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BRIEF COMMUNICATION

Comanagement of Risk Factors in Patients With Coronary Artery Disease: Insights From the APPEAR Study

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BACKGROUND: Effective management of cardiovascular risk factors is the foundation of secondary prevention in coronary artery disease. The physician under whose sphere these are managed can vary, primary care physicians, cardiologists, or both, and the optimal management strategy for risk factor control is unknown.

METHODS AND RESULTS: The APPEAR (Angina Prevalence and Provider Evaluation of Angina Relief) study was a cross-sectional cohort study of outpatients with coronary artery disease (stable angina, percutaneous coronary intervention, coronary artery bypass grafting, or myocardial infarction) from 25 US cardiology practices. After each patient visit, providers noted who managed each risk factor. Blood pressure and lipid levels were recorded from charts. We compared adherence to guideline-directed risk factor control between management strategies (primary care physician alone, cardiologist alone, or comanaged). Among 1259 outpatients with coronary artery disease (mean [SD] age, 71 [11.1] years; 69% men), blood pressure and lipid management strategy varied. Mean blood pressure was 127.9/72.3 mm Hg, with 74% of patients at <140/90 mm Hg and 46% at <130/80 mm Hg. Mean low-density lipoprotein was 83.5 mg/dL, with 75% of patients at <100 mg/dL and 91% on appropriate statin therapy. Patients managed by cardiologists alone tended to have higher rates of risk factor control for both blood pressure and lipids, even after adjusting for covariates.

CONCLUSIONS: Although comanagement has shown benefit in some clinical situations, we found that risk factor control in patients with coronary artery disease tended to be poorer when care was shared between cardiologists and primary care physicians. Further research is needed to better define which conditions are best comanaged and how to more effectively comanage patients in the fractured US healthcare system.

Key Words: comanagement ■ risk factors ■ secondary prevention

Effective risk factor control (eg, blood pressure [BP], lipids, smoking, obesity, and diabetes mellitus) is essential for reducing both the initial development of coronary artery disease (CAD) and recurrent events in those with established disease.[1] Although primary prevention is typically controlled by primary care physicians (PCPs), patients with CAD typically see PCPs and cardiologists, both of whom are capable of managing these risk factors. In these situations, with >1 physician treating the same comorbidity, the role that cardiologists should optimally play in risk factor management is not clear. As patients are typically seen more frequently by their PCPs than specialists, PCPs may have a greater ability to actively manage risk factors and improve control. However, it is also possible that comanagement by PCPs and cardiologists could result in poorer control because of conflicting management strategies. Although a collaborative approach between PCPs and cardiologists makes intuitive sense to reduce burden on either provider, its overall impact on risk factor control needs to be rigorously evaluated. Accordingly, we used a multicenter, cross-sectional study of patients with CAD at the time of outpatient

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Nonstandard Abbreviations and Acronyms	
APPEAR	Angina Prevalence and Provider Evaluation of Angina Relief
CAD	coronary artery disease

cardiology visit to examine the prevalence of risk factor comanagement among outpatients with CAD and its association with risk factor control.

METHODS

Study Protocol and Population

The APPEAR (Angina Prevalence and Provider Evaluation of Angina Relief) study was a cross-sectional study from April 2013 to July 2015 of patients with CAD from 25 US cardiology practices.[2] Consecutive adult patients with established CAD (defined as stable angina, prior myocardial infarction, or prior coronary revascularization) and at least 1 prior visit at that site were approached for enrollment. Patients with dementia, patients unable to read or write in English, and those who refused to provide consent were excluded. Each participating site obtained Institutional Research Board approval. A waiver of written informed consent was allowed at all but 1 site, where written informed consent was obtained. The data that support the findings of this study are available from the author (J.A.S.; spertusj@umkc.edu) on reasonable request.

Patient demographics, medical history, vital signs, medications, and most recent laboratory values were abstracted from the chart by trained research personnel. After each clinic visit, providers noted whether particular risk factors were managed by the PCP, the cardiologist, or comanaged. The management strategy was self-reported by the cardiologist and reflected his/her understanding of how the risk factor was being managed. For the purpose of this study, we examined control of BP and lipids, which are more likely to be managed by both PCPs and cardiologists compared with other factors (eg, diabetes mellitus and obesity). BP control was defined as <140/90 mm Hg at the current office visit, with a secondary analysis of <130/80 mm Hg. Lipid control was defined as most recent low-density lipoprotein cholesterol (LDL-C) <100 mg/dL. Appropriate statin was defined as high-intensity statin use (atorvastatin, ≥40 mg, or rosuvastatin, ≥20 mg) for patients aged <75 years or any statin use in those aged ≥75 years. Patients with documented statin intolerance were excluded from the analysis.

