Search trends are only proxies for engagement, and sentinel surveillance (such as surveys) will clarify these early findings. However, our findings demonstrate the power of grassroots movements to respond to large-scale public health crises. These results suggest that #MeToo may have reduced the stigma of sexual harassment and/or assault as more seek help.[5]

Public health investments in preventing sexual harassment and/or assault is disproportionately small compared with the scale of the problem,[6] in part because the problem is hidden from the public. With millions more persons than ever voicing their needs months after #MeToo began, public health leaders should respond by investing in enhanced prevention training and improving resources for survivors.

Theodore L. Caputi, BS
Alicia L. Nobles, PhD, MS
John W. Ayers, PhD, MA

Author Affiliations: Health Equity Research Lab, Cambridge Health Alliance, Harvard Medical School, Cambridge, Massachusetts (Caputi); Division of Infectious Diseases and Global Public Health, Department of Medicine, University of California, San Diego, La Jolla (Nobles, Ayers).

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Corresponding Author: John W. Ayers, PhD, MA, Department of Medicine, University of California, San Diego, 9500 Gilman Dr, Ste 333 Central Research Services Facility (CRSF), 9500 Gilman Drive, La Jolla, CA 92093-0507 (ayers.john.w@gmail.com).

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Concept and design: Caputi, Ayers.
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1. Zacharek S, Dockterman E, Edwards HS. Time person of the year: the silence breakers. Time. 2017. http://time.com/time-person-of-the-year-2017-silence-breakers/. Accessed August 2, 2018.

2. Ayers JW, Althouse BM, Dredze M. Could behavioral medicine lead the web data revolution? *JAMA*. 2014;311(14):1399-1400. doi:10.1001/jama.2014.1505

3. Khandakar Y, Hyndman RJ. Automatic time series forecasting: the forecast package for R. https://www.jstatsoft.org/article/view/v027i03. Accessed July 29, 2018.

4. Breiding MJ, Smith SG, Basile KC, Walters ML, Chen J, Merrick MT. Prevalence and characteristics of sexual violence, stalking, and intimate partner violence victimization—national intimate partner and sexual violence survey, United States, 2011. Morbidity and mortality weekly report. 2014. https://www.cdc.gov/mmwr/preview/mmwrhtml/ss6308a1.htm. Accessed July 23, 2018.

5. Kennedy AC, Prock KA. "I still feel like I am not normal": a review of the role of stigma and stigmatization among female survivors of child sexual abuse, sexual assault, and intimate partner violence. *Trauma Violence Abuse*. 2016;7(9):8-21. doi:10.1177/1524838016673601

6. Waechter R, Ma V. Sexual violence in America: public funding and social priority. *Am J Public Health*. 2015;105(12):2430-2437. doi:10.2105/AJPH.2015.302860

Temporal Trends in Unstable Angina Diagnosis Codes for Outpatient Percutaneous Coronary Interventions

Recent health care policy initiatives have focused on reducing misuse or overuse of expensive cardiovascular procedures. The appropriate use criteria (AUC) for coronary revascularization were released in 2009 with the aim of reducing inappropriate percutaneous coronary interventions (PCIs).[1] In addition, national efforts to provide hospitals with information about their performance on PCI appropriateness began in 2011.[2]

