ORIGINAL RESEARCH

Acute Myocardial Infarction Mortality During Dates of National Interventional Cardiology Meetings

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***Background*—**Previous research has found that patients with acute cardiovascular conditions treated in teaching hospitals have lower 30-day mortality during dates of national cardiology meetings.

***Methods and Results*—**We analyzed 30-day mortality among Medicare beneficiaries hospitalized with acute myocardial infarction (overall, ST-segment–elevation myocardial infarction, and non–ST-segment–elevation myocardial infarction) from January 1, 2007, to November 31, 2012, in major teaching hospitals during dates of a major annual interventional cardiology meeting (Transcatheter Cardiovascular Therapeutics) compared with identical nonmeeting days in the ±5 weeks. Treatment differences were assessed. We used a database of US physicians to compare interventional cardiologists who practiced and did not practice during meeting dates ("stayers" and "attendees," respectively) in terms of demographic characteristics and clinical and research productivity. Unadjusted and adjusted 30-day mortality rates were lower among patients admitted during meeting versus nonmeeting dates (unadjusted, 15.3% [482/3153] versus 16.7% [5208/31 556] [P=0.04]; adjusted, 15.4% versus 16.7%; difference −1.3% [95% confidence interval, −2.7% to −0.1%] [P=0.05]). Rates of interventional cardiologist involvement were similar between dates (59.5% versus 59.8% of hospitalizations; P=0.88), as were percutaneous coronary intervention rates (30.2% versus 29.1%; P=0.20). Mortality reductions were largest among patients with non–ST-segment–elevation myocardial infarction not receiving percutaneous coronary intervention (16.9% versus 19.5% adjusted 30-day mortality; P=0.008). Compared with stayers, attendees were of similar age and sex, but had greater publications (18.9 versus 6.3; P<0.001), probability of National Institutes of Health funding (5.3% versus 0.4%; P<0.001), and clinical trial leadership (10.3% versus 3.9%; P<0.001), and they performed more percutaneous coronary interventions annually (85.6 versus 63.3; P<0.001).

***Conclusions*—**Hospitalization with acute myocardial infarction during Transcatheter Cardiovascular Therapeutics meeting dates was associated with lower 30-day mortality, predominantly among patients with non–ST-segment–elevation myocardial infarction who were medically managed. **(*J Am Heart Assoc*. 2018;7:e008230. DOI: 10.1161/JAHA.117.008230.)**

Key Words: acute coronary syndrome • acute myocardial infarction • Cardiology meetings • health services research • Mortality

Thousands of physicians attend national scientific meetings annually. Within hospitals, the composition of physicians who attend scientific meetings may differ from nonattendees who remain behind to treat patients, potentially resulting in differences in care patterns and outcomes for patients hospitalized during meeting dates. A quasi-experimental evaluation of outcomes of patients hospitalized with acute cardiovascular conditions during the American Heart Association (AHA) and American College of Cardiology (ACC) annual meetings compared with identical nonmeeting days in the surrounding weeks found that, within teaching hospitals, patients admitted with cardiac arrest or high-risk heart failure during meeting dates had lower adjusted 30-day mortality compared with similar patients on nonmeeting dates.[1]

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Accompanying Tables S1 through S5 and Figure S1 are available at http://jaha.ahajournals.org/content/7/6/e008230/DC1/embed/inline-supplementary-material-1.pdf

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Clinical Perspective

What Is New?

- Patients hospitalized with acute myocardial infarction during dates of Transcatheter Cardiovascular Therapeutics annual meetings had lower 30-day mortality compared with patients hospitalized with acute myocardial infarction during identical nonmeeting days in the ±5 weeks.
- Rates of interventional cardiologist involvement were similar between meeting and nonmeeting dates, as were percutaneous coronary intervention rates.
- Mortality reductions were largest among patients hospitalized with non–ST-segment–elevation myocardial infarction who did not receive percutaneous coronary intervention.
- Compared with cardiologists who treated patients during Transcatheter Cardiovascular Therapeutics meeting dates, those not practicing were of similar age and sex, but had greater publications, probability of National Institutes of Health funding, and clinical trial leadership; they also performed more percutaneous coronary interventions annually.

What Are the Clinical Implications?

- Changes in acute myocardial infarction treatment patterns that occur during dates of Transcatheter Cardiovascular Therapeutics meetings likely explain observed differences in patient mortality, as opposed to unobservable differences in characteristics of patients treated on Transcatheter Cardiovascular Therapeutics meeting versus nonmeeting dates.
- Identifying the precise changes in treatment through use of registry data may provide valuable insights into the causal effects of specific care patterns on acute myocardial infarction mortality.

Although no mortality differences for patients with acute myocardial infarction (AMI) were identified, percutaneous coronary intervention (PCI) rates in patients with AMI decreased by one third during meeting dates.

Little is known about patterns of care during other national cardiology meetings, or the demographic, clinical, and research characteristics of physicians who attend them. In particular, analyses of care patterns during meetings catering to cardiology subspecialists, which attract physicians with more homogeneous clinical practices than the ACC and AHA meetings, may help to elucidate specific mechanisms by which different practice styles affect clinical outcomes. Moreover, comparisons of meeting attendees and nonattendees may identify specific physician characteristics that relate to patient outcomes.

