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ORIGINAL ARTICLE

Implementing an Electronic Medical Record–Based Reminder for Cardiovascular Risk Screening in Rheumatoid Arthritis

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Objective. **Although cardiovascular disease (CVD) is the leading cause of death among individuals with rheumatoid arthritis (RA), CVD risks are not being assessed frequently and systematically in RA. We implemented an electronic medical record (EMR)–based reminder in a tertiary care center and assessed the effects of this intervention on CVD risk screening by rheumatologists and primary care providers.**

Methods. **The EMR reminder was implemented in December 2013 and included the most recent value and target ranges for body mass index, blood pressure (BP), and lipid profiles. It was displayed for every rheumatology and primary care visit for all patients with the International Classification of Diseases, Ninth Revision code for RA (714.0). Lipid screening rates, as well as changes in BP and obesity rates were compared pre- and postimplementation. Factors associated with lipid screening postimplementation were assessed using multivariate logistic regression.**

Results. **A total of 138 and 112 RA patients were seen in the outpatient clinics pre- and postimplementation, respectively. The demographic characteristics were similar in the pre- and postimplementation groups. Lipid screening rates were 50% preimplementation and 46% postimplementation ($P = 0.58$). There were no significant improvements in BP or obesity rates postimplementation. Factors associated with the higher odds of lipid screening included older age and history of diabetes mellitus.**

Conclusion. **Implementing an EMR reminder did not improve CVD risk screening among RA patients. Future research is needed to identify and address barriers to CVD screening, and to educate patients and providers about RA-related risks.**

INTRODUCTION

Despite tremendous advances in the treatment of rheumatoid arthritis (RA) in recent years, RA is associated with significantly higher mortality rates compared with the general population (1). Cardiovascular disease (CVD) is the leading cause of death among individuals with RA (2,3), and the risk of CVD events is comparable to that of patients with type 2 diabetes mellitus, and to non-RA patients who are 10 years older (3–5). The current guidelines from the European League Against Rheumatism (EULAR) recommend annual CVD risk assessment for all RA patients in accordance with the national guidelines (6). However, CVD risks, including hypertension, diabetes mellitus, dyslipidemia, and obesity, are not being assessed frequently and systematically in RA (7–10). Most notably, patients with RA are 2–3 times less likely to be screened for dyslipidemia compared with patients with other chronic conditions such as diabetes mellitus, hypertension, chronic kidney disease, and obesity (11).

Possible barriers to appropriate CVD risk screening include poor awareness of the cardiovascular impact of RA, providers' unfamiliarity with the current guidelines, time limitations during clinic visits, and fragmented care between rheumatologists and primary care physicians (7,8,12–15). On the other hand, point-of-care reminders have been shown to improve physician compliance with preventive care protocols, such as with lipid and cancer screening as well as pneumococcal vaccination (16,17).

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Significance & Innovations

- Cardiovascular disease (CVD) risks are not assessed frequently and systematically in rheumatoid arthritis (RA). Developing effective interventions to improve CVD screening is an important goal to decrease cardiovascular mortality.
- Implementing an electronic medical record–based reminder and decision support tool did not improve screening.
- RA patients who were older and had diabetes mellitus were more likely to be screened for CVD risks.
- Physicians may be unaware that the risk of CVD events in RA is comparable to that of patients with type 2 diabetes mellitus, and to non-RA individuals who are up to 10 years older.
- Future research is needed to identify and address barriers to CVD screening, and to educate patients and providers about RA-related risks.

Point-of-care reminders are reminders that occur at the point of contact with the patient, with the goal to influence the provider's choice by providing evidence-based information. Electronic point-of-care reminders in general are considered more effective than reminders prior to patient contact or post hoc reminders (18,19).

With these barriers and facilitators in mind, we sought to improve CVD screening at a large tertiary care center. We designed and implemented a self-populated electronic medical record (EMR)–based reminder that contained a summary of the most recent dates and values for CVD risk factors, as well as the normal ranges for blood pressure (BP), lipids, and body mass index (BMI), for each RA patient at every outpatient visit. We hypothesized that this intervention would increase CVD risk screening rates by raising awareness of the CVD risk in RA, and by providing an efficient way of viewing all existing information of a patient's CVD risk on a single screen. The effects of the intervention on lipid screening rates, BP control, BMI, and obesity rates were assessed. In addition, patient characteristics associated with lipid screening were ascertained.

