

Choosing Wisely for Syncope: Low-Value Carotid Ultrasound Use

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Background—The United States spends more than \$750 billion annually on tests and procedures that do not benefit patients. Although there is no physiological indication for carotid ultrasound in “simple” syncope in the absence of focal neurological signs or symptoms suggestive of stroke, there is concern that this practice remains common for routine syncope workups.

Methods and Results—We used a 5% random-sample Medicare claims database to evaluate large-scale national trends in utilization of low-value carotid ultrasound imaging for simple syncope. We found that 16.5% of all Medicare beneficiaries with simple syncope underwent carotid imaging and 6.5% of all carotid ultrasounds ordered in 2009 were for this low-value indication. These findings were complemented by a manual chart review of 313 patients at a large academic medical center who underwent carotid ultrasound for simple syncope over a 5-year period. For the 48 (15.4%) of 313 patients with stenosis $\geq 50\%$, carotid ultrasound did not yield a causal diagnosis. Only 2% of the 313 patients imaged experienced a change in medications after a positive study, and $<1\%$ of patients underwent a carotid revascularization procedure.

Conclusions—These data suggest that carotid ultrasound for patients with uncomplicated syncope are still commonly ordered and may be an easy target for institutions striving to curtail low-value care. (*J Am Heart Assoc.* 2014;3:e001063 doi: 10.1161/JAHA.114.001063)

Key Words: carotid artery • outcome and process assessment • syncope • syncope (fainting) • tests

The United States spends an estimated \$2.7 trillion annually on health care, nearly 19% of the nation’s economy.¹ The Institute of Medicine voiced concern regarding the value of this investment, noting that a sizable fraction—\$750 billion—may be spent on wasteful, nonproductive care.² The Institute of Medicine emphasizes the need to reduce this low-value care and promote policies that both improve patient health outcomes and reward the delivery of high-value care.²

Similar calls to action can be found in the recently launched “Choosing Wisely” campaign and the American College of Physician’s “High-Value, Cost-Conscious Care” initiatives, both of which are focused on eliminating unnecessary tests and procedures and shifting spending to proven,

high-value investments.¹ Within these initiatives, much attention has been devoted to eliminating low-value diagnostic testing.³ In total, 24 of the 45 wasteful practices initially highlighted by the Choosing Wisely campaign are diagnostic studies.^{2,4} Between 2000 and 2007, diagnostic imaging rose faster than any other physician service among Medicare patients, although some project that 20% to 50% of diagnostic imaging provides no useful information for improving patient care.^{2,4} Despite much attention given to high-priced items, there has been less focus on lower priced imaging, which may still constitute a substantial amount of spending by virtue of its frequent use.^{1,5,6}

One low-priced but low-value test is carotid duplex ultrasound (CDUS) for the evaluation of syncope. Recent reports from the European Society of Cardiology’s Task Force on Syncope,⁷ the American College of Physicians’ Clinical Efficacy Assessment Project,⁸ and other comprehensive reviews and editorials^{9,10} have pointed out that CDUS should be used only for patients presenting with concerns of stroke, transient ischemic attacks (TIAs), focal neurological signs, or carotid bruits—and that syncope in the absence of these signs or symptoms is not a result of carotid artery stenosis.

In this paper, we define simple syncope as a syncopal episode not accompanied by focal neurological deficits or other signs and symptoms suggestive of TIA or stroke.

Despite broad consensus in the medical literature that simple, self-resolving syncope is not caused by carotid arterial

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occlusive disease,^{7–10} numerous studies have shown that CDUS testing in syncopal patients remains common practice, even in the absence of neurological signs or symptoms of concern for stroke or TIA.^{6,11–15}

Given that syncope-related conditions represent approximately 1% to 6% of all hospital admissions in the United States^{16,17} and result in an annual estimated cost of \$2.4 billion,¹⁷ even a modest reduction in low-value diagnostic testing for this single service could lead to meaningful savings. A recent study suggests that \$33 million to \$49 million are spent annually on low-value carotid ultrasound, carotid computed tomography, and carotid magnetic resonance imaging for Medicare patients with syncope in the absence of signs of stroke or TIA.⁶ As such, better quantifying the amount of unnecessary diagnostic carotid ultrasound screening is critically important for both clinicians and policy makers.¹⁷

To better understand the full scope of this problem, we sought to obtain national estimates of the proportion of patients presenting with simple syncope who undergo CDUS annually and the proportion of patients undergoing carotid ultrasound for syncope who had simple syncope. Second, we sought to use charge data from the Centers for Medicare and Medicaid to estimate the amount of annual spending on this low-value practice. Finally, to gain clinical insight into the reported low utility of these nonindicated but commonly

ordered studies, we manually reviewed 5 years of electronic medical record (EMR) data at a large academic hospital to determine the diagnostic yield of these ultrasound studies and the proportion of studies that lead to a change in clinical management.