We investigated differences in 30-day mortality among all Medicare fee-for-service beneficiaries hospitalized with AMI in major US teaching hospitals from January 1, 2007, to November 31, 2012, during a major annual interventional cardiology meeting (Transcatheter Cardiovascular Therapeutics [TCT]) compared with identical nonmeeting days before and after this meeting. We compared use of specific treatments on meeting and nonmeeting dates and the characteristics of interventional cardiologists who treated patients during meeting dates with those who only cared for patients in the surrounding weeks.

Methods

Because of data use requirements for Medicare data, the data, analytic methods, and study materials from this study will not be made available to other researchers for purposes of reproducing the results or replicating the procedure. The study was approved by the institutional review board at Harvard Medical School (Boston, MA), which waived the requirement for informed consent by subjects.

Data on Patient Outcomes

We used the Medicare Provider Analysis Review 100% files to identify all admissions to major teaching hospitals between January 1, 2007, and November 31, 2012, with a primary diagnosis of AMI among Medicare fee-for-service beneficiaries aged ≥65 years (*International Classification of Diseases, Ninth Revision* [*ICD-9*], code 410.X1).[2] We excluded December 2012 discharges to allow 30-day postadmission follow-up. We focused on major teaching hospitals for 2 reasons. First, a larger proportion of interventional cardiologists in major teaching hospitals may attend the TCT meetings ("TCT") compared with nonteaching hospitals. For example, although data on academic affiliations of physicians attending TCT were not publically available, ≈70% of 9482 attendees of the 2012 ACC meetings reported a primary activity of medical research or teaching.[3] Second, mortality reductions in the prior study of ACC/AHA meetings were concentrated in major teaching hospitals.[1] We used American Hospital Association annual surveys to identify major teaching hospitals on the basis of a ratio of resident physicians per bed of >0.60.[1,4–6]

Study Sample

We obtained dates for TCT scientific sessions held from 2007 to 2012. We focused on TCT because of its large size and because most physician-attendees are interventional cardiologists. In 2015, 82.3% (3690/4483) of physicians attending TCT were interventional/invasive cardiologists.[7] In contrast to the homogeneity of specialization among TCT attendees, large numbers of cardiologists from all cardiology subspecialties, and cardiothoracic surgeons, attend the AHA/ACC meetings.

By focusing on AMI, and analyzing outcomes of patients treated during dates of a meeting that is primarily attended by interventional cardiologists, we assumed that differences in patient outcomes between meeting and nonmeeting dates could be more directly linked to differences in interventional cardiologists practicing during the 2 periods.

We identified all patients with AMI who were admitted during TCT meeting dates (exposure) and on identical days of the week in the ±5 weeks surrounding the meetings (control). For instance, for patients with AMI admitted during the 2012 meeting (held Monday, October 22, to Friday, October 26), the control group included patients admitted Monday through Friday in the ±5 weeks surrounding the meetings.

Outcome Measures

Our primary outcome was risk-adjusted, all-cause, 30-day mortality among patients with AMI admitted during meeting versus nonmeeting dates. In addition, we separately analyzed mortality among patients with ST-segment–elevation myocardial infarction (STEMI; *ICD-9* codes 410.11, 410.21, 410.31, 410.41, 410.51, 410.61, 410.81, and 410.91) and non-STEMI (NSTEMI; *ICD-9* code 410.71). Within both STEMI and NSTEMI groups, we further analyzed 30-day mortality according to whether PCI was performed during hospitalization (*ICD-9* procedure codes 00.66, 36.01, 36.02, 36.05, 36.06, 36.07, and 36.09).[8]

We evaluated whether rates of specific treatments varied between meeting and nonmeeting dates, including the following: PCI, mechanical circulatory support (defined as intra-aortic balloon pump counterpulsation [procedure code 37.61] or percutaneous ventricular assist device [procedure codes 37.60, 37.62, 37.65, 37.66, and 37.68]), and coronary artery bypass grafting (procedure codes 36.10–36.19). In addition to analyzing PCI rates during hospitalization, we computed rates within 30 days of admission, to account for the possibility that PCI may be deferred postmeeting. Finally, we investigated whether length of stay (LOS) varied between meeting and nonmeeting dates.

Physician Characteristics

We compared characteristics of interventional cardiologists who tended to treat patients with AMI during TCT (termed "stayers") versus only during nonmeeting dates (termed "attendees"). Because we lacked information on TCT attendance by individual cardiologists, we used a claims-based approach, described later, to categorize physicians as stayers or attendees.

First, we used the Medicare 20% Carrier File to identify Part B claims filled by interventional cardiologists during meeting and nonmeeting dates. The file includes the National Provider Identifier for physicians responsible for a given claim. To ascertain physician specialty, we used National Provider Identifier to link the file to a comprehensive database of physician specialty and demographics from Doximity. Doximity is an online physician networking service that has assembled this information through multiple sources and data partnerships, including the National Plan and Provider Enumeration System, the American Board of Medical Specialties, and state medical boards.[9] Database details have been published previously.[9–11] We identified interventional cardiologists by board certification in interventional cardiology.

Second, interventional cardiologists with at least 1 claim filed during TCT dates were defined as stayers for that year (whether they filed claims during control dates). Interventional cardiologists who only filed claims during control dates were defined as meeting attendees in that year.