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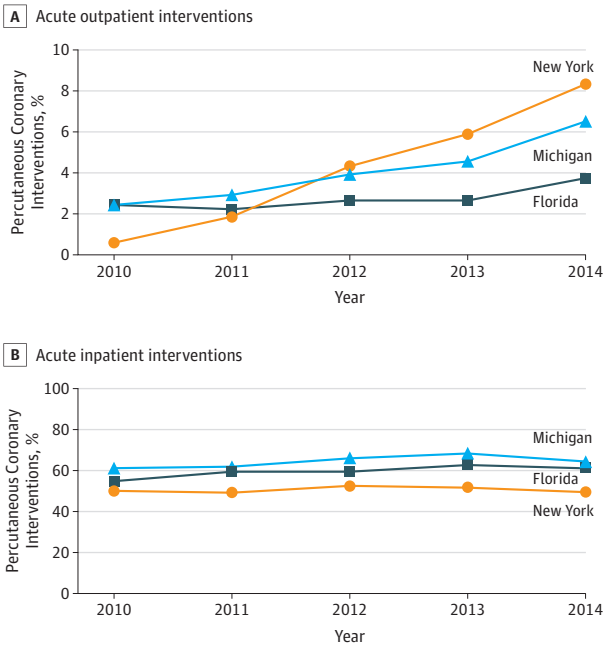
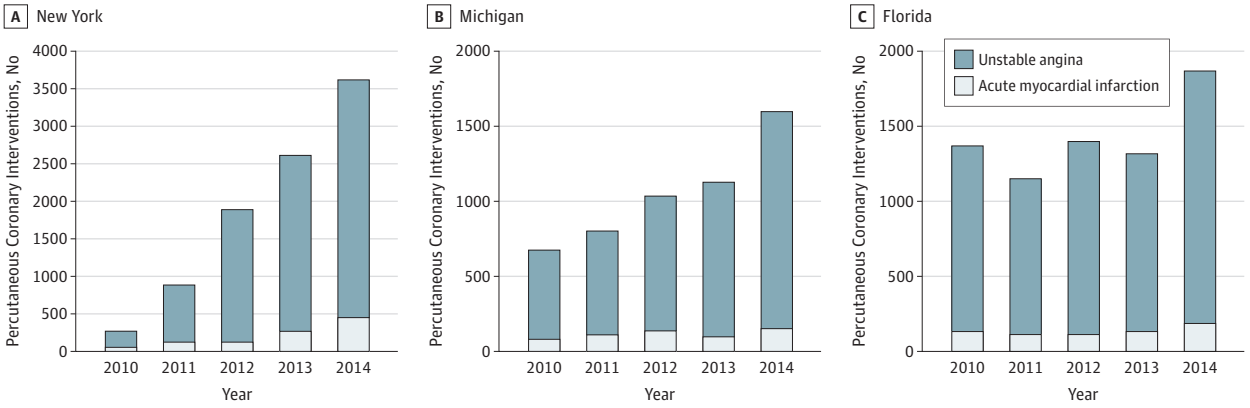
Since these initiatives were enacted, the volume of PCIs performed for nonacute indications in the United States has declined, as have rates of PCIs considered inappropriate.[3,4] Some have declared this a policy success—that the fewer inappropriate PCIs performed nationally reflect better selection of patients likely to experience improved outcomes. However, it may be that these initiatives incentivized physicians to classify patients with stable chest pain as having unstable angina (UA) to meet AUC. To explore this possibility, we examined trends in PCIs coded for acute indications in the outpatient setting in 3 large and geographically dispersed states.

Figure 1. Proportion of Percutaneous Coronary Interventions (PCIs) Coded for Acute Indications in the Outpatient and Inpatient Settings



A, Acute outpatient PCIs. B, Acute inpatient PCIs. Proportions reflect PCIs coded for acute indications in the outpatient setting, or PCIs coded for acute indications in the inpatient setting, divided by total PCIs (acute and nonacute in both outpatient and inpatient settings) for each state by year.

Figure 2. Number of Percutaneous Coronary Interventions (PCIs) Performed for Unstable Angina or Acute Myocardial Infarction in the Outpatient Setting



Number of PCIs in New York (A), Michigan (B), and Florida (C).

Methods | Using Healthcare Cost and Utilization Project state databases, we identified all inpatient and outpatient PCIs in New York, Michigan, and Florida from 2010 to 2014. Percutaneous coronary interventions were classified as acute if associated with a primary or secondary diagnosis of UA or acute myocardial infarction (AMI). We then calculated the proportion of outpatient PCIs coded for acute indications relative to total PCIs performed in each state by year. Percutaneous coronary interventions performed for AMI and UA in an outpatient setting should be infrequent and remain stable over time—a significant increase would suggest potential shifts in diagnostic and/or coding patterns. We also characterized the proportion of acute inpatient PCIs relative to total PCIs.

Results | A total of 615 649 PCIs were performed in both the inpatient and outpatient setting from 2010 to 2014. The proportion of outpatient PCIs coded for acute indications increased over time in New York (0.6% to 8.3%), Michigan (2.4% to 6.5%), and Florida (2.4% to 3.8%) (**Figure 1**A). This increase was driven by a substantial rise in the crude number of outpatient PCIs coded for UA (New York, 242 to 3179; Michigan, 587 to 1426; Florida, 1231 to 1686). The number of outpatient PCIs coded for AMI were lower, but also increased: New York (49 to 435), Michigan (90 to 162), and Florida (134 to 192) (**Figure 2**). In the inpatient setting, PCIs coded for acute indications increased in 2 states (Figure 1B).