Methods

Population-Based Analysis

To obtain a national estimate of the prevalence of this practice, we relied on 2009 Medicare claims data for a 5% random sample of Medicare beneficiaries. We restricted our sample to those beneficiaries who were continually enrolled in Parts A and B of traditional Medicare from 2008 to 2009. Patients were excluded from the sample if they were aged younger than 65 years in 2009, were enrolled in Medicare Part C, or were not living in one of the 50 US states or the District of Columbia. The final sample consisted of 1 360 908 beneficiaries (Figure).

Syncope is defined in this study by the presence of a 2009 Medicare carrier or outpatient claim that contains a diagnosis of syncope and collapse (International Classification of Diseases, 9th revision [ICD-9] code 780.2) or heat syncope (ICD-9 992.1). Claims were excluded if the patient had any history of prior stroke or TIA based on the Medicare Chronic

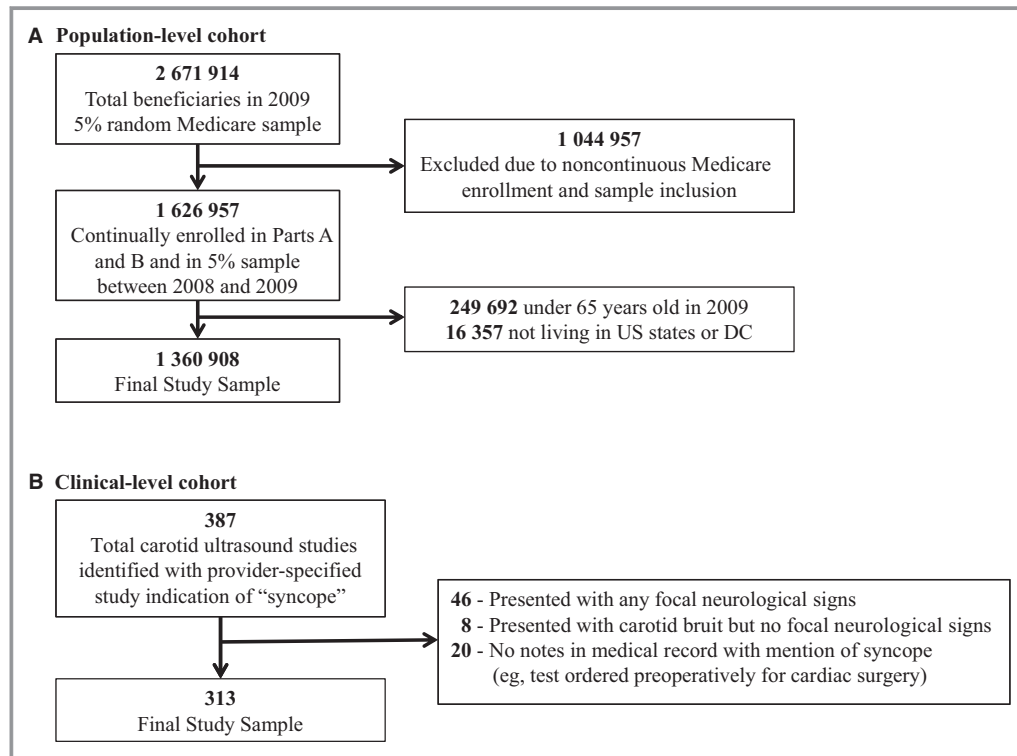


Figure. Derivation of study sample cohorts: (A) population-level cohort and (B) clinical-level cohort. DC indicates District of Columbia.