Third, we dichotomously defined interventional cardiologists as attendees for the entire study period (ie, tended to attend TCT) if they were classified as attendees during at least half of the years that they were included in our sample. For example, interventional cardiologists classified as attendees during 3 of 5 years in our sample, or 2 of 4 years, were labelled as attendees for the overall study period.

Fourth, using Doximity data, we described the characteristics of stayers and attendees, including the following: age; years since residency; graduation from a medical school ranked in the top 20 for research by *US News and World Report* in 2013 (binary indicator); sex; measures of research productivity, including number of publications indexed in PubMed; and whether the cardiologist was ever a principal investigator on a National Institutes of Health grant (obtained from National Institutes of Health Research Portfolio Online Reporting Tool) or a principal or subinvestigator on a registered clinical trial (ClinicalTrials.gov). Validation of these measures has been reported.[11]

Finally, to compare overall clinical practices of attendees and stayers, we evaluated their average annual volumes of Medicare patients with AMI treated and PCIs performed in these patients. To do so, we identified all AMI hospitalizations in our data from 2007 to 2012 (across each entire year) and assigned each hospitalization to the interventional cardiologist who accounted for the most Part B spending during that hospitalization.[12] We excluded hospitalizations for which no interventional cardiologist filed a Part B claim. For each interventional cardiologist, we then computed the average annual number of Medicare patients with AMI treated and PCIs performed for AMI (values were multiplied by 5 to reflect computation from the 20% Carrier File).

Statistical Analysis

We compared characteristics of patients admitted during meeting and nonmeeting dates, including age, sex, race, and chronic conditions present before admission (obtained from the Chronic Condition Warehouse). We then compared unadjusted 30-day AMI mortality between meeting and nonmeeting dates, both overall and among patients with STEMI and NSTEMI. To evaluate whether the quality of procedural and nonprocedural care differed during meeting and nonmeeting dates, we conducted additional analyses of STEMI and NSTEMI mortality among patient subgroups who did, or did not, undergo PCI. Standard errors were clustered at the hospital level, and *t* tests and χ^2 tests were used as appropriate.

Next, we estimated several patient-level multivariable logistic models with distinct outcomes: overall 30-day mortality (including patients with both STEMI and NSTEMI), STEMI mortality (overall including all patients with STEMI, and separately among STEMI patients with or without PCI), and NSTEMI mortality (overall including all patients with NSTEMI, and separately among NSTEMI patients with or without PCI). In each of these 7 models, covariates included patient characteristics, hospitalization year, and whether a hospitalization occurred during a meeting date (the main exposure of interest in all models). For each outcome, we reported adjusted 30-day mortality among patients admitted during meeting and nonmeeting dates.

We also examined how rates of PCI, coronary artery bypass grafting, mechanical circulatory support (MCS), and LOS compared between meeting and nonmeeting dates. For each treatment, we estimated multivariable logistic models with the covariates previously described. For LOS, we estimated multivariable linear regression models. We reported both unadjusted and adjusted treatment rates and LOS among patients admitted during meeting and nonmeeting dates.

Finally, we compared demographic, clinical, and research characteristics of stayers and attendees. *t*-Tests and χ^2 tests were used for comparisons, as appropriate.

The 95% confidence interval (CI) around reported means reflects 0.025 in each tail. Stata software, version 14 (StataCorp), was used for analyses. The study was exempted from human subjects review at the University of Southern California.

Sensitivity Analyses

We conducted several sensitivity analyses. First, we performed a falsification analysis to assess for confounding in mortality among patients hospitalized during meetings.[13–15] We analyzed 30-day mortality for 5 common noncardiac conditions (gastrointestinal hemorrhage, pneumonia, hip fracture, chronic obstructive pulmonary disease, and acute renal failure) between meeting and nonmeeting dates, assuming that mortality changes during meetings would suggest confounding by unmeasured patient characteristics or hospital-wide practice changes.[1] Second, we analyzed whether transfers into teaching hospitals declined during meetings, which could confound our analysis if transfer patients tend to have greater mortality risk. Third, we estimated models with hospital fixed effects to examine whether our results were driven by patients preferentially being admitted to hospitals of higher quality during meeting dates. Fourth, we considered alternative definitions of our control period (2 or 3 weeks surrounding meeting dates). Fifth, to assess whether observed mortality differences between meeting and nonmeeting dates were driven by chance alone, we performed a permutation test to assess the relative magnitude of the observed mortality difference. We calculated the unadjusted mortality difference between meeting and nonmeeting dates, assigning random "meeting" dates in each of 1000 replications. Sixth, we evaluated 90-day mortality to explore longer-term effects. Finally, to better account for skewness in LOS, we considered alternative model specifications (generalized linear model with log-link Poisson) for analyses of this variable.

Results

Patient Characteristics

Our sample included 3153 AMI hospitalizations during meeting dates and 31 156 AMI hospitalizations during nonmeeting dates. The per-period frequency of hospitalization was similar between dates (3153 during meetings versus 3116 per period in the surrounding ±5 weeks [31 156/10], a 1% difference), suggesting that hospitalizations were not shifted before or after meetings. Patient age, sex, race, existing comorbidities, and the proportion of patients hospitalized with NSTEMI versus STEMI were similar between dates (Table 1) (NSTEMI, 83.7% during meetings versus 83.9% during nonmeetings; STEMI, 16.3% during meetings versus 16.1% during nonmeetings).