Discussion | Overall, we found that outpatient PCIs coded for acute indications increased in 3 states in the years following initiatives designed to reduce rates of inappropriate PCIs. In New York, the proportion of PCIs labeled as acute, but performed as outpatient procedures, increased 14-fold, driven largely by a rise in PCIs performed for UA. Similar, but less pronounced, patterns were observed in Michigan and Florida.

The observed rise in outpatient PCIs performed for acute indications is inconsistent with population-level trends.[5] Our data raise the possibility that physicians increasingly classified patients with stable chest pain as UA in the outpatient setting, or that hospitals shifted coding patterns, potentially owing to external factors including reporting of appropriateness or differences in reimbursement. The significant increase observed in New York may have been driven by additional state policy initiatives—notably, the 2011 announcement that inappropriate PCIs performed for patients insured by Medicaid would no longer be reimbursed.[6] It is also possible, however, that outpatient PCIs were coded more accurately or that PCIs performed for acute indications shifted from the inpatient to outpatient setting over time, though the stable-to-rising rates of acute PCI performed in the inpatient setting make this less likely.

Overall, our findings suggest that observed declines in inappropriate PCIs[3,4] may, in part, be related to shifts in diagnostic and/or coding practices. Further study is needed to understand the rise in outpatient PCIs coded for UA. These data also highlight the need for developing mechanisms to more accurately assess PCI appropriateness.

Rishi K. Wadhera, MD, MPP, MPhil
Devraj Sukul, MD, MSc
Eric A. Secemsky, MD, MSc
Changyu Shen, PhD
Hitinder S. Gurm, MD
William E. Boden, MD
Robert W. Yeh, MD, MSc

Author Affiliations: Brigham and Women's Hospital Heart & Vascular Center, Harvard Medical School, Boston, Massachusetts (Wadhera); Richard and Susan Smith Center for Outcomes Research in Cardiology, Division of Cardiology, Beth Israel Deaconess Medical and Harvard Medical School, Boston, Massachusetts (Wadhera, Secemsky, Shen, Yeh); Division of Cardiovascular Medicine, Department of Internal Medicine, University of Michigan, Ann Arbor (Sukul, Gurm); Division of Cardiovascular Medicine, VA Ann Arbor Healthcare System, Ann Arbor, Michigan (Gurm); VA New England Healthcare System, Boston University School of Medicine, Boston, Massachusetts (Boden).

Corresponding Author: Robert W. Yeh, MD, MSc, Smith Center for Outcomes Research in Cardiology, Beth Israel Deaconess Medical Center, 185 Pilgrim Rd, Boston, MA 02215 (ryeh@bidmc.harvard.edu).

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Author Contributions: Drs Wadhera and Sukul contributed equally to this manuscript.
Study concept and design: Wadhera, Sukul, Shen, Yeh.
Acquisition, analysis, or interpretation of data: Wadhera, Secemsky, Shen, Gurm, Boden, Yeh.
Drafting of the manuscript: Wadhera, Sukul, Shen.
Critical revision of the manuscript for important intellectual content: Wadhera, Sukul, Secemsky, Gurm, Boden, Yeh.
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1. Patel MR, Dehmer GJ, Hirshfeld JW, Smith PK, Spertus JA. ACCF/SCAI/STS/AATS/AHA/ASNC 2009 Appropriateness Criteria for Coronary Revascularization: A Report of the American College of Cardiology Foundation Appropriateness Criteria Task Force, Society for Cardiovascular Angiography and Interventions, Society of Thoracic Surgeons, American Association for Thoracic Surgery, American Heart Association, and the American Society of Nuclear Cardiology: Endorsed by the American Society of Echocardiography, the Heart Failure Society of America, and the Society of Cardiovascular Computed Tomography. *Circulation*. 2009;119(9):1330-1352. doi:10.1161/CIRCULATIONAHA.108.191768

2. Understanding the Reporting of Appropriate Use Criteria in the CathPCI Registry National Cardiovascular Data Registry. 2012; https://www.ncdr.com/WebNCDR/docs/default-source/cathpci-auc-documents/auc_companion_guide-2-25-15.pdf?sfvrsn=3. Accessed May 30, 2018.