Conditions Data Warehouse or if there were any diagnoses in the claim noting stroke, TIA, history of stroke or TIA, or focal neurological symptoms. Neurological symptoms were defined using ICD-9 codes used in a prior study.⁶ Carotid imaging was detected on the basis of Healthcare Common Procedure Coding System (HCPCS) codes 93880 and 93882, which denote CDUS.

We calculated the number of beneficiaries with simple syncope, the number of beneficiaries undergoing carotid ultrasound, and the number of beneficiaries meeting both of those criteria. National estimates for the Medicare population were generated by extrapolation of the counts and associated 95% binomial confidence intervals from this random sample. Cost data were obtained from the Medicare Physician Fee Schedule data from 2009¹⁸ and based on the global national payment amount for extracranial Doppler exams with Current Procedural Terminology code 93880.

Analysis of Individual Medical Records

For the second stage of our analysis, we identified all individuals who underwent a CDUS, as an inpatient or outpatient, for the provider-specified indication of syncope between January 1, 2006, and December 31, 2010, at our tertiary referral academic medical center. Ultrasound studies in which the ordering provider chose “syncope” as the indication for testing via checkbox on the computerized physician order entry program were identified from our department’s prospective vascular ultrasound database. Because our intention was to describe the tests that were ordered without sufficient indication, we excluded patients who presented with focal neurological deficits at the time of their syncopal episode, including unilateral motor or sensory deficits, amarusus fugax, aphasia, or neglect, which could be identified through our manual review of the EMR or in the indication field of the carotid ultrasound order. To further refine our sample we also excluded patients if carotid bruit was mentioned anywhere in their medical record reviews or as a study indication. Finally, we excluded any studies in which the imaging order indicated syncope as the indication but manual review of notes in the EMR revealed no mention of a syncopal episode or if an alternate indication was mentioned (eg, ordered preoperatively for cardiac surgery) (Figure).

The manual review of the EMR consisted of a detailed review of outpatient clinic history and physical notes; outpatient consultation notes; hospital admission notes; hospital consult notes from cardiology, neurology, or vascular surgery; and hospital discharge summaries. For each ultrasound that met our inclusion criteria, we reviewed 2 qualifying notes prior to the order of the study and 2 qualifying notes either after discharge for inpatients or after the study date for outpatients. To identify potential referrals for vascular surgical

intervention for carotid disease, any vascular surgery consultation note within 1 year after the ultrasound test date was also reviewed. Manual review of the EMR was used to identify other patient demographics and risk factors for carotid arterial disease, as outlined in the 2011 Society for Vascular Surgery guidelines for the management of extracranial carotid disease,¹⁹ including age; sex; past medical history including history of stroke, carotid disease, peripheral vascular disease, coronary artery disease, cigarette smoking, and dyslipidemia; and family history of stroke in a first-degree relative. Finally, manual review of the aforementioned consultation notes, discharge summaries, follow-up clinic notes, and referrals was performed to determine whether any providers attributed the patient’s syncopal episode to being related to the results of the carotid ultrasound.

Because existing evidence supports the beneficial role of medical and operative stroke risk prevention for those patients with stenosis $\geq 50\%$,¹⁴ the primary end point of this study was any stenosis of $\geq 50\%$ found in either the common carotid or internal carotid artery by ultrasound. Each positive study was classified as “moderate stenosis” if 50% to 69% carotid stenosis was noted, “high-grade stenosis” if $\geq 70\%$ was noted, and “total occlusion” if 100% was noted. Each ultrasound report was also reviewed for evidence of ante-grade, retrograde, or abnormal flow in each vertebral artery. Secondary end points were changes in medical or surgical stroke-risk-reduction therapies, as identified by the manual EMR review. Changes in medical stroke-risk-reduction therapy included any modifications of blood pressure management, cholesterol-lowering agents, diabetes pharmacotherapy, smoking cessation, and antiplatelet therapy as a result of ultrasound findings. Surgical stroke-risk-reduction interventions included carotid artery stenting or carotid endarterectomy as a result of ultrasound findings.

For the analysis, we used the Wilcoxon rank-sum test to compare the proportion of patients with these noted risk factors for carotid disease among patients with a positive ultrasound study against those with negative studies. All statistical tests were performed using Stata MP version 13.1 (StataCorp), and a 2-sided *P* value of 0.05 was used to establish statistical significance. This study received approval from the appropriate institutional review boards prior to any data collection or analysis.