Mortality During Meeting and Nonmeeting Dates

Unadjusted 30-day mortality was lower among patients with AMI admitted during meeting versus nonmeeting dates (15.3% [482/3153] versus 16.7% [5208/31 156]; absolute risk difference, −1.4% [95% CI, −2.8% to −0.1%]; *P*=0.04; Table 2). Mortality differences were concentrated among patients admitted with NSTEMI (13.9% [366/2639] versus 15.9% [4156/26 130]; risk difference, −2.0% [95% CI, −3.5% to −0.6%]; *P*=0.006), rather than STEMI (22.6% [116/514] versus 20.9% [1052/5026]; risk difference, 1.6%

Table 1. Characteristics of Patients Hospitalized With AMI During Dates of National Interventional Cardiology Meetings

Characteristics of Patient Sample	Cardiology Meeting Dates (n=3153)	Nonmeeting Dates (n=31 156)	*P* Value
Mean age, y	74.4	74.5	0.56
Female sex, %	44.9	46.0	0.24
Race, %			
White	75.1	75.7	0.50
Black	17.6	17.6	0.95
Hispanic	2.5	2.7	0.51
Asian or Pacific Islander	2.2	1.7	0.03
Other	2.6	2.4	0.57
Preexisting comorbidities, %			
Ischemic heart disease	72.3	71.5	0.32
Dementia	16.5	16.7	0.75
Atrial fibrillation	19.0	18.5	0.51
Chronic kidney disease	39.8	39.2	0.51
Chronic obstructive pulmonary disease	32.7	32.8	0.92
Congestive heart failure	50.0	50.3	0.73
Diabetes mellitus	51.5	49.9	0.08
Hyperlipidemia	73.5	71.0	0.003
Hypertension	82.4	80.9	0.03
Prior stroke or transient ischemic attack	22.6	21.6	0.17
Cancer	14.5	15.3	0.24
STEMI, %	16.3	16.1	0.81
NSTEMI, %	83.7	83.9	0.81
Interventional cardiologist involved, %*	59.5	59.8	0.88

AMI indicates acute myocardial infarction; NSTEMI, non–ST-segment–elevation myocardial infarction; and STEMI, ST-segment–elevation myocardial infarction.
*Interventional cardiologist involvement in a given hospitalization was based on the presence of an Evaluation & Management (E&M) claim billed to Medicare. The percentage was estimated in the 20% Medicare Carrier File.

[95% CI, −2.1%–5.3%]; *P*=0.39). After adjustment, overall AMI mortality was 15.4% (95% CI, 13.7%–17.0%) during meeting dates and 16.7% (95% CI, 15.9%–17.6%) during nonmeeting dates (absolute adjusted risk difference, −1.3%; 95% CI, −2.7% to −0.01%; *P*=0.04). Among patients with NSTEMI, adjusted mortality was significantly lower during meeting dates (13.9% versus 15.8%; absolute adjusted risk difference, −1.9%; 95% CI, −3.6% to −0.4%; *P*=0.01) (Figure). Adjusted estimates of STEMI mortality did not differ significantly between dates.

Treatment Use

Interventional cardiologists were involved in similar proportions of AMI hospitalizations during meeting and nonmeeting dates (59.5% versus 59.8%; *P*=0.88) (Table 1). PCI rates during hospitalization were statistically similar between dates among patients with STEMI (53.1% [273/514] versus 51.5% [2588/5026]; *P*=0.48) and NSTEMI (25.8% [680/2639] versus 24.8% [6487/26 130]; *P*=0.29) (Table 3) and in the 30 days after admission (Table S1). Rates of coronary artery bypass grafting and MCS were also similar between dates. These findings were unaffected by covariate adjustment. Finally, both unadjusted and adjusted LOS among patients with NSTEMI were slightly longer for patients admitted during meetings (adjusted LOS, 9.3 versus 8.8 days; difference, 0.5 days; 95% CI, 0.1–0.8 days).

Mortality According to Whether PCI Was Performed

Mortality among patients undergoing PCI was similar between meeting and nonmeeting dates in patients with STEMI and NSTEMI (Table 2, unadjusted differences; Figure, adjusted differences). However, among patients with NSTEMI who did not receive PCI during hospitalization, mortality was lower during meeting dates (16.9% [332/1959] versus 19.5% [3834/19 643]; unadjusted risk difference, −2.6% [95% CI, −4.3% to −0.8%]; *P*=0.004; adjusted risk difference, −2.5% [95% CI, −4.4% to −0.7%]; *P*=0.008; *P*=0.04 for PCI-meeting interaction), despite NSTEMI patient characteristics being similar (Table S2). Among patients with STEMI who did not receive PCI, mortality was nonsignificantly higher during meeting dates (adjusted mortality, 38.6% versus 33.3%; adjusted risk difference, 5.6% [95% CI, −0.9%–12.2%]; *P*=0.094).