3. Desai NR, Bradley SM, Parzynski CS, et al. Appropriate use criteria for coronary revascularization and trends in utilization, patient selection, and appropriateness of percutaneous coronary intervention. *JAMA*. 2015;314(19):2045-2053. doi:10.1001/jama.2015.13764

4. Hannan EL, Samadashvili Z, Cozzens K, et al. Changes in percutaneous coronary interventions deemed "inappropriate" by appropriate use criteria. *J Am Coll Cardiol*. 2017;69(10):1234-1242. doi:10.1016/j.jacc.2016.12.025

5. Yeh RW, Sidney S, Chandra M, Sorel M, Selby JV, Go AS. Population trends in the incidence and outcomes of acute myocardial infarction. *N Engl J Med*. 2010;362(23):2155-2165. doi:10.1056/NEJMoa0908610

6. Medicaid Redesign Team; Basic Benefit Review Work Group. Final Recommendations. New York State Department of Health 2011; https://www.health.ny.gov/health_care/medicaid/redesign/docs/basic_benefit_review_wrk_grp_final_rpt.pdf. Accessed August 8, 2018.

Invited Commentary

Gaming, Upcoding, Fraud, and the Stubborn Persistence of Unstable Angina

Unstable angina (UA), previously known as crescendo or preinfarction angina, is one of the acute coronary syndromes (ACS) that includes non-ST-segment elevation myocardial infarction (NSTEMI) and ST-segment elevation MI (STEMI). Unstable angina is unique among the ACS in that, despite clinical evidence of myocardial ischemia, biomarkers of myocardial necrosis are not elevated.[1] Symptoms and signs of ischemia are usually controlled by antianginal medications, systemic anticoagulation, and antiplatelet therapy but coronary angiography and revascularization, usually by percutaneous coronary intervention (PCI) are generally performed on an urgent or semiurgent basis to prevent progression to MI. In the early 1990s, in an era that preceded widespread use of troponin assays, UA was one of the most common reasons for hospital admission.[1] With the introduction of more sensitive troponin biomarkers, an increasing proportion of patients previously diagnosed with UA began being reclassified as NSTEMI based on elevation of biomarkers. For example, in the TIMI 3 trial, conducted between 1989 and 1992, 25% of patients classified as UA based on absent creatine kinase (CK)-MB measurements had conventional cardiac specific troponin I (cTnI) levels of 0.4 ng/mL or more (to convert to µg/L, multiply by 1.0), a relatively high cutoff compared with current standards.[2] The reclassification of patients with UA to NSTEMI has continued because the upper reference limit (URL) has been adjusted downward in recognition of the increased risk of adverse events with even minimal troponin elevations.[1] With the introduction of more sensitive troponin assays beginning in around 2010, the number of patients who present with an ACS without a rise in detectable troponin has continued to decline. In a post hoc analysis of the PROTECT-TIMI 30 trial, published in 2009, 82% of patients with typical features of UA including rest pain exceeded the URL of a high-sensitivity assay by 8 hours, thus shifting their diagnosis to NSTEMI.[3] As a result, in 2013, Braunwald and Morrow proposed it was time to prepare a requiem for UA, and they concluded that "it is not clear that ACS events can occur without some increase in circulating cTn when measured by a high-sensitivity assay."[1(p2455)]

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Despite this well-reasoned, biologically based prediction of its demise, UA is alive and well. In 2014, when sensitive troponin assays were widely available, 40% of PCIs in the United States were coded as being performed for UA.[4] The high percentage of PCI for UA in an era of increasingly sensitive biomarkers has long suggested that at least some patients with stable angina are being upcoded to a diagnosis of UA. In the current issue of *JAMA Internal Medicine*, Wadhera et al[5] now provide more evidence of upcoding (euphemistically referred to as "gaming"). Using administrative data, they describe the trends in PCI being performed for UA and NSTEMI in the outpatient setting from 2010 to 2014 in 3 states.[5] In theory, a patient with a true ACS would be admitted to the hospital and not be treated in the outpatient setting. Nevertheless, the authors document both an increase in the proportion and the raw number of PCIs being performed for acute conditions in the outpatient setting, driven by PCI for UA. This rise did not correlate with a decrease in PCIs for acute conditions on inpatients, which might have suggested shifting of the admission classification from inpatient to outpatient. The trend was most evident in New York, where the proportion of PCIs coded for acute conditions in the outpatient setting rose 15-fold from 0.6% to 8.3%, again being driven by UA.