Results

Among the 1 360 908 Medicare beneficiaries in the random sample of 2009 claims, 55 140 patients (4.1%) had syncope without stroke, TIA, history of stroke or TIA, or focal neurological symptoms (Table 1). Among these 55 140 patients with simple syncope, 8955 (16.2%) underwent carotid imaging. These 8955 patients represent 6.5% of the

Table 1. Proportion of Medicare Sample Undergoing Carotid Imaging for Simple Syncope

	Count	Proportion of Corresponding Subpopulation	Proportion of Medicare Random Sample	National Medicare Population Estimates*
Total patients included in sample [†]	1 340 908	—	100.0%	44 873 621
Patients who had simple syncope [‡]	55 140	—	4.1%	1 845 266
Patients who also underwent carotid ultrasound	8955	16.2%	0.7%	299 680
Patients who underwent carotid ultrasound for all indications	137 424	—	10.2%	4 598 908
Patients who also presented with simple syncope [‡]	8955	6.5%	0.7%	299 680

*National Medicare population estimates were scaled based on the total number of Medicare enrollees in the US states and the District of Columbia in 2009: 44 873 261.

[†]See Figure A for derivation of population-level study cohort.

[‡]Simple syncope defined as a syncopal episode with no focal neurological signs and no signs of stroke or transient ischemic attack.

Source: 2009 random sample of Medicare claims, n=1 340 908.

137 424 total patients in the sample who underwent carotid imaging. National Medicare population estimates were scaled based on the total number of Medicare enrollees in the US states and the District of Columbia in 2009 (ie, 44 873 261 enrollees).²⁰ Extrapolation of the study sample suggests that the total number of Medicare beneficiaries in the United States who underwent carotid imaging for simple syncope in 2009 was 299 680 (95% CI: 294 016 to 305 409). Using the global national payment amount of \$248.50 reported in the 2009 Medicare Physician Fee Schedule,¹⁸ an estimated \$73 062 895 to \$75 894 186 was spent on carotid ultrasound for patients in this population with simple syncope.

In the subsequent EMR review, we identified a total of 387 patients who underwent CDUS for the indication of syncope between 2006 and 2010. Seventy-four patients were excluded due to presence of focal neurological signs on presentation, carotid bruit on physical examination, or improperly coded study indications (eg, a test ordered for non-syncope-related indications such as preoperative testing prior to cardiac surgery). Our final study sample included 313 patients, with a mean age of 73.6 years (SD 12.4 years), who underwent carotid ultrasound for syncope in the absence of presenting signs or symptoms attributable to carotid artery stenosis. Forty-eight (15.3%) of 313 patients had any stenosis $\geq 50\%$ on ultrasound. Age, sex, and previously defined risks factors for carotid disease among those patients with and without $\geq 50\%$ carotid stenosis on ultrasound are shown in Table 2. Notably, 40 (83.3%) of the 48 patients with $\geq 50\%$ carotid stenosis had 1 or more of these risk factors.

Of the 48 patients with a positive ultrasound, 31 had stenosis of 50% to 69%, 10 had stenosis of 70% to 99%, and 7 had stenosis of 100% (Table 3). Seven (2.2%) of the 313 patients in our sample underwent a change in medications that could potentially target stroke-risk reduction after a finding of $\geq 50\%$ carotid stenosis on ultrasound, and only 1 such patient (0.3%) subsequently underwent a carotid artery

Table 2. Comparison of Patient Cardiovascular Risk Factors

	Positive Studies, n=48 (15%)*	Negative Studies, n=265 (85%)	P Value
Mean age (SD)	75 (10)	73 (13)	0.65
Male	65%	51%	0.07
History of carotid disease	31%	5%	<0.001
Known CAD	65%	31%	<0.001
Known PAD	31%	4%	<0.001
Tobacco use	31%	22%	0.18
Dyslipidemia	73%	49%	0.002
Family history [†]	10%	5%	0.10

CAD indicates coronary artery disease; PAD, peripheral arterial disease.

*Positive study defined as stenosis $>50\%$ on carotid ultrasound.