MATERIALS AND METHODS

Study setting. The study was conducted at the Montefiore Medical Center (MMC), a community-based urban tertiary care center that provides primary and specialty care to over 2 million people in the Bronx, New York. The setting was the outpatient clinics affiliated with MMC, both primary care and rheumatology. The study was approved by the hospital's Institutional Review Board. An informed consent waiver was obtained for a quality improvement study. Data were de-identified and presented on the aggregate level.

Design and implementation of the EMR reminder. A self-populated form to serve as a reminder and decision support tool was developed by a multidisciplinary team of providers, including a rheumatologist, a cardiologist, and a primary care physician. Through an iterative process, early versions were evaluated by other providers. The final version of the form (Figure 1) was integrated into the outpatient clinic visit template in the EMR and contained dates of the latest assessment of CVD risks (BMI, BP, smoking, and lipid screening), the latest values for all of the above CVD risks, the normal ranges for each of the above, based on the National Adult Treatment Panel III guidelines (3,20–22), and the Framingham risk score calculator (23,24). This form was triggered electronically for every rheumatology and primary care outpatient visit for every patient with an International Classification of Diseases, Ninth Revision (ICD-9) code for RA (714.0). This form would appear right after the Disease Activity Calculation form, and right before the Assessment and Plan Form at the end of the visit. The implementation of this form within the EMR began at the end of June 2013 and was completed by December 1, 2013. The form was not a hard stop or forced function. Therefore, completion of the form was not enforced, and providers were afforded the option of moving forward in the visit without completing it.

The goals of this project and the current screening recommendations were shared with the primary care and the rheumatology providers via an email. Although increased cardiovascular risk is common knowledge among rheumatologists, we have found in the planning stages that the rheumatologists were not familiar with the detailed guidelines regarding BP goals and definitions of abnormal lipid profiles. Therefore, detailed recommendations were also discussed at the weekly rheumatology division conference at the beginning of the implementation stage.

Data collection and definitions. The data were obtained from EMR by using Clinical Looking Glass, a proprietary software application developed at MMC that allows clinicians and researchers to identify populations of interest from the medical center database and to gather information about laboratory data, medications, demographics, and mortality (25). To evaluate the impact of this intervention on CVD screening, we compared CVD risk screening rates among RA patients seen before and after implementing the electronic reminder. The implementation phase was completed in December 2013, and the postimplementation period was defined as the 6 months following the completion date (January 1 to June 30, 2014). RA patients ages >18 years were identified using a previously validated algorithm requiring 2 or more rheumatology visits with the ICD-9 code 714.0 (RA) in a 6-month period, and at least 1 prescription for a disease-modifying antirheumatic drug (DMARD) (26). For comparison, the preimplementation period was defined as the time between January 1, 2012 and June 30, 2012. The index visit was defined as the earliest visit within each period. Because we sought to measure lipid screening rates in the 12-month period following the index visit, we chose the preimplementation period to include the same calendar months, and to allow a 1-year