Physician Characteristics

No differences were observed in average age of stayers versus attendees (51.0 versus 50.8 years; *P*=0.65; Table 4), average years since residency (20.9 versus 20.3 years; *P*=0.29), or in the proportion who were women (4.6% versus 4.0%; *P*=0.64). However, attendees were more likely to have graduated from a medical school ranked highly in research (23.0% versus 14.5%; *P*=0.001), led a clinical trial (10.3% versus 3.9%; *P*=0.001), or had National Institutes of Health funding (5.3% versus 0.4%; *P*=0.001). On average, attendees had more publications than stayers (18.9 versus 6.3; *P*=0.001), treated more patients with AMI annually (85.6 versus 63.3 Medicare patients with AMI; *P*=0.001), and performed more PCIs among these patients (40.7 versus 25.1 PCIs annually; *P*=0.001).

Table 2. Unadjusted 30-Day Mortality Among Patients Admitted for AMI During Dates of National Interventional Cardiology Meetings

Population	30-d Mortality, % (No. of Events/No. at Risk)		*P* Value
	Cardiology Meeting Dates	Nonmeeting Dates	
All patients	15.3 (482/3153)	16.7 (5208/31 156)	0.04
Patients with STEMI, overall	22.6 (116/514)	20.9 (1052/5026)	0.39
Received PCI during hospitalization	8.4 (23/273)	9.3 (241/2588)	0.63
Did not receive PCI during hospitalization	38.6 (93/241)	33.3 (811/2438)	0.10
Patients with NSTEMI, overall	13.9 (366/2639)	15.9 (4156/26 130)	0.006
Received PCI during hospitalization	5.0 (34/680)	5.0 (322/6487)	0.97
Did not receive PCI during hospitalization	16.9 (332/1959)	19.5 (3834/19 643)	0.006

AMI indicates acute myocardial infarction; NSTEMI, non–ST-segment–elevation myocardial infarction; PCI, percutaneous coronary intervention; and STEMI, ST-segment–elevation myocardial infarction.

Sensitivity Analysis

Mortality was similar between meeting and nonmeeting dates among patients hospitalized with common noncardiac conditions (Table S3). AMI transfers into teaching hospitals occurred with similar frequency during meeting and nonmeeting dates (Table S4). Our findings were robust to including hospital fixed effects, considering alternative control group periods ($\pm$2 or $\pm$3 weeks), analyzing 90-day mortality, including alternative model specifications for LOS (Table S5), and including a permutation analysis to assess the possibility that our findings were attributable to chance (Figure S1).

Discussion

We found lower 30-day mortality among patients hospitalized with AMI in major teaching hospitals during dates of a large interventional cardiology meeting. We found no differences in PCI, coronary artery bypass grafting, or MCS rates between meeting and nonmeeting dates. Observed mortality reductions were concentrated among patients with NSTEMI who did not undergo PCI.

Our findings have important similarities and differences to a prior study that demonstrated reduced mortality among patients hospitalized with high-risk heart failure or cardiac arrest in major teaching hospitals during ACC/AHA meetings.[1] Both the current and prior study found that patients hospitalized during meeting and nonmeeting dates were observationally similar, that hospitalization rates did not differ between periods (suggesting that patients did not delay care until after meetings), and that mortality for noncardiac conditions was similar. In addition, we found that rates of hospital transfer into teaching hospitals did not decline during meetings, which could otherwise explain our findings if transferred patients have higher mortality risk. Combined, these findings argue against unmeasured confounding.

The prior study on this topic found a one-third reduction in PCI rates during ACC/AHA meeting dates without concomitant changes in AMI mortality. However, because cardiologists of all subspecialties attend ACC and AHA meetings, it was unclear whether this reduced PCI volume reflected compositional changes in noninterventional cardiologists, who may differ in their propensity to involve an interventional cardiologist or agree with PCI (if recommended), or compositional changes in interventional cardiologists, whose propensity to perform PCI may differ.

The current study found no differences in PCI rates between meeting and nonmeeting dates, either during hospitalization or within 30 days of admission. This suggests that compositional changes in interventional cardiologists that occur during TCT do not affect in-hospital or 30-day PCI rates. One hypothesis that may reconcile the findings of both studies is that noninterventional cardiologists play an important role in deciding whether to consult interventional cardiology for patients with AMI and pursue PCI. Clinical practice differences among noninterventional cardiologists who attend general cardiology meetings may account for previously observed reductions in PCI during AHA/ACC meetings.

More important, we found that mortality reductions during TCT were concentrated among medically managed patients with NSTEMI. This suggests that interventional cardiologists practicing on meeting versus nonmeeting dates have similar procedural outcomes and similarly match patients to PCI versus medical management alone (because PCI rates and mortality among patients undergoing PCI were similar between dates, and characteristics of patients with NSTEMI were similar between dates in both PCI and non-PCI subgroups). However, it also suggests that care of medically