[†]Family history defined as first-degree relative with a history of stroke.

stenting procedure (Table 3), although the consultation note reported asymptomatic carotid disease as the indication for the procedure. Of note, in none of these 7 cases, or in any of the patients with a positive ultrasound, was the cause of syncope attributed to carotid artery stenosis. In addition, 10 (3.2%) of the 313 patients had either retrograde or altered vertebral artery waveforms (data not shown). On further review of the EMR, however, none of these patients were diagnosed with vertebral basilar insufficiency, and all 10 had causal diagnoses for their syncope unrelated to abnormal vertebral artery flow.

Discussion

Large-scale analysis of a national Medicare claims database suggests that nearly 1 in 6 older Americans presenting with syncope in the absence of focal neurological signs underwent CDUS. These studies represent an estimated \$73.1 million to

Table 3. Diagnostic Yield and Changes in Stroke Risk Management After Carotid Ultrasound for Simple Syncope

	Among All 313 Patients Undergoing Ultrasound for Simple Syncope*		Etiology of Syncope Related to Results of Carotid Ultrasound		Change in Medical Management of Stroke Risk Factors After Ultrasound**†		CEA or CAS for Carotid Stenosis After Ultrasound**‡	
	n	% Total (95% CI)	n	% Total (95% CI)	n	% Total (95% CI)	n	% Total (95% CI)
All positive studies	48	15.3% (11.5 to 19.8)	0	0% (0 to 1.2)	7	2.2% (0.9 to 4.6)	1	0.3% (0.0 to 1.8)
50% to 69% stenosis	31	9.9% (6.8 to 13.7)	0	0% (0 to 1.2)	6	1.9% (0.7 to 4.1)	0	0% (0 to 1.2)
70% to 99% stenosis	10	3.2% (1.5 to 5.8)	0	0% (0 to 1.2)	1	0.3% (0.0 to 1.8)	1	0.3% (0.0 to 1.8)
100% stenosis	7	2.2% (0.9 to 4.6)	0	0% (0 to 1.2)	0	0% (0 to 1.2)	0	0% (0 to 1.2)

CAS indicates carotid artery stenting; CEA, carotid endarterectomy; 95% CI, 95% binomial confidence interval.

*Proportion based on all 313 studies.

†Changes in medical management defined as any modifications of blood pressure management, cholesterol-lowering agents, diabetes pharmacotherapy, smoking cessation, and antiplatelet therapy as a result of ultrasound findings.

‡Includes any CEA or CAS undertaken within 1 year of incident carotid ultrasound study.

\$75.9 million in Medicare spending in 2009. A detailed review of more than 300 patient records at a large academic tertiary referral center, the largest sample of such patients to date, corroborated the assertion of national guidelines that these tests are of low clinical utility because none of the studies resulted in a causal diagnosis and just more than 2% of all studies led to a change in clinical management. Taken together, these findings build on the wealth of evidence demonstrating both the low-value nature of this imaging procedure and its persistent practice.

Nearly 1 in 6 Medicare beneficiaries with simple syncope underwent carotid ultrasound, which is alarming in light of the clear guidelines about the lack of utility for this procedure under these conditions. Because this study is limited to only Medicare beneficiaries, our results underestimate the total extent of this imaging practice, which is likely to be pervasive, given the high prevalence of syncope (1% to 6% of all admissions in the United States).¹⁶ The results from our manual review of more than 300 patient files augment the claims-based analysis and demonstrate that clinicians are frequently failing to adhere to well-established guidelines.

Numerous prior studies have demonstrated the pervasive misuse of carotid ultrasound in syncopal patients without focal neurological signs.^{8–12} In a report by Morrison et al in 1999, 72 of their 88 syncopal trauma patients underwent carotid ultrasound, whereas only 2% of these patients exhibited symptoms of TIA or stroke.⁸ In 2005, Schnipper et al reported on a selected population of syncopal patients in which only 33% presented with neurological findings but 78% underwent carotid ultrasonography.¹⁰ In a 2009 study, Mendu et al reported on 267 patients who underwent carotid ultrasound for syncope, with 46% of studies having an abnormal finding but only 1% to 2% leading to a change in patient care. Finally, a 2011 study by Maung et al found that 25% of syncopal patients admitted to a medical service and a full 96% of syncopal patients admitted to a trauma service

underwent carotid ultrasound testing and less than 5% of patients were found to have a new stenosis of $\geq 60\%$.¹²