Upcoding may be an unintended consequence of and facilitated by the appropriate use criteria (AUC), which were developed to codify the appropriateness of coronary revascularization for patients with various clinical syndromes. In the AUC for ACS, UA and NSTEMI are considered equivalent with no setting specified in which revascularization is "rarely appropriate."[6] In contrast, the AUC for stable angina includes thresholds for symptoms, prior antianginal therapy, and results of noninvasive stress testing in determining appropriateness of PCI.[7] In a 2011 study of over 500 000 PCIs from more than 1000 hospitals, PCIs performed in the acute setting (STEMI, NSTEMI, and high-risk UA) were almost uniformly classified as appropriate. However, among patients receiving PCI in nonacute settings, 50% of the procedures were classified as appropriate, 38% as uncertain, and 12% as inappropriate.[8] Whereas more recent data has documented a decline in the number of inappropriate or rarely appropriate PCIs,[4] the study by Wadhera et al suggests that some of that decline may be driven by upcoding, falsely and intentionally misclassifying patients with stable angina as UA. The fact that in the United States in 2014, only 13% of PCI were performed for stable angina,[4] whereas in the United Kingdom during the same year, 33% of PCI were for stable angina provides further evidence of upcoding of stable angina patients (Mamas A. Mamas, MA, DPhil, MRCP; personal written communication; August 22, 2018).

The rationale for upcoding of UA remains unclear but very concerning. The AUC were intended for internal quality improvement and benchmarking by PCI programs. Thus, without public disclosure of the appropriateness of procedures performed by individual hospitals or cardiologists, there is no motive for upcoding to improve the public perception of quality and enhance referrals. Furthermore, since the indication for PCI (stable angina vs UA) does not affect reimbursement, differential payment is unlikely to explain upcoding. A more likely albeit troublesome explanation could be to justify performance of PCI in patients who may not need the procedure. Because many patients with stable angina will become asymptomatic on medical therapy, current guidelines recommend PCI in the setting of stable angina only for patients with anginal symptoms refractory to medication.[9] Thus, in the absence of a better explanation, it seems that upcoding to unstable angina is being used to circumvent the guideline-mandated trial of medical therapy prior to PCI and thereby justify inappropriate PCI in stable angina patients. This practice, at best, damages the credibility of the profession, increases health care spending, violates patient autonomy, puts patients at risk of procedural complications and, at worse, may cross the threshold into criminal activity if used to extract reimbursement for unindicated procedures. Of note, the federal False Claim Act imposes civil liability on any person who knowingly submits a false or fraudulent claim to the Federal Government, including Medicare and Medicaid while the Criminal Health Care Fraud Statute prohibits knowingly defrauding any health care benefit program.[10]

Although, the cardiology community has long been a leader in data collection and voluntary quality improvement, it is time for cardiologists individually and collectively to do more to police themselves before outside forces do. Turning a blind eye toward the biologically implausible diagnosis of UA driving 40% of PCIs performed in the United States has undoubtedly resulted in unnecessary procedures, health care expenditures, and patient harm. Registries should be regularly audited for coding accuracy and penalties imposed for upcoding. Third-party payers should scrutinize claims for PCI performed for UA. In the meantime, we encourage all stakeholders to question the diagnosis of UA in patients with angina and negative biomarkers. In that setting, the more likely diagnosis is stable angina, which initially is more appropriately treated with guideline-directed medical therapy rather than PCI.

Christian A. McNeely, MD
David L. Brown, MD

Author Affiliations: Cardiovascular Division, Washington University School of Medicine, St Louis, Missouri.

Corresponding Author: David L. Brown, MD, Cardiovascular Division, Washington University School of Medicine, 660 S Euclid Ave, Campus Box 8086, St Louis, MO 63110 (d.brown@wustl.edu).