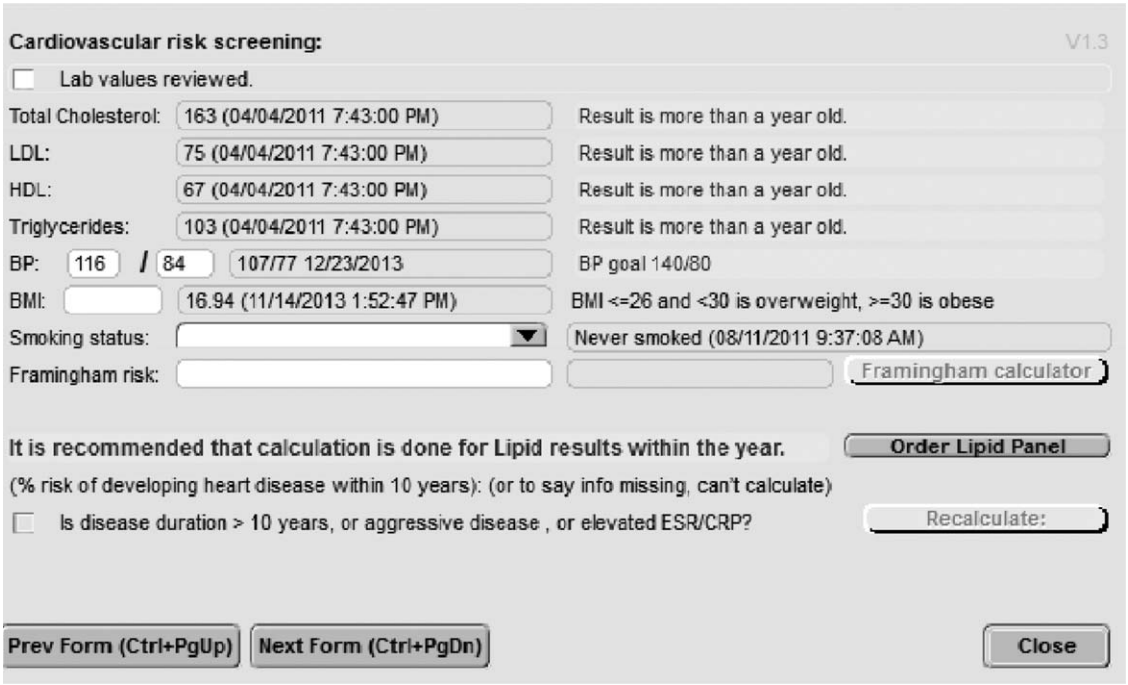

Figure 1. Electronic medical record–based reminder to aid with cardiovascular screening in rheumatoid arthritis. LDL = low-density lipoprotein; HDL = high-density lipoprotein; BP = blood pressure; BMI = body mass index; ESR = erythrocyte sedimentation rate; CPR = C-reactive protein.

followup time after each study period without overlap. Our main analyses were restricted only to patients who were seen in continuity clinics pre- and postimplementation to ensure a relatively homogeneous patient population in terms of access to care.

Although our main analyses were restricted to RA patients using DMARDs seen at least twice in the rheumatology continuity clinics during each study period, we ascertained lipid screening rates in 2 additional analyses. The first sensitivity analysis included patients who were followed either in the rheumatology continuity clinics or in the Rheumatology Faculty Practice. Compared to continuity clinics, Faculty Practice includes a higher proportion of patients with private insurance and patients who receive primary care outside of Montefiore. In the second sensitivity analysis, lipid screening rates were ascertained for all patients with at least 1 ICD-9 code for RA by any provider within each study period.

From the medical records of the RA patients, we collected the following data: age at the time of the index visit, sex, self-designated race (white, black, multiracial), and ethnicity (Hispanic, non-Hispanic). The Charlson Comorbidity Index (CCI), which is a well-validated index that takes into account the impact of comorbidities on patient outcomes, particularly life expectancy, was calculated from the ICD-9 codes prior to the index visit (27). Health care insurance was defined as public (mostly Medicaid- and Medicare-based schemes), private, and no insurance. Because the majority of patients reported their race as multiracial, and <10% were white, race was analyzed as black versus other.

Outcome measures. To determine whether the lipid screening rates improved following the implementation of the EMR reminder, we collected data on whether patients were screened for lipids in the 12-month period following the index visit pre- and postintervention. In accordance with the current guidelines, up-to-date screening was defined as having lipids measured within 1 year prior to the index visit. Using these criteria, we identified subsets of patients who did not have an up-to-date lipid screen prior to the index visit within each study period. For these patients, we determined a proportion of patients who had a subsequent lipid panel measured within 12 months after the index visit. Hyperlipidemia was defined by one of the following criteria: low-density lipoprotein (LDL) levels >100 mg/dl, high-density lipoprotein (HDL) levels <50 mg/dl for women and <40 mg/dl for men, and triglycerides >150 mg/dl (20).