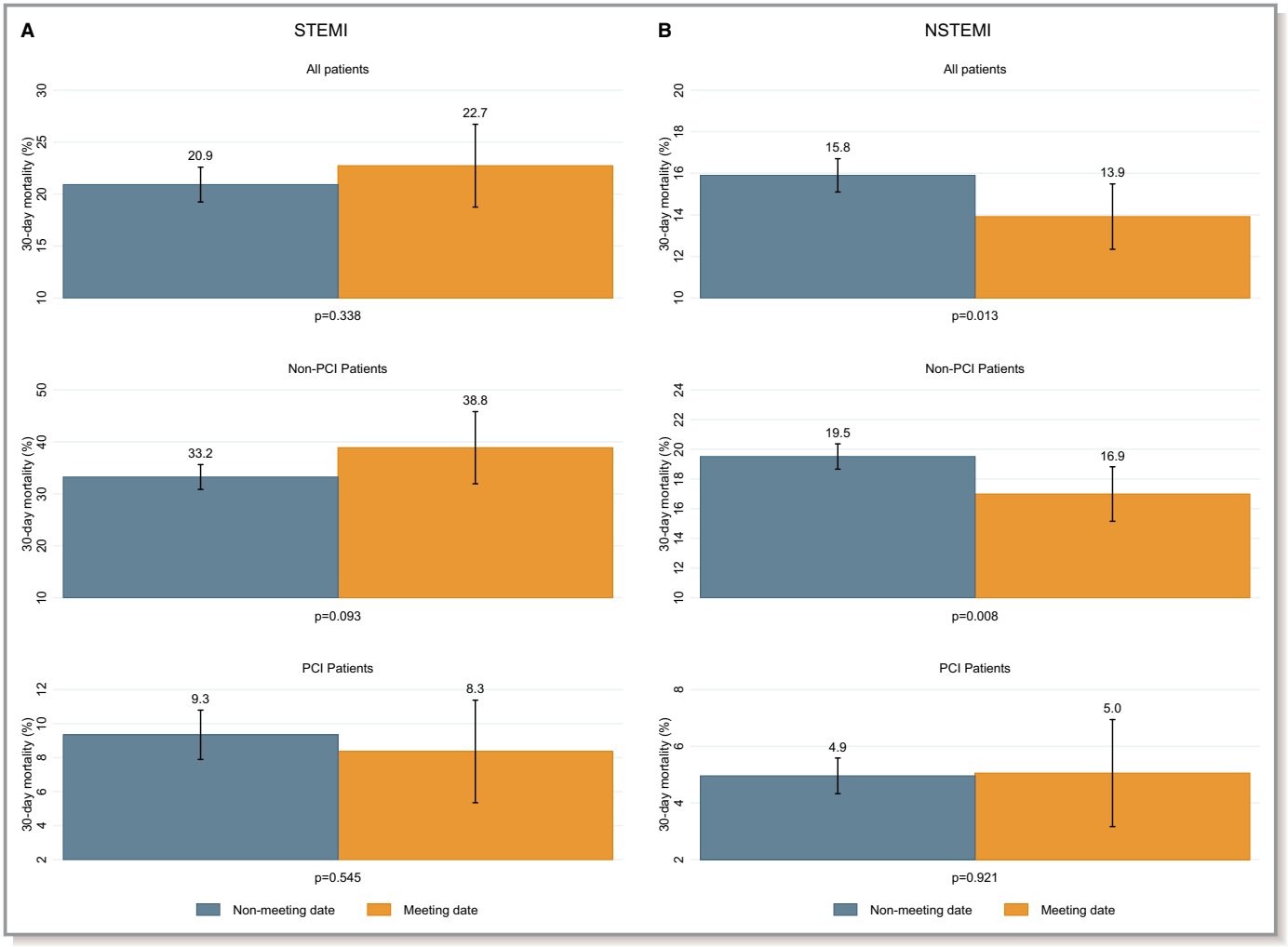

Figure. Adjusted 30-day mortality among patients admitted to teaching hospitals with acute myocardial infarction during dates of national interventional cardiology meetings. NSTEMI indicates non–ST-segment–elevation myocardial infarction; PCI, percutaneous coronary intervention; and STEMI, ST-segment–elevation myocardial infarction.

managed patients with NSTEMI may change during meeting dates in ways that result in improved outcomes for this subgroup of patients with AMI.

Although the mechanism underlying our findings is unclear, several explanations are possible. First, NSTEMI is a heterogeneous, complex, high-mortality disease. Acuity ranges from asymptomatic cardiac biomarker elevations to shock. Certain physical and chest x-ray findings (rales, elevated jugular venous pressure, hypotension, and pulmonary edema on x-ray film) predict short- and long-term NSTEMI mortality, but assessing risk can be challenging and nuanced.[16] Compared with STEMI, patients with NSTEMI frequently have more comorbidities[17] and management is often less clear cut. In particular, the precise indications for, and timing of, invasive treatment for NSTEMI are less straightforward than for STEMI, and have evolved considerably during the past decade.[18–20] These features of NSTEMI, the evolution of guidelines for managing this disease, and potential differences across physicians in how coexisting conditions are managed in the short-term create an ideal set of conditions for practice variation to affect patient outcomes. Our results could, therefore, reflect broad differences in nonprocedural care provided to patients with NSTEMI by interventional cardiologists practicing on meeting versus nonmeeting dates. Whether such differences might manifest in differential use of medical therapies with proven short-term benefits in medically managed NSTEMI (eg, clopidogrel, β blockers, angiotensin-converting enzyme inhibitors, high-potency statins, or selective aldosterone antagonists) or in other ways, such as differential skill in managing noncardiovascular conditions, is not clear and should be investigated.[20–24]