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1. Braunwald E, Morrow DA. Unstable angina: is it time for a requiem? *Circulation*. 2013;127(24):2452-2457. doi:10.1161/CIRCULATIONAHA.113.001258

2. Antman EM, Tanasijevic MJ, Thompson B, et al. Cardiac-specific troponin I levels to predict the risk of mortality in patients with acute coronary syndromes. *N Engl J Med*. 1996;335(18):1342-1349. doi:10.1056/NEJM199610313351802

3. Wilson SR, Sabatine MS, Braunwald E, Sloan S, Murphy SA, Morrow DA. Detection of myocardial injury in patients with unstable angina using a novel nanoparticle cardiac troponin I assay: observations from the PROTECT-TIMI 30 Trial. *Am Heart J*. 2009;158(3):386-391. doi:10.1016/j.ahj.2009.06.011

4. Desai NR, Bradley SM, Parzynski CS, et al. Appropriate use criteria for coronary revascularization and trends in utilization, patient selection, and appropriateness of percutaneous coronary intervention. *JAMA*. 2015;314(19):2045-2053. doi:10.1001/jama.2015.13764

5. Wadhera RK, Sukul D, Secemsky E, et al Temporal trends in unstable angina diagnosis codes for outpatient percutaneous coronary interventions [published online December 17, 2018]. *JAMA Intern Med*. doi:10.1001/jamainternmed.2018.5124

6. Patel MR, Calhoon JH, Dehmer GJ, et al. ACC/AATS/AHA/ASE/ASNC/SCAI/SCCT/STS 2016 Appropriate Use Criteria for Coronary Revascularization in Patients With Acute Coronary Syndromes: A Report of the American College of Cardiology Appropriate Use Criteria Task Force, American Association for Thoracic Surgery, American Heart Association, American Society of Echocardiography, American Society of Nuclear Cardiology, Society for Cardiovascular Angiography and Interventions, Society of Cardiovascular Computed Tomography, and the Society of Thoracic Surgeons. *J Am Coll Cardiol*. 2017;69(5):570-591. doi:10.1016/j.jacc.2016.10.034

7. Patel MR, Calhoon JH, Dehmer GJ, et al. ACC/AATS/AHA/ASE/ASNC/SCAI/SCCT/STS 2017 Appropriate Use Criteria for Coronary Revascularization in Patients With Stable Ischemic Heart Disease: A Report of the American College of Cardiology Appropriate Use Criteria Task Force, American Association for Thoracic Surgery, American Heart Association, American Society of Echocardiography, American Society of Nuclear Cardiology, Society for Cardiovascular Angiography and Interventions, Society of Cardiovascular Computed Tomography, and Society of Thoracic Surgeons. *J Am Coll Cardiol*. 2017;69(17):2212-2241. doi:10.1016/j.jacc.2017.02.001

8. Chan PS, Patel MR, Klein LW, et al. Appropriateness of percutaneous coronary intervention. *JAMA*. 2011;306(1):53-61. doi:10.1001/jama.2011.916

9. Fihn SD, Gardin JM, Abrams J, et al; American College of Cardiology Foundation; American Heart Association Task Force on Practice Guidelines; American College of Physicians; American Association for Thoracic Surgery; Preventive Cardiovascular Nurses Association; Society for Cardiovascular

Angiography and Interventions; Society of Thoracic Surgeons. 2012 ACCF/AHA/ACP/AATS/PCNA/SCAI/STS Guideline for the diagnosis and management of patients with stable ischemic heart disease: a report of the American College of Cardiology Foundation/American Heart Association Task Force on Practice Guidelines, and the American College of Physicians, American Association for Thoracic Surgery, Preventive Cardiovascular Nurses Association, Society for Cardiovascular Angiography and Interventions, and Society of Thoracic Surgeons. *J Am Coll Cardiol*. 2012;60(24):e44-e164. doi:10.1016/j.jacc.2012.07.013

10. Avoid Medicare Fraud & Abuse. A Roadmap for Physicians. November 2017. https://www.cms.gov/Outreach-and-Education/Medicare-Learning-Network-MLN/MLNProducts/Downloads/Avoiding_Medicare_FandA_Physicians_FactSheet_905645.pdf. Accessed August 21, 2018.

LESS IS MORE

Association of Inferior Vena Cava Filter Use With Mortality Rates in Older Adults With Acute Pulmonary Embolism

Acute pulmonary embolism (PE) is a common cause of morbidity and mortality in older adults.[1] Inferior vena cava (IVC) filters are frequently used to prevent subsequent PE; nearly 1 in 6 of elderly Medicare fee-for-service (FFS) beneficiaries with PE received an IVC filter.[2] However, the evidence supporting device efficacy and safety is scant.[3] In recent years, the US Food and Drug Administration raised concerns about the safety of IVC filters, and some studies have indicated a temporal decrease in the use of this technology.[4] Meanwhile, some investigators, using administrative data with limited adjustments, have found that the use of IVC filters was associated with reduced mortality rates, recommending their use.[5] This study sought to determine the association between use of IVC filters and mortality rates in Medicare FFS beneficiaries with PE using 3 distinct statistical approaches.