Our findings build on this prior body of literature in 3 meaningful ways. First, by using a nationally representative Medicare claims database, we provide the most comprehensive estimates of the proportion of elderly patients with simple syncope that undergo unnecessary imaging (16.2%) and the proportion of carotid imaging studies that are performed for this reason (6.5%). Second, although our manual review comes from a single institution, it is the largest and most focused sample to date to elucidate these trends; prior studies have had smaller samples and did not exclude patients with an appropriate indication (ie, focal neurological signs, bruits, and clinical concern for stroke or TIA at presentation). Consequently, our data provide more precise estimates of the clinical utility of this low-value study by excluding studies obtained for legitimate clinical indications. Third, our data are particularly relevant to the current discussion regarding the use of payment reform to curtail of low-value care. Our data span our institution’s transition to becoming a Pioneer Accountable Care Organization in 2009, which followed its participation in the Alternative Quality Contract, both of which provided incentives for the institution to curb spending without compromising quality.²¹ The persistence of this specific form of low-value spending may suggest that there are untapped opportunities to meet these twin goals of lower spending and improved quality. Moreover, it may highlight that provider behavior may lag behind institutional goals, even amid payment reforms being enacted as a part of the Affordable Care Act.

Given well-established clinical guidelines¹⁴ and broad consensus that carotid ultrasound imaging is not indicated for syncopal patients who lack focal neurological signs or a carotid bruit, its continued use is representative of the type of low-value care that should be identified, understood, and curtailed to eliminate wasteful spending. The collective

expenses of frequently ordered “small-ticket items” like carotid ultrasound compose a more substantial proportion of wasteful spending than the less frequently used, more expensive technologies.^{22,23} Given the high prevalence of syncope nationally,¹⁶ the impact of even a small reduction in wasteful spending for syncope could have sizable impact nationally. Our finding that CDUS for simple syncope represents an estimated \$73 million to \$75 million in wasted Medicare spending builds on prior estimates that low-value services represent up to 2.7% of all Medicare spending.⁶ Savings from eliminating low-value care such as CDUS for presentations of simple syncope could be directed toward other tests and procedures that yield greater health benefits.²⁴

Both of the data sets that we used for this analysis have their limitations. First, our estimates from the Medicare random sample, although representative of Medicare fee-for-service beneficiaries in 2009, cannot be generalized to the rest of the US population; however, this source represents nearly 45 million patients and covers the age group in which syncope is most common. Consequently, our estimate of the prevalence of this practice would be conservative because it would miss cases in those aged younger than 65 years, and the Medicare claims data are based on the number of beneficiaries undergoing a study, not the number of studies performed. Second, the Medicare database is a claims database and does not provide enough clinical detail to allow for complete understanding of clinical decision making. For this reason, we chose to perform dual analyses and to include a manual chart review of a single institution with robust EMRs to better capture details of clinical decision making and clinical outcomes. Our single-institution data set has the limitations common to retrospective chart reviews, namely, that risk factors are likely to be underreported, that it is only as detailed as a clinician’s documentation, that paper notes are not readily accessible in our EMRs, that we used sensitive but not specific definitions of medication changes (leading to overestimation of outcomes), and that we were also unable to determine the total number of syncopal patients at our institution over the study period, although the Medicare data are more likely to be representative of national trends than a single academic medical center. Finally, our hospital-level data are limited by the low number of events, thus the zero percent proportions must be interpreted in light of the upper of the 95% binomial confidence intervals, which range from 0.012 to 0.074 (data not shown). Our study, however, includes the largest sample of ultrasounds for this indication in the literature, and a finding of 1% to 7% instead of zero would not change the clinical implications of our findings.

This study provides support that routine carotid ultrasonography for syncope is both common nationwide and is of

low value.³ Because clinical leaders and policy makers aim to eliminate wasteful spending without compromising quality, it may be useful to examine ways to curb this unnecessary testing. This may be accomplished by improving awareness of the persistence of this wasteful practice among clinical providers and trainees or by use of electronic clinical decision support to explicitly recommend against carotid ultrasound for this population of patients if a provider attempts to order one for a common syncope workup. Carotid ultrasound evaluation for patients with simple syncope is just an example of the types of practices that need to be identified, enumerated, evaluated, and curtailed so that clinicians can begin to choose more wisely to deliver truly value-based care.

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Disclosures

None.

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