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Use of a hypertension registry to identify patients at high risk for cardiovascular events caused by metabolic syndrome

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BACKGROUND: The use of information technology in health care has lagged behind other industries but provides great promise in improving the quality and efficiency of health care delivery. Computerized disease registries can provide an affordable and practical way for physicians to improve the management of their patients with chronic medical conditions.

METHODS: Using the American Osteopathic Association's Clinical Assessment Program registry for residencies, we identified 654 nondiabetic patients across 32 residency programs being treated for hypertension between 2006 and 2008. We evaluated this cohort for elevated risk of cardiovascular disease based on the presence of other components of metabolic syndrome.

RESULTS: A total of 338 nondiabetic patients with hypertension (51.70%) had elevated cardiovascular risk secondary to the presence of other metabolic syndrome criteria. In a univariate analysis, patients receiving Medicaid or who were self-pay had an increased frequency of metabolic syndrome. Only female gender and younger age showed positive correlations with the presence of metabolic syndrome in a multivariate analysis. Patients older than 60 years had a reduced likelihood of metabolic syndrome compared with their younger counterparts, which was associated with a reduced body mass index.

CONCLUSIONS: The results of this study demonstrate that a significant number of nondiabetic, hypertensive patients in ambulatory residency programs have an increased frequency of other cardiovascular risk factors. This study illustrates a method of using an ambulatory registry to identify specific subsets of hypertensive patients at high risk for cardiovascular events within participating practices because of the presence of metabolic syndrome, and demonstrates a mechanism to facilitate comprehensive patient care consistent with the precepts of a patient-centered medical home.

Introduction

The integration of computers and information technology into the health care system over the past two decades has led to the use of medical registries to track process and outcomes in health care delivery. Registries such as the National Registry for Myocardial Infarction, the American College of Cardiology National Cardiac Data Registry, and the Society for Thoracic Surgery Registry have been used to track performance and identify opportunities to improve medical care. These registries have provided information that affect several levels of health care including manage-

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ment of individual patients and patient populations, quality reporting initiatives, and policy formation.[1-3] The use of registries in the ambulatory environment can provide practicing physicians in the office with information to improve the management of their patients with chronic medical conditions. Ambulatory registries offer the opportunity for physicians to evaluate not only care delivered to a patient population, but also the impact of health care treatment interventions. An analysis of patient registry data can offer insight to physicians and others, including policymakers and payers, which can ultimately improve health care. Physicians can analyze interventions and outcomes to identify opportunities for quality improvement. Health insurers can review treatment trends that will impact coverage decisions.

A recent study demonstrated that the use of information systems, not exclusively electronic health records, is associated with improved patient-centered care.[4] Patient-centered care has gained increasing recognition over the past several years as an important goal for the health care system. Data from studies have shown that patients often grade hospitals and medical care providers highly, but report difficulties with access to medical information, therapeutic options, instruction on medication use and side effects, and receiving compassionate care from their health care providers.[4] Recognition that the current health care delivery system is not fully patient-centric has led to the concept of the patient-centered medical home. Patients with chronic diseases require management over time and use multiple resources, which include primary and secondary preventive care as well as the active participation of the patient in self-care.

The need for patient-centered care can be seen as we look at examples of the current state of health care delivery. In a recent study, patients with common chronic diseases including hypertension and diabetes were surveyed regarding collaborative care. Participants in this study were considered to have "good" collaborative care if they received both helpful information regarding their disease process from their health care providers and if they reported feeling confident about their ability to control and manage their disease process. Those respondents who reported one of these criteria were described as having "fair" collaborative care, and those who reported neither as having "poor" care. The researchers found that 21% of patients reported good collaborative care, 36% fair collaborative care, and 43% poor collaborative care. Common findings in this study that were associated with good collaborative care were provider continuity, access to care, and efficiency of care. Efficiency of care includes a reduction of poor outcomes, providing care in a time-efficient manner, and cost savings over time. Good collaborative care was associated with improved outcomes including control of blood pressure, glucose, and lipids. Other studies have suggested common components of enhanced patient-centered care: access to care, including ease of making appointments, variety of days and times of service available, and short waiting times at appointments. The involvement of the patient in health care decisions with information on treatment plans and preventive care, access to medical records, and counseling are important additional factors.[4]