Statistical Analysis

The study cohort was categorized on the basis of BP and lipid management strategy: cardiology only, PCP only, or comanagement. Risk factor control was compared among these groups using χ^2 tests as well as hierarchical logistic regression models that accounted for clustering of patients by site as well as patient factors that could impact risk factor control: age, sex, white race, high school education, and prior myocardial infarction. Finally, among patients seen by providers who enrolled ≥5 patients, we examined provider-level variability in comanagement strategies for BP and lipids. All analysis was performed using SAS v9.4 (SAS Institute Inc, Cary, NC) with a 2-way significance level of 0.05.

RESULTS

Our primary study cohort included 1259 outpatients with CAD seen by 155 cardiologists at 25 US sites. Mean age was 71.1±11.1 years, 68.5% were men, 93.3% were white, and 38.3% had a prior myocardial infarction (Table 1).

Blood Pressure

At the time of clinic visit, mean BP was 127.9/72.3 mm Hg, 73.8% of patients had BP <140/90 mm Hg, and 46.3% had BP <130/80 mm Hg. BP was managed by the cardiologist alone in 66.3% of patients, comanaged in 29.1%, and the PCP alone in 4.6%, with substantial variability in choice of management strategy across physicians (Figure). A greater proportion of patients in the cardiology only group were at BP goal <140/90 mm Hg compared with comanagement and PCP only strategies (77.0% versus 69.3% versus 61.8%; *P*=0.003), with similar proportions of patients at goal of <130/80 mm Hg across management strategies (*P*=0.65). After accounting for patient clustering and patient factors, cardiologist only strategy remained optimal for BP <140/90 mm Hg (cardiology only versus PCP: odds ratio [OR], 0.36; 95% CI, 0.18–0.69; *P*=0.002; cardiology only versus comanagement: OR, 0.65; 95% CI, 0.46–0.91; *P*=0.012), with no differences for BP <130/80 mm Hg (cardiology only versus PCP: OR, 0.73; 95% CI, 0.40–1.34; *P*=0.31; cardiology only versus comanagement: OR, 0.89; 95% CI, 0.67–1.18; *P*=0.41).

Lipids

Mean LDL-C in the cohort was 83.5 mg/dL, 75.1% of patients had LCL-C <100 mg/dL, and 90.7% were on appropriate statin therapy. Lipids were managed by cardiologists alone in 55.6%, comanaged in 28.4%, and by the PCP alone in 16.0%, again with substantial