Methods | This study was exempt from additional review by the Human Investigation Committee at Yale University because all data were deidentified. Using the Medicare inpatient claims data and *International Classification of Diseases, Ninth Revision, Clinical Modification* codes, we identified elderly patients (aged ≥65 years) with a principal discharge diagnosis of PE (codes 415.1X, 415.11, 415.13, and 415.19) from 2011 to 2014. Procedure code 38.7 was used to identify patients who received an IVC filter. The main outcomes were 30-day and 1-year all-cause mortality rates. Mixed models were fitted with hospital as random effects, adjusting for patient characteristics (**Table**).

To account for the potential imbalances in baseline characteristics, a weighted analysis with the stabilized inverse probability weighting (IPW) approach was used. Each patient was weighted by inverse propensity scores of receiving an IVC filter, and the model only included the IVC filter use indicator (yes or no). To obtain the propensity scores, a logistic regression model was fitted with receiving an IVC filter as a dependent variable and baseline characteristics as covariates. The score performance was evaluated by comparing the standardized mean proportion difference in patient characteristics between the IVC filter group and no IVC filter group after the IPW adjustment. A difference of 0.2 or more was considered a significant imbalance.

In addition, a matched cohort was created for patients with PE who received an IVC filter and for those who did not. We matched for each of the individual characteristics exactly (ie, same demographics and same comorbidities) and compared the mortality rates. Analyses were performed using SAS, version 9.4 (SAS Institute).

Results | There were 214 579 FFS beneficiaries (57.4% women; 84.9% white; mean [SD] age, 77.8 [7.9] years) hospitalized for acute PE, of whom 13.4% received an IVC filter. Those receiving an IVC filter had a higher 30-day mortality rate than those who did not receive a filter (11.6% vs 9.3%). The adjusted odds ratio (OR) of 30-day mortality was 1.02 (95% CI, 0.98-1.06). The findings from the IPW analysis were statistically significant (OR, 1.16; 95% CI, 1.12-1.21).

One-year mortality rates among patients who survived longer than 30 days after index admission ware 20.5% in the IVC filter group and 13.4% in the no IVC filter group. In the model adjusted for patient characteristics, the adjusted OR was 1.35 (95% CI, 1.31-1.40), and in the model with IPW, the adjusted OR was 1.56 (95% CI, 1.52-1.61). Among patient characteristics used for risk adjustment, the maximum absolute IPW-adjusted standardized mean difference was 0.04, indicating that there were no substantial imbalances.

In the individually matched cohort, 76 198 FFS beneficiaries were hospitalized with acute PE, of whom 18.2% received an IVC filter. Mixed models with IVC filter as the dependent variable showed that the IVC filter group had higher odds for 30-day mortality (OR, 1.61; 95% CI, 1.50-1.73) and 1-year mortality (OR, 2.19; 95% CI, 2.06-2.33) compared with the no filter group (**Figure**).

Discussion | Our study of Medicare FFS beneficiaries with acute PE, consistent across 3 different statistical adjustment methods, does not suggest an association between IVC filter use and lower mortality rates. These findings stand in contrast with prior reports from administrative databases that suggested efficacy of IVC filters but did limited adjustment for potential confounders.[5] Instead, our study showed hypothesis-generating findings for increased risk.

The limitations of this study should be noted. First, limitations of administrative claims bring uncertainty for claiming the efficacy of health interventions using such data.[6] Second, the IPW analysis may become unstable in case the estimated propensities are small. However, in this study, the large size of the study cohort minimized this concern. Third, immortal time bias is another factor to consider in controlled studies in which an exposure (treatment) occurs only in 1 group. Patients in the exposure group need to be alive (immortal) until the day of the procedure, which may suggest a false beneficial treatment effect. In this analyses, however, patients receiving IVC filters did not have reduced mortality rates and the study did not adjust for immortal time bias. Despite the limitations, these findings in combination with the paucity of evidence from trials raise concerns about the widespread use of these IVC filters. There is a need for more and better studies (randomized clinical trials or prospective controlled observational stud-