In the United States, heart disease is the number one cause of death. The Centers for Disease Control and Prevention (CDC) estimate that there are 217 deaths due to heart disease per 100,000 people according to 2004 data.[5] The annual direct and indirect costs for coronary heart disease were estimated at $142.5 billion in 2006.[6] These statistics demonstrate the burden that cardiac disease has on patient lives, their productivity, and the entire health care system. Metabolic syndrome affects more than 26% of adults, or more than 50 million Americans. The presence of metabolic syndrome increases the risk for atherosclerotic cardiovascular disease 1.5- to 3-fold and raises the risk for type 2 diabetes 3- to 5-fold.[7] This finding is not surprising, because each of the individual components of the metabolic syndrome are significant cardiovascular risk factors. The National Cholesterol Education Program Adult Treatment Panel III (NCEP ATP III) requires the presence of three or more of the following parameters to make the diagnosis of metabolic syndrome: increased fasting glucose $\geq$110 mg/dL, triglycerides (TG) $\geq$150 mg/dL, high-density lipoprotein cholesterol (HDL-C) $<$40 mg/dL in men or $<$50 mg/dL in women, blood pressure $\geq$130/85 mm Hg, and waist circumference $>$40 inches in men or $>$35 inches in women. If metabolic syndrome conveyed no additional risk beyond its components, physicians would have little reason to treat the constellation of risk factors of metabolic syndrome rather than addressing each risk factor as it was identified. Risk factors in patients are not often assessed and treated as a bundle to prevent disease. The use of a registry allows physicians to better identify which of their patients are at the greatest risk of cardiovascular disease and offer an opportunity to improve both primary and secondary prevention of metabolic syndrome and its individual components.

The American Osteopathic Association's Clinical Assessment Program (AOA-CAP) registry for hypertension was used to develop estimates of metabolic syndrome in patients seen with a principal diagnosis of hypertension. By obtaining estimates of metabolic syndrome in patients treated for hypertension in the ambulatory environment we provide a way to identify those patients at elevated risk. We also discuss new models of care delivery to address these patients at higher risk of cardiovascular events.

Methods

The AOA-CAP for Residencies is a web-based, ambulatory care registry developed by the AOA to provide primary care residency programs with current performance data on clinical parameters for patients within their practice and to satisfy core competencies regarding evidence-based prac-

tice. It is currently in use by all osteopathic internal medicine and family medicine training programs nationally and covers eight clinical entities with evidence-based measures of care consistent with standards from the National Quality Foundation. The AOA-CAP for Residencies was developed using standardized patient selection and abstraction techniques, allowing meaningful comparison of both process of care and outcomes to other residency programs and to nationally recognized, disease-based practice performance guidelines.

The hypertension module, started in 2006, collects patient level data on demographic, physiologic, and laboratory parameters for patients with an International Classification of Diseases (ICD-9) diagnosis of hypertension and at least two visits during the study year. Cases are selected on a random basis from each residency, abstracted, and then entered into a web-based portal. This project was found to be exempt from formal institutional review board review by the director of research for Ohio University College of Osteopathic Medicine's Centers for Research and Education.

The hypertension module used for this analysis contained 654 nondiabetic patient observations across 32 residency programs during 2006 and 2008. Patients were included in the analysis if they had a diagnosis of hypertension, had at least two office visits during the study year, and had abstraction of all elements necessary for construction of metabolic syndrome risk including the measurement of systolic and diastolic blood pressure, body mass index (BMI), height, weight, abdominal girth, triglyceride level, HDL-C level, and blood glucose level. Each of these criteria was entered into the database to obtain the number of hypertensive patients that had one or more of these additional risk factors. This study used the values for metabolic syndrome criteria published by the NCEP ATP III. In addition, demographic information including gender, age, and insurance type were collected. Payer type was identified as Medicare, Medicaid, commercial insurance, self-pay, and other. The frequency of metabolic syndrome in patients with hypertension was evaluated according to payer type. Patients were excluded from the module if they had insufficient diagnostic terms such as "rule out hypertension," "white coat hypertension," or "consistent with hypertension."

Table 1 Gender and insurance mix

	Overall % (*n*)
Study cohort (654)	
Male gender	47.25 (309)
Mean age	57.54
Primary insurance	
Medicare	22.8 (149)
Medicaid	14.2 (93)
Commercial	39.0 (255)
Self-pay	11.31 (74)
Other	12.7 (83)

Table 2 Distribution of metabolic syndrome risk factors

Clinical condition	Number of patients	% of patients
Blood glucose ≥110 mg/dL	130	19.90%
Triglyceride ≥150 mg/dL	270	41.28%
HDL <40 mg/dL (male) or <50 mg/dL (female)	330	50.46%
Waist circumference >40 in (male) or >35 in (female) or BMI >30	309	47.25%
At least two of the above risk factors in addition to being hypertensive (nondiabetic)	338	51.70%

Analysis was completed using SAS version 9.1 (SAS Institute, Cary, NC). Chi-square analysis was used for dichotomous variables and *t*-tests for continuous variables. The independent effect of demographic variables on the frequency of metabolic syndrome was investigated using a logistic regression model.