Table 1. Characteristics of the Study Cohort

Patient Characteristics	Blood Pressure Management			Lipid Management		
	Cardiologist Alone (n=795)	Comanagement (n=349)	PCP Alone (n=55)	Cardiologist Alone (n=660)	Comanagement (n=337)	PCP Alone (n=190)
Sociodemographic						
Age, y	70.7 (11.3)	71.9 (10.5)	73.9 (10.2)	71.0 (11.5)	71.6 (10.5)	71.6 (10.6)
Male sex	554 (69.7)	230 (65.9)	37 (67.3)	474 (71.8)	211 (62.6)	126 (66.3)
White	700 (88.1)	325 (93.1)	47 (85.5)	607 (93.1)	315 (95.2)	148 (89.7)
Married	514 (65.6)	237 (68.3)	35 (63.6)	428 (65.6)	230 (68.5)	117 (62.9)
High school education	698 (89.7)	297 (86.3)	46 (83.6)	593 (91.4)	296 (88.9)	143 (77.7)
Insurance for medications	756 (96.2)	332 (95.7)	54 (98.2)	630 (95.9)	324 (97.3)	179 (96.2)
Comorbidities						
Hypertension	632 (79.6)	278 (79.7)	44 (80)	527 (80)	273 (81)	147 (77.4)
Dyslipidemia	642 (80.9)	313 (89.7)	47 (85.5)	549 (83.3)	295 (87.5)	149 (78.4)
Diabetes mellitus	278 (35.0)	123 (35.2)	23 (41.8)	224 (34.0)	116 (34.4)	74 (38.9)
Current smoker	82 (10.4)	31 (9.0)	4 (7.4)	64 (9.8)	26 (7.8)	27 (14.8)
Atrial fibrillation	194 (24.4)	74 (21.2)	8 (14.5)	159 (24.1)	71 (21.1)	44 (23.2)
Peripheral arterial disease	43 (5.4)	40 (11.5)	3 (5.5)	44 (6.7)	34 (10.1)	4 (2.1)
Stroke/transient ischemic attack	55 (6.9)	29 (8.3)	5 (9.1)	51 (7.7)	22 (6.5)	15 (7.9)
Lung disease	69 (8.7)	41 (11.7)	1 (1.8)	54 (8.2)	35 (10.4)	20 (10.5)
Risk factor control						
Systolic blood pressure, mm Hg	126.8 (16.5)	129.4 (18.5)	131.8 (16.1)	127.0 (16.7)	128.9 (17.7)	127.9 (17.4)
Diastolic blood pressure, mm Hg	72.1 (10.2)	72.6 (10.3)	71.9 (9.6)	72.5 (10.1)	72.8 (10.3)	70.6 (10.2)
Total cholesterol, mg/dL	156.3 (40.6)	158.8 (38.1)	154.5 (43.2)	154.0 (38.2)	160.2 (41.1)	165.3 (44.6)
Low-density lipoprotein, mg/dL	83.2 (33.5)	83.9 (33)	83.0 (32.1)	81.8 (32.0)	85.0 (34.6)	89.0 (36.7)
High-density lipoprotein, mg/dL	46.6 (14.5)	46.8 (14.5)	42.1 (13.0)	46.8 (14.1)	46.7 (14.5)	44.8 (16.1)
Triglycerides, mg/dL	136.1 (74.9)	142.9 (99.1)	140.5 (94.5)	132.2 (71)	145.4 (102.3)	150.5 (88)
Medications						
β Blocker	645 (81.1)	279 (79.9)	38 (69.1)	539 (81.7)	269 (79.8)	146 (76.8)
Angiotensin-converting enzyme inhibitor	329 (41.4)	131 (37.5)	26 (47.3)	278 (42.1)	130 (38.6)	70 (36.8)
Angiotensin receptor blocker	197 (24.8)	107 (30.7)	10 (18.2)	167 (25.3)	97 (28.8)	47 (24.7)
Calcium channel blocker	209 (26.3)	97 (27.9)	15 (27.3)	170 (25.8)	94 (27.9)	55 (29.1)
Diuretic	372 (46.8)	167 (47.9)	23 (41.8)	301 (45.6)	161 (47.8)	90 (47.4)
Statin	691 (86.9)	297 (85.1)	43 (78.2)	579 (87.7)	290 (86.1)	150 (78.9)

Data are presented as mean (SD) or number (percentage). PCP indicates primary care physician.

variability in management strategy across physicians (Figure). In the cardiology only strategy, a greater proportion of patients had LDL-C <100 mg/dL and were on appropriate statin compared with comanagement and PCP only management strategies (LDL-C <100 mg/dL: 78.7% versus 71.9% versus 67.9%; *P*=0.012; appropriate statin: 92.4% versus 88.7% versus 89.6%; *P*=0.16; Table 2). After accounting for patient clustering and patient factors, cardiologist only strategy remained optimal for LDL-C <100 mg/dL (cardiology only versus PCP: OR, 0.59; 95% CI, 0.36–0.97; *P*=0.038; cardiology only versus comanagement: OR, 0.64; 95% CI, 0.45–0.91; *P*=0.012) and appropriate statin treatment (cardiology only versus PCP: OR, 0.65; 95% CI, 0.35–1.25; *P*=0.20; cardiology only versus comanagement: OR, 0.57; 95% CI, 0.35–0.94; *P*=0.028).

DISCUSSION

The adoption of a collaborative cardiovascular care approach has been suggested to improve quality of care and entails the comanagement of risk factors among stable patients with CAD.[3] Accordingly, in this cross-sectional study of outpatients with CAD, we evaluated the real-world impact of comanagement between cardiologists and PCPs on BP and lipid

