66 years, and had Medicare Parts A and B coverage on January 1 of each year from 2008 to 2012, and had ≥12 months continuous coverage preceding January 1 (baseline period).

- We excluded patients who received PCI, CABG, angiography, kidney transplant, or participated in an HMO anytime in the baseline period, and who had AMI or ACS in the last two months of the baseline period.

- Follow-up started on January 1 of each year from 2008 to 2012 and ended at the earliest of stress test, death, disenrollment from Medicare coverage, the day before CKD/ESRD diagnosis for non-CKD patients, the day before kidney transplant for ESRD patients, or December 31 of the year.

Definitions:

- Patients with CKD were identified via diagnosis codes 585.X requiring1 IP claim or two OP/PB claims at least 30 days apart in the baseline period. CKD stage was determined by the highest stage specific code.

- Patients with ESRD were identified using the algorithm in 2013 USRDS Annual Data Report

- Stress tests were identified via CPT or ICD-9 procedure codes during the follow-up period.

- If two or more tests occurred on the same day, assignment of first test type followed a hierarchal approach starting with stress echo, followed by stress nuclear, stress MRI, until stress ECG. If none of the above were found, we searched for non-invasive coronary CT angiography (CCTA). If none of the above and no angiography, we searched for CT coronary calcium scan.

Statistical analysis:

- Patient characteristics were described for yearly cohorts of CKD and non-CKD patients and their subgroups who received their first stress test.

- Frequency distribution of type of first stress test was examined.

- Unadjusted rates of first stress test (any type) were measured using number of patients who received a stress test per 100 patient-years.

- Differences in trends in stress testing rates between non-CKD and CKD cohort were assessed using a generalized linear model with a negative binomial distribution.
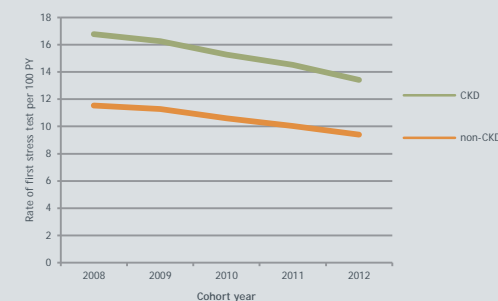
Results

Table 1. Demographic characteristics for patients with and without CKD, 2008-2012

	2008 non-CKD	2008 CKD	2009 non-CKD	2009 CKD	2010 non-CKD	2010 CKD	2011 non-CKD	2011 CKD	2012 non-CKD	2012 CKD
Total N	4,385,897	210,001	4,323,838	228,486	4,259,010	258,237	4,271,734	290,839	4,232,080	332,058
Age, %										
65-74 years	51.7	34.9	52.2	34.8	52.8	34.7	53.4	34.7	53.8	34.1
75-84 years	35.4	43.6	34.7	43.0	33.8	42.3	33.1	41.5	32.7	41.3
85+ years	12.9	21.6	13.1	22.2	13.4	23.0	13.5	23.8	13.5	24.6
Gender, %										
Male	40.7	48.7	40.9	48.0	41.0	47.2	41.2	46.8	41.6	46.8
Female	59.3	51.4	59.1	52.0	59.0	52.8	58.8	53.2	58.4	53.2
Race, %										
White	88.2	81.6	88.1	81.4	87.8	81.5	87.5	81.3	87.3	81.5
Black	7.0	13.2	6.9	13.1	7.0	13.0	7.1	13.0	7.1	12.8
Asian	1.6	1.6	1.7	1.8	1.7	1.8	1.8	1.9	1.8	1.9
Hispanic	1.6	1.9	1.6	1.9	1.6	1.9	1.6	2.0	1.6	1.9
Other/Unknown	1.7	1.7	1.8	1.8	1.9	1.8	2.0	1.9	2.1	1.9
CKD Stage, %										
CKD Stage 1-2		6.8		6.5		6.5		6.6		6.8
CKD Stage 3-5ND		51.3		57.6		61.1		63.5		64.3
CKD Stage 5D		8.9		8.6		7.9		7.3		6.6
CKD Stage Unknown		33.0		27.3		24.6		22.6		22.3

Table 2. Demographic characteristics for patients receiving stress test, by CKD status, 2008-2011