Results

Table 1 displays the demographic information showing the patient population to be more frequently female and commercially insured. Table 2 provides data on the frequency of metabolic syndrome and the frequency of the various risk factors for metabolic syndrome. In the study population, a total of 338 patients with hypertension (51.7%) had elevated cardiovascular risk secondary to the presence of metabolic syndrome. The most frequent contributing reason for metabolic syndrome was low HDL followed by elevated BMI or increased waist circumference. Table 3 shows the distribution of metabolic syndrome in patients according to gender and payer type. Females, younger patients, and hypertensive patients with Medicaid or who were self-pay were more likely to have metabolic syndrome. Commercial insurance and Medicare were associated with a significantly lower frequency of metabolic syndrome.

To determine the independent effects of the factors displayed in Table 3, a logistic regression analysis was completed modeling the presence of metabolic syndrome. Table 4 demonstrates the results of a multivariate analysis of age, gender, and payer type on the development of metabolic syndrome. In the multivariate analysis there was no significant difference in the presence of metabolic syndrome based on insurance type after adjustment for gender and age. Both increasing age and male gender were associated with a lower frequency of metabolic syndrome in this population.

Because the aforementioned relationship between metabolic syndrome and age was not consistent with prevailing

Table 3 Distribution of metabolic syndrome in hypertensive patients

Factors associated with metabolic syndrome in hypertensive patients			
Demographic factor	Percent of patients with characteristic having criteria for metabolic syndrome	Percent of patients without characteristic having criteria for metabolic syndrome	*p*-value
Male gender (309)	46.60	56.23	0.0139
Medicare (149)	44.97	53.66	0.0619
Medicaid (93)	63.44	49.73	0.0143
Commercial (255)	45.49	55.64	0.0113
Self-pay (74)	63.51	50.71	0.0306
Other (83)	59.04	50.61	0.1513
	Patients having criteria for Metabolic Syndrome	Patients not having criteria for Metabolic Syndrome	
Mean age	54.04	57.97	0.0005

literature,[8] we evaluated the association of each of the risk factors with age to determine which risk factor was causing a decrease in metabolic syndrome. This analysis identified the BMI/waist circumference variable to be associated with the reduction. Figure 1 graphically represents the findings that younger patients were more likely to be obese than older patients. This further clarifies the information in Table 3 relating to the mean age of patients meeting criteria for metabolic syndrome: older patients with a lower BMI were less likely to develop metabolic syndrome.

Discussion

This study provides a method of using an ambulatory registry to identify subsets of nondiabetic, hypertensive patients at high risk for cardiovascular events within participating practices. Fifty-one-point-seven percent of hypertensive patients in the residency program ambulatory setting are at significant risk for cardiovascular disease because of the presence of metabolic syndrome. The National Health and Nutrition Examination Survey (NHANES) 1999–2000 data revealed the unadjusted prevalence of metabolic syndrome in adults in the United States to be 26.7%.[8]

Table 4 Multivariate analysis of factors associated with metabolic syndrome

Lotistic regression model evaluating the association between factors and metabolic syndrome			
	Adjusted odds ratio	LCL	UCL
Male gender	0.623	0.452	0.857
Medicare (reference)			
Medicaid	1.56	0.869	2.799
Commercial	0.759	0.48	1.199
Self-pay	1.46	0.776	2.745
Other	1.317	0.738	2.349
Age	0.982	0.97	0.994

The multivariate analysis performed on variables in this hypertensive patient study population is consistent with the findings in NHANES 1999–2000, which also showed an increased prevalence of metabolic syndrome in adult females who did not have diabetes mellitus. However, this study demonstrated a decreased frequency of metabolic syndrome in patients older than 60 years; in NHANES 1999–2000, age-adjusted rates of metabolic syndrome were increased in patients older than 60 years.[8] Further examination of the data in this study provides an explanation for this difference: the association between age and obesity. The likelihood of metabolic syndrome decreased each decade beginning at age 60, and there was a corresponding decrease in BMI or waist circumference. The relationship between obesity and insulin resistance is well-established, and the decreasing frequency of obesity in older patients in this study may have been a result of complications of hypertensive end-organ damage, other comorbidities, or nutritional challenges seen commonly in the elderly.