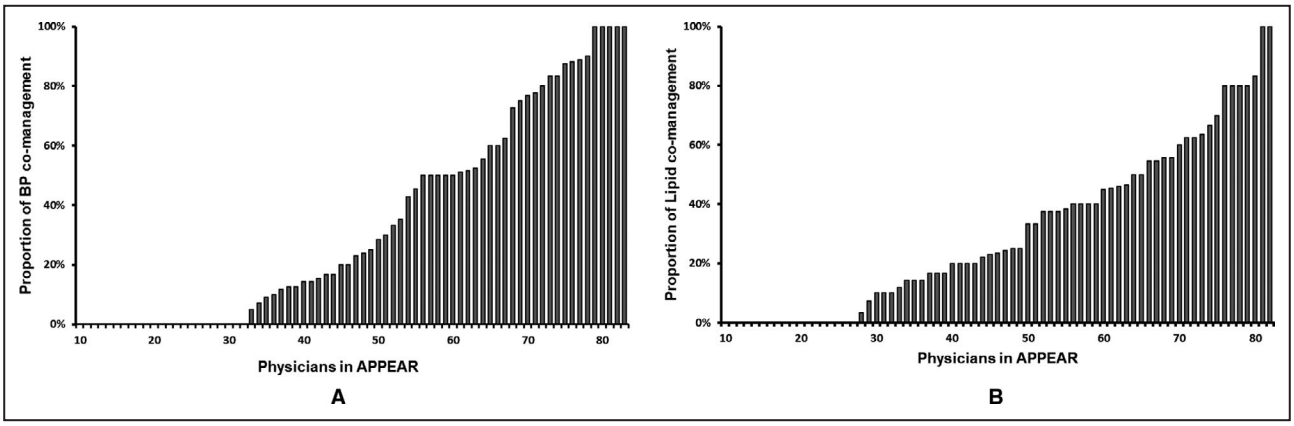

Figure. Provider-level variability in the comanagement of blood pressure (A) and lipids (B).
Analysis limited to providers who saw ≥5 patients. APPEAR indicates Angina Prevalence and Provider Evaluation of Angina Relief; and BP, blood pressure.

control. We found that although the choice of management strategy varied substantially across providers, overall, cardiologists were more likely to primarily manage or comanage BP versus a lower participation in lipid management. The implication of a lower participation of cardiologists in risk factor management was a lower degree of guideline-directed risk factor control.

The underperformance of comanagement in our study could be attributable to multiple reasons, such as suboptimal communication between providers, lack of infrastructural support and financial incentive to facilitate effective comanagement, and the lack of defined responsibilities.[4] Although comanagement has the potential to improve interphysician trust, reduce provider burnout, and increase achievement of goals of care (given the ability to more rapidly adjust treatment plans with more points of contact), our results likely illustrate the potential concerns of comanagement in the fractured US healthcare system. One study showed that nearly 68% of specialists report not receiving any information about the patient before referral and 25% of PCPs report not receiving a response from the specialist after referral.[5] These results are

Table 2. Guideline-Directed Risk Factor Control by Management Strategy

Risk Factor	All Patients	Management Strategy			
		Cardiologist Alone	Comanagement	PCP Alone	*P* Value*
Blood pressure	n=1259†	n=795	n=349	n=55	
Systolic blood pressure, mm Hg	127.9 (17.1)	126.8 (16.5)	129.4 (18.5)	131.8 (16.1)	0.012
Diastolic blood pressure, mm Hg	72.3 (10.2)	72.1 (10.2)	72.6 (10.3)	71.9 (9.6)	0.77
Blood pressure <140/90 mm Hg	73.8%	77.0%	69.3%	61.8%	0.003
No. of medications	2.7 (1.2)	2.7 (1.2)	2.8 (1.1)	2.6 (1.3)	0.50
Blood pressure <130/80 mm Hg	46.3%	47.3%	44.7%	43.6%	0.65
No. of medications	2.7 (1.1)	2.7 (1.1)	2.9 (1.1)	2.5 (1.1)	0.19
Lipids	n=1259†	n=660	n=337	n=190	
LDL-C <100 mg/dL‡	75.1%	78.7%	71.9%	67.9%	0.012
Any statin	1085 (86.2)	579 (87.7)	290 (86.1)	150 (78.9)	0.009
High-intensity statin	417 (39.2)	224 (39.6)	114 (39.6)	51 (34.9)	0.56
Moderate-intensity statin	575 (54.1)	301 (53.3)	157 (54.5)	87 (59.6)	0.39
Low-intensity statin	71 (6.7)	40 (7.1)	17 (5.9)	8 (5.5)	0.69
Statin intolerant	78 (6.2)	36 (5.5)	25 (7.4)	14 (7.4)	0.39
Appropriate statin§	90.7%	92.4%	88.7%	89.6%	0.16