	2008 non-CKD	2008 CKD	2009 non-CKD	2009 CKD	2010 non-CKD	2010 CKD	2011 non-CKD	2011 CKD	2012 non-CKD	2012 CKD
Total N	452,520	29,112	437,101	31,124	405,907	33,324	387,199	35,941	361,365	38,215
Age, %										
65-74 years	57.1	46.1	57.6	46.0	58.0	46.0	58.6	45.5	58.8	45.4
75-84 years	37.3	45.2	36.8	44.9	36.2	44.6	35.5	44.4	35.2	44.4
85+ years	5.5	8.7	5.7	9.1	5.8	9.4	6.0	10.0	6.0	10.2
Gender, %										
Male	48.7	55.5	48.2	55.0	48.3	54.1	47.9	53.6	48.0	53.6
Female	51.3	44.6	51.8	45.0	51.7	45.9	52.1	46.4	52.0	46.4
Race, %										
White	89.5	81.0	89.1	80.3	88.7	80.3	88.4	79.7	88.2	80.1
Black	5.9	13.4	6.2	13.5	6.4	13.4	6.5	13.8	6.6	13.5
Asian	1.5	1.8	1.6	2.1	1.7	2.0	1.7	2.2	1.7	2.1
Hispanic	1.4	2.1	1.4	2.2	1.5	2.3	1.5	2.3	1.5	2.1
Other/Unknown	1.6	1.8	1.7	2.0	1.7	2.0	1.9	2.1	2.0	2.2
CKD Stage, %										
CKD Stage 1-2		6.8		6.6		6.6		6.9		6.8
CKD Stage 3-5ND		57.1		62.3		64.9		66.7		67.5
CKD Stage 5D		10.8		10.2		9.5		9.4		8.5
CKD Stage Unknown		25.3		20.9		19.0		17.0		17.3

Figure 1. Temporal trends in rates of stress testing

Significance testing: Trends in stress testing rates 2008-2012 between CKD and non-CKD: P=0.93; overall trends in stress testing rates: P=0.007; stress testing rates between CKD and non-CKD: P<0.0001

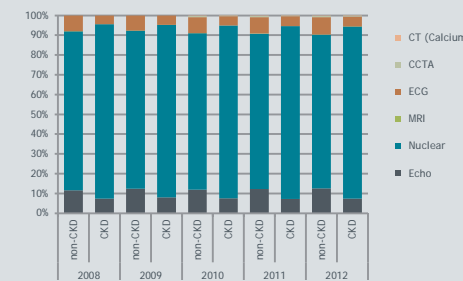Figure 2. Type of stress test among patients who had a first stress test, by CKD status, 2008-2012

Table 3. Distribution of type of first test, by CKD status, 2008-2012

	2008 non-CKD	2008 CKD	2009 non-CKD	2009 CKD	2010 non-CKD	2010 CKD	2011 non-CKD	2011 CKD	2012 non-CKD	2012 CKD
Echo	11.6	7.4	12.4	8.0	11.9	7.5	12.2	7.2	12.6	7.4
Nuclear	80.3	88.2	80.0	87.3	79.1	87.3	78.5	87.4	77.7	87.1
MRI	0.04	*	0.04	0.04	0.05	*	0.5	*	0.06	0.03
ECG	8.0	4.7	7.7	4.7	8.0	4.7	8.3	5.0	8.7	5.0
CCTA					0.7	0.4	0.6	0.3	0.7	0.4
CT (Calcium)							0.2	0.1	0.2	0.1

Note: Table cells with * indicate suppressed data when sample size <11

Summary

- There has been a progressive decline in rates of stress testing in both non-CKD and CKD patients from 2008 to 2012 (non-CKD: 11.5→ 9.4 per 100 patient-years; CKD: 16.8→13.4 per 100 patient-years)

- CKD patients have a consistently higher rates of stress testing compared to non-CKD patients in 2008-12.

- Stress nuclear imaging accounts for more than three-fourths of all stress tests.

- Approximately 2,000,000 Medicare patients age 65+ received at least one stress test In 2012.

Conclusions

- Commonly held perceptions of absolute under-utilization of stress testing for CAD in CKD pts are false in the current era.

Limitations

- Data based on claims. Sensitivity of CCTA and CT (Calcium) score ascertainment is reduced due to re-imbursement issues.

- Reported rates of stress testing are not adjusted for potential CAD severity.

- Data do not apply to pts with recent ACS events (i.e. differential utilization of stress testing in CKD vs non-CKD pts with recent ACS events may be different).

- Absolute number of tests is higher since this analysis only focused on the first stress test.

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