Metabolic syndrome as a constellation of risk factors is not a new concept and is in fact somewhat controversial as a diagnostic entity of its own. The value of having a syndrome designating higher cardiovascular risk in patients treated for hypertension is that it identifies a group of patients to focus increased efforts at risk reduction. The recognition of the constellation allows the physician to treat the whole patient using primary and secondary prevention measures, not simply treating hypertension, but all associated risk factors. Because each of the factors contributing to metabolic syndrome are modifiable by lifestyle and pharmaceutical interventions on both a macro and micro level, the measure of frequency of metabolic syndrome in hypertensive patients can be used to track response after any systematic change in caring for this patient population in addition to determining the individual patient's response to therapeutic management decisions.

A recent article examined the dramatic decrease in deaths from cardiovascular disease between 1980 and 2000 in the United States. The investigators found that 44% of the reduction was attributable to better control of risk factors

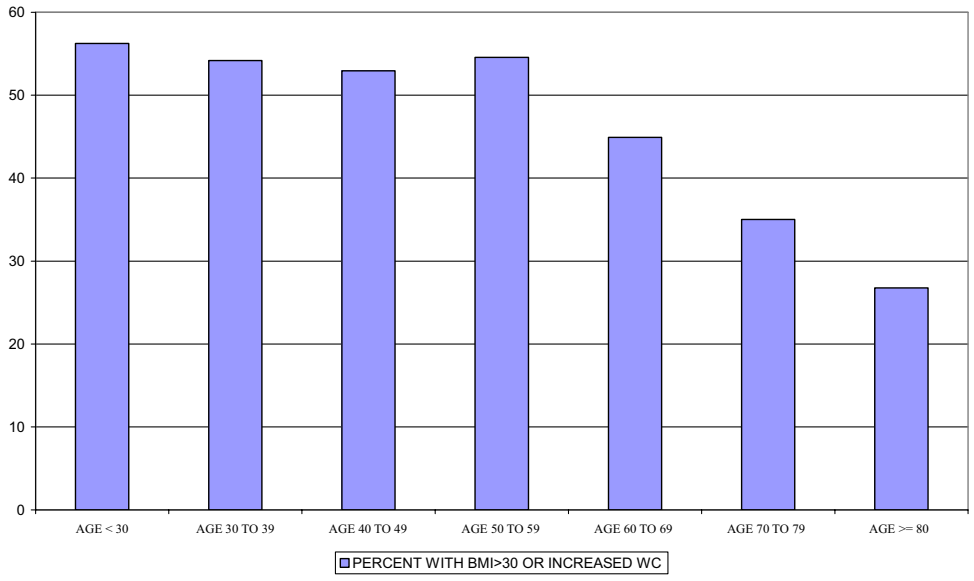

Figure 1 Association between age and BMI > 30 or waist circumference > 40 cm male or > 35 cm female.

including reductions in total cholesterol (24%), systolic blood pressure (20%), smoking prevalence (12%), and physical inactivity (5%). This article emphasizes the importance of primary prevention in reduction of morbidity and mortality associated with coronary disease and, in conjunction with the information from the AOA-CAP, demonstrates the need for a heightened focus on risk reduction in this high-risk population through more aggressive pharmacotherapy and engagement of patients on the need for lifestyle interventions.[6]

This study highlights the importance of systematic review for clustering risk factors in the development of chronic disease and the potential role of registries as one of the tools that can be used to improve the assessment and management of patients. A variety of tools are needed to achieve the goal of managing and controlling the different components of the metabolic syndrome. The physician acts as the manager of the tools, using his or her own knowledge and experience combined with available medical system resources, and must involve the patient as an active participant in the individualized care plan. There are, of course, barriers to each of the three components that must be overcome to maximize the outcome of the individual patient, as well as the entire population of patients managed by the physician. Physicians have always been engaged in the management of chronic conditions with varying rates of success. As a result of our nation's current system of reimbursement to primary care physicians, where more patients must be seen in a finite amount of time to run a successful practice, patient education regarding these chronic diseases in the office setting may be brief and cursory. Having the right tools, which may include dietary, exercise, or medication-related information, to meet each patient's individual needs in each physician's office also presents a challenge. It has also proven difficult for an individual physician to actually be aware of how much or how little success is achieved in the management of all the patients with a given diagnosis in his or her practice as a population. The measurement of patient outcomes is a relatively new concept to most physicians, and the ability to effectively measure these patient outcomes has been laborious at best for those practices without an electronic health record. The Joint Principles of the Patient-Centered Medical Home, as advocated by the American Academy of Family Physicians, the American Academy of Pediatrics, the American College of Physicians, and the AOA, includes the use of registries to facilitate the delivery of health care and as a tool to improve both quality and safety.[9] Factors that have been reported to be associated with the successful development of patient-centered care include a clearly stated and effectively communicated strategy, with strong support from the practice's medical leadership with the clear involvement of patient and families at all levels. The practice needs to develop information technology that supports both the health care provider and the patient. In addition, quality of care must involve systematic measurement and feedback to the health care providers.[10]