Data are presented as mean (SD), percentage, or number (percentage). LDL-C indicates low-density lipoprotein cholesterol; and PCP, primary care physician.
**P* values were obtained from χ^2 tests.
†Includes 60 patients whose blood pressure and 72 patients whose lipids were managed by providers other than their PCP or cardiologist.
‡A total of 201 patients were excluded because of missing data.
§Defined as high-intensity statin (atorvastatin, ≥40 mg, or rosuvastatin, ≥20 mg) for patients aged <75 years or any statin use in those aged ≥75 years.

especially concerning because of the growing complexity of BP and lipid management, with newer medications being included into guidelines.[6] In addition, the poor distribution of primary care access further deepens this problem, requiring innovative strategies to optimize care.[7]

Personalized medicine with the help of a multidisciplinary care approach has been suggested as one potential solution to the current burden of cardiovascular risk factors but is heavily dependent on effective communication between providers.[8] Despite broader use of electronic medical records over the past decade, effective communication between PCPs and specialists remains suboptimal.[9] At the individual provider level, comanagement appears to be most effective in structured environments, where there are defined roles and pathways for distributing care and platforms for communication (both scheduled and open).[10,11] The use of electronic consultations within the electronic medical record is one such example that has been shown to improve access to specialist care.[12] Similarly, communication at the level of professional societies is important to maintain concordance in the guideline recommendations. Unfortunately, the primary care and cardiology societies have often worked in siloes, which has intermittently resulted in discrepant management goals between the 2 groups.[13–15]

Prior studies have shown the importance of participation of cardiologists in the management plan of patients with cardiovascular disease. A US registry of 25 686 outpatients with atherosclerotic disease or multiple risk factors (2003–2004) showed higher use of medications for cardiovascular risk reduction among those treated by cardiologists compared with PCPs, although this study did not examine risk factor control.[16] In patients admitted for an acute coronary syndrome, patients seen by cardiologists had higher use of guideline-based medications for the secondary prevention of CAD.[17] Although these studies support the importance of involving a cardiologist in the management of cardiovascular risk factors, they do not address the concept of collaborative care. One study in Spain showed a care model that actively integrated care between cardiologists and PCPs resulted in several positive effects for both patients and providers. Risk factors were controlled more effectively, guideline-recommended medications were more commonly prescribed, physician satisfaction increased, and resource use remained stable.[10] Integrated care allows the cardiologist to focus on serious pathological conditions while cardiovascular risk factors and stable patients can be monitored by PCPs. However, our results show that comanagement without this structure (eg, defined roles and responsibilities, collaboratively designed pathways, and active communication) does not result in improved care. Potential solutions include the expansion of accountable care organizations to include specialist care, which fosters an organizational support for effective comanagement.[18] With the increasing cost of medical care and the growing burden of risk factors, accountable care organizations, with a reimbursement structure that encourages comanagement, could both reduce healthcare cost by avoiding duplicate testing and support the infrastructure to improve care coordination. Data sharing between multiple electronic medical record platforms and explicitly defining the role of comanagement in an outpatient setting, similar to such efforts among inpatient providers, may also be effective strategies.[11,19] Future research efforts include quality improvement programs to better understand the current gaps in outpatient coordinated care and the development of a system to address gaps in care.

Our results should be interpreted in the context of the following potential limitations. First, as a cross-sectional study, we cannot examine the impact of management strategy on long-term cardiovascular events. Second, management strategy was self-reported by the treating physician, and we were unable to confirm or quantify the degree of comanagement. Furthermore, we were unable to explore any aspects of comanagement (eg, shared electronic medical record and communication strategies) that could be associated with better risk factor control, all of which highlight the need for future researchers to delve more fully into how such systems of care might influence risk factor control. Finally, although our cohort included 155 providers and 25 sites from across the country, it is unclear if our results generalize to other healthcare systems and clinics.

In conclusion, we found that guideline-directed risk factor control was poorer among outpatients with CAD whose management was deferred to the PCP or comanaged. Although integrated care with PCPs and specialists has immense potential to improve care, comanagement without a well-defined structure does not appear to be beneficial. Given the aging population and the increasing burden of chronic disease, comanagement of stable patients with CAD will become essential, simply from a workforce perspective. Further research is needed to define criteria for initiating comanagement, task sharing, and improving communication to effectively deliver collaborative care.

ARTICLE INFORMATION

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