Second, overall differences in the level of involvement of stayers and attendees in the care of medically managed patients with NSTEMI could contribute to observed mortality differences. Third, attendees were not only more productive researchers but performed substantially more PCIs among

Table 3. Treatment Use Among Patients With AMI Hospitalized During Dates of National Interventional Cardiology Meetings

	Unadjusted Analysis			Adjusted Analysis			
Outcome	Nonmeeting Dates	Meeting Dates	*P* Value	Nonmeeting Dates	Meeting Dates	Difference (95% CI)	*P* Value
NSTEMI (N=28 769)							
PCI, %	24.8	25.8	0.29	24.8	25.7	0.9 (−0.8–2.6)	0.31
CABG, %	7.5	7.7	0.81	7.5	7.6	0.1 (−0.9–1.1)	0.87
Mechanical circulatory support, %	3.8	3.4	0.26	3.8	3.4	−0.4 (−1.1–0.2)	0.19
Length of stay, d	8.8	9.3	0.05	8.8	9.3	0.5 (0.1–0.8)	0.02
STEMI (N=5540)							
PCI, %	51.5	53.1	0.48	51.5	53.3	1.8 (−2.7–6.5)	0.43
CABG, %	8.3	7.2	0.40	8.3	7.1	−1.2 (−3.5–1.4)	0.40
Mechanical circulatory support, %	12.5	12.1	0.78	12.5	12.0	−0.5 (−3.3–2.3)	0.73
Length of stay, d	7.8	8.0	0.71	7.8	7.9	0.1 (−0.8–1.0)	0.83

Mechanical circulatory support includes intra-aortic balloon pump counterpulsation or peripherally inserted ventricular assist device. AMI indicates acute myocardial infarction; CABG, coronary artery bypass grafting; CI, confidence interval; NSTEMI, non–ST-segment–elevation myocardial infarction; PCI, percutaneous coronary intervention; and STEMI, ST-segment–elevation myocardial infarction.

patients with AMI compared with stayers. In addition to patient volume, a physician's degree of clinical specialization (ie, the relative extent to which efforts are clinically focused, independent of absolute clinical volume) has been positively associated with improved clinical outcomes.[25] Finally, although a prior meta-analysis found that time (years) of clinical experience is negatively associated with adherence to standards of care, patient outcomes, and factual knowledge,[26] we found no evidence that interventional cardiologists who attend TCT meetings have greater years of experience, as has been suggested.[27]

Our study's main limitation was an inability to establish why AMI mortality is lower during TCT meetings. We could not identify specific clinical decisions that differ during meetings, although differences in nonprocedural care appear relevant. Second, residual confounding is always possible.

Table 4. Characteristics of Interventional Cardiologists Practicing During Meeting and Nonmeeting Dates

Physician Characteristics	Stayers (n=671)*	Attendees (n=525)*	*P* Value
Proportion women, %	4.0	4.6	0.64
Average age, y	50.8	51.0	0.65
Attended a top-20 medical school, %	14.5	23.0	0.001
Average time since residency, y	20.3	20.9	0.29
Ever led clinical trial, %	3.9	10.3	0.001
Ever had NIH grant, %	0.4	5.3	0.001
No. of publications	6.3	18.9	0.001
No. of annual patients with AMI treated, fee-for-service Medicare	63.3	85.6	0.001
No. of annual PCIs performed among patients with AMI, fee-for-service Medicare	25.1	40.7	0.001

Top-20 medical schools were defined on the basis of *US News and World Report* 2013 medical school research rankings. Number of authored scientific publications was based on publications indexed in the US National Library of Medicine's PubMed database. NIH grant information was obtained from the NIH Research Portfolio Online Reporting Tool grants database. Clinical trial information was obtained from ClinicalTrials.gov database. *P* values reflect 2-sided *t* tests and χ^2 comparisons, where appropriate. AMI indicates acute myocardial infarction; NIH, National Institutes of Health; and PCI, percutaneous coronary intervention.

*For each year, an interventional cardiologist was defined as a stayer in that year if he or she had at least one Evaluation & Management (E&M) claim filled during the dates of that year's Transcatheter Cardiovascular Therapeutics (TCT) meeting. Interventional cardiologists who had E&M claims only in the surrounding control dates were defined as meeting attendees in that year. Interventional cardiologists with E&M claims during both meeting and nonmeeting periods were defined as stayers in that year. To dichotomously categorize whether, during the study period, a given interventional cardiologist tended to treat patients during meeting dates, we classified physicians as stayers versus attendees on the basis of the plurality of this designation across years in our data. Data on actual TCT meeting attendance were not available.

However, patients were similar between meeting and non-meeting dates; we found no declines in hospitalization or transfer of patients into teaching hospitals; and our falsification analysis argues against confounding. Third, our analysis of physician characteristics was based on a claims-driven approach to identifying physicians who likely attend TCT meetings, rather than meeting rosters. Physicians classified as stayers may also have attended only portions of meetings. Nonetheless, our finding that physicians designated as attendees have substantially greater research productivity is consistent with known demographics of meeting attendees. Finally, our analysis was restricted to Medicare.