Although physicians endorse patient-centered care, only 22% have implemented core components into their practices. Many physician practices offer same-day appointments, but team-based care, e-mail availability with patients, registries for chronic disease management, medication lists, access to medical records or test results, information on quality of care, and information systems are often not fully incorporated. Additional education and financial support might facilitate broader application of patient-centered care.[11] The recent incorporation by the Accreditation Council for Graduate Medical Education, the AOA, and the Accreditation Council for Continuing Medical Education of longitudinal core competencies, including practice-based learning and improvement and systems-based practice, will begin to focus physicians

on the potential patient-centered tools listed here, with concomitant improvement in patient care.

There has been interest in evaluating the effect of the different components of patient-centered care. A recent meta-analysis of 66 trials evaluating quality improvement strategies aimed at improving glycemic control in patients with type 2 diabetes mellitus demonstrated that most produced small to modest improvements in glycemic control, with team changes and case management showing the largest amount of change. Team changes in this study included the addition of a new team member as an adjunct to the physician and the use of multidisciplinary teams or expanding the role of members already a part of the team, whereas case management included "any system for coordinating diagnosis, treatment or ongoing patient management."[12] Quality improvement interventions in which nurses or pharmacists were able to change medications without physician approval reduced hemoglobin A1c values by 0.8%.[12]

Part of the challenge of this meta-analysis was the inability to determine isolated effect in many studies because of the overlap of multiple interventions. The same may be true of typical physician practices because of the heterogeneity of structural issues, such as practice staffing and size and payer type and coverage. The ability to quantify the intermediate outcomes of these patients, whether it is glycemic control in diabetic patients or reduction of metabolic syndrome risk factors in hypertensive patients, will require knowledge of potential interventions and tools to measure the effect of these interventions on the population of interest. The recent shift of the accrediting agencies in medical training acknowledges the need for these core competencies. A major challenge lies in providing this training for practicing physicians.

A strength of this study is that it encompasses a large, diverse population of patients covering 32 osteopathic residency practice sites from across the United States. Limitations of this study include potential chart reviewer bias and issues of generalizability, and the frequency of metabolic syndrome in this cohort may be higher than in the general population. In addition, sample size within certain insurance type subgroups was small, and patient race was not recorded in the data collection. Not surprisingly for residency-based practices, the distribution of payment type is skewed towards public programs and self-pay, populations that have traditionally had lower rates of performance on the type of intermediate outcomes investigated here.[13] Another challenge in determining the true prevalence of metabolic syndrome in this cohort is treatment bias. Some hypertensive patients may have been treated for lipid disorders, and although classified as having normal lipids for our study, would actually be considered at risk for metabolic syndrome. There was no method to determine whether patients included in this study were undergoing treatment for the individual components of metabolic syndrome, were partially treated, or were untreated. The fact that 51% of the patients continue to fall in the category of metabolic syndrome using our criteria illustrates the need for more intensive lifestyle and/or pharmacologic interventions. We did not discuss the level of hypertension control in this population.

Conclusions

The use of a web-based, chronic disease registry among 32 osteopathic primary care residencies across the United States demonstrated that in patients with a known diagnosis of hypertension, the prevalence of metabolic syndrome was significant. The recognition of metabolic syndrome allows the physician to aggressively treat the whole patient using primary and secondary prevention measures, not simply treating hypertension but treating all associated cardiovascular risk factors.

For physicians to improve the care they deliver to a given patient population, an appropriate framework needs to be established including an easily usable structure that determines current practice results, a well-defined process to identify and improve areas of deficiency, and measurable outcomes after interventions. The use of patient registries can be used to assist physicians in defining the scope of population management, testing solutions, and measuring process at both local and national levels.

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