In summary, we observed lower 30-day mortality among patients with AMI admitted to major teaching hospitals during dates of a major interventional cardiology meeting. PCI rates were similar during meetings, and mortality reductions were predominantly observed among patients with NSTEMI who were medically managed. One explanation for our findings is that the quality of medical management may differ during these meetings.

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SUPPLEMENTAL MATERIAL

Table S1. Thirty-day PCI rates among patients admitted with AMI during TCT meeting and non-meeting dates.

	Admitted during Non-meeting Dates	Admitted during Meeting Dates	P-value
PCI rate within 30 days of admission, overall %	31.1	28.1	0.15

Thirty-day PCI rates were computed using the 20% Carrier File, which allows for the identification of PCIs performed in the outpatient setting. In-hospital PCI rates in the baseline analysis were computed from the 100% MEDPAR file. We report overall PCI rates within 30 days of admission, rather than by NSTEMI and STEMI, given the sample size of admissions when using the 20% Carrier File is approximately 1/5th of that when using the 100% MEDPAR file.

Table S2. Characteristics of patients hospitalized with NSTEMI during meeting and non-meeting dates, according to whether PCI was performed during hospitalization.

	Non-meeting dates			Meeting dates		
Patient characteristics	**No PCI during hospitalization**	**PCI during hospitalization**	**p**	**No PCI during hospitalization**	**PCI during hospitalization**	**p**
Age, years	75.3	72.6	<0.001	75.3	72.5	<0.001
White, %	73.1	80.3	<0.001	73.5	77.8	0.03
Black, %	19.9	13.0	<0.001	19.3	15.0	0.01
Hispanic, %	2.9	2.5	0.083	2.5	2.5	0.94
Asian, %	1.8	1.5	0.087	2.3	1.8	0.41
Other, %	2.3	2.7	0.038	2.5	2.9	0.49
Female, %	48.0	41.0	<0.001	47.3	39.7	<0.001
Ischemic heart disease	74.3	73.8	0.37	74.4	75.7	0.50
Dementia	20.2	9.2	<0.001	19.2	11.5	<0.001
Atrial fibrillation	20.8	15.9	<0.001	21.3	15.6	0.001
Chronic kidney disease	44.7	33.4	<0.001	44.1	37.5	0.003
Chronic obstructive pulmonary disease	35.4	30.2	<0.001	35.3	30.4	0.02
Congestive heart failure	53.2	49.5	<0.001	54.5	50.4	0.07
Diabetes	56.0	45.3	<0.001	55.6	44.3	<0.001
Hyperlipidemia	72.7	73.2	0.45	74.4	76.6	0.26
Hypertension	83.6	80.1	<0.001	84.9	83.1	0.26
Prior stroke or transient ischemic attack	24.0	18.1	<0.001	24.2	21.8	0.20
Cancer	16.1	13.8	<0.001	15.3	14.7	0.73

Table S3. Falsification analyses.

Condition	Non-meeting Dates	Meeting Dates	P-value
Gastrointestinal Bleeding, Patient No.	14,192	1,380	
Gastrointestinal Bleeding, 30-day mortality	7.3	7.2	0.81
Hip Fracture, Patient No.	8,765	819	
Hip Fracture, 30-day mortality	7.8	6.7	0.28
Pneumonia, Patient No.	43,945	4,361	
Pneumonia, 30-day mortality	13.0	12.7	0.58
Chronic obstructive pulmonary disease, Patient No.	25,704	2,599	
Chronic obstructive pulmonary disease, 30-day mortality	3.5	3.3	0.64
Acute Renal Failure, Patient No.	64,610	6,624	
Acute Renal Failure, 30-day mortality	10.9	10.6	0.42
Combined, Patient No.	148,831	14,953	
Combined, 30-day mortality	9.8	9.5	0.29

Table S4. Hospital transfers during meeting and non-meeting periods.

Week relative to meeting	Percent of AMI admissions that are transfers from an outside hospital
-5	33.6% (1,223 / 2,421)
-4	32.8% (1,221 / 2,505)
-3	32.2% (1,199 / 2,524)
-2	33.2% (1,249 / 2,514)
-1	34.6% (1,335 / 2,523)
0	34.7% (1,343 / 2,530)
1	35.2% (1,344 / 2,475)
2	33.1% (1,335 / 2,698)
3	33.8% (1,346 / 2,641)
4	33.7% (1,337 / 2,635)
5	34.6% (1,386 / 2,625)

Table S5. Additional sensitivity analyses.

	Non-meeting Dates	Meeting Dates	P-value
Model	**NSTEMI adjusted 30-day mortality**		
Inclusion of hospital fixed effects	15.9%	14.0%	0.02
Defining control group by ±2 weeks	15.8	13.9	0.02
Defining control group by ±3 weeks	15.8	13.9	0.01
	NSTEMI adjusted 90-day mortality		
90-day mortality	23.4%	21.8%	0.02
	Adjusted NSTEMI length of stay, days		
LOS model estimated as GLM with Poisson log-link to account for skewness in LOS	8.8	9.3	0.02

In our baseline analysis, mortality reductions during meeting dates were concentrated among patients with NSTEMI. The above sensitivity analyses were conducted among patients hospitalized with NSTEMI.

Figure S1. Permutation test of 1,000 randomly-assigned meeting dates.