BP and BMI are routinely recorded for all patients at each visit at our institution in compliance with the Centers for Medicare and Medicaid Services Meaningful Use requirements (28). Therefore, all patients had serial BP and BMI measurements for each outpatient visit. To determine whether our intervention may lead to changes in BP and BMI, we measured the change in the BP and BMI for each patient between the index visit and the latest visit 2–12 months thereafter. The 2-month minimum was chosen to allow changes in BP and BMI to take effect and since most of the patients were seen at a minimum interval of 2 months. High BP was defined as systolic BP ≥140 mm Hg and/or diastolic BP ≥90 mm Hg, and obesity was defined as BMI ≥30 kg/m^2 (3,20–22).

Statistical analysis. Descriptive statistics were used to summarize demographic characteristics, lipid screening, BP-related measures, and obesity rates for the patients seen pre- and postimplementation. Generalized linear mixed models were used to test the differences between the demographic characteristics and outcome measures during both periods because some of the patients were seen during both the pre- and postimplementation periods. Changes in BP, BMI, and lipid screening rates within each time period were computed. Because this is a physician-level intervention, we believed that CVD screening rates should be assessed among all patients who met the inclusion criteria pre- and postintervention. However, since a large proportion of patients were seen during both the pre- and postimplementation periods, additional analyses were performed to determine the changes in lipid screening rates, BP, and BMI in these patients who had data for both the pre- and postimplementation periods. Paired *t*-tests (for continuous variables) or McNemar's tests (for dichotomous variables) were used to test whether these changes were significant. To assess which factors were associated with screening in the postimplementation period, we compared demographic characteristics, comorbidities, BP, and BMI between the screened versus the nonscreened using Mann-Whitney-Wilcoxon tests (for continuous variables) and Pearson's chi-square or Fisher's exact tests (for categorical variables). Logistic regression was used to assess these factors with adjustment for covariates, where variables with a *P* value of less than 0.20 in the univariable analysis were included in the multivariable logistic regression. Analyses were conducted in SAS 9.4 software, and a *P* value of less than 0.05 was considered to represent statistical significance.

RESULTS

Demographic characteristics. A total of 138 and 112 patients with RA were seen in the outpatient rheumatology or primary care clinics pre- and postimplementation, respectively (Table 1). Seventy-six of these patients were seen both pre- and postimplementation. In the postimplementation group, 91% were women, mean ± SD age was 59.4 ± 13.7 years, 21% were black, 46% were multiracial, 6% were white, and 25% were Hispanic. Race was listed as declined for 26% of patients. The median CCI (interquartile range) was 2 (1–3). Thirty-two patients (28.6%) had a history of diabetes mellitus, and 7 (6.3%) had a history of CVD. Baseline characteristics were similar pre- and postimplementation, except that the postimplementation group was slightly older (mean ± SD 59.4 ± 13.7 versus 57.5 ± 14.1 years; $P < 0.001$).

Lipid screening. The overall rates of lipid screening were 50% preimplementation, and 46% postimplementation ($P = 0.58$) (Table 2). In the postimplementation period, 55 of the 112 patients (49%) did not have an up-to-date lipid screen at the index visit. Only 15 (27%) were subsequently screened for lipids in the 12 months following the index visit. Similarly, in the preimplementation period, 67 of the 138 patients (49%) did not have an up-to-date lipid screen. Only 16 (24%) had lipid screening in the subsequent 12 months. Among the patients who were screened for hyperlipidemia, a high proportion had lipid abnormalities. During the postimplementation period, 44% of those screened had high LDL levels, 37% had low HDL levels, 30% had high triglycerides, and 33% had high total cholesterol.

Table 1. Baseline patient characteristics pre- and postimplementation of the electronic reminder*

	Preimplementation Jan-Jun 2012, (n = 138)	Postimplementation Jan-Jun 2014, (n = 112)	*P*
Age, mean ± SD years	57.5 ± 14.1	59.4 ± 13.7	< 0.001
Women	121 (88)	102 (91)	0.40
Black	39 (28)	24 (21)	0.41
Multiracial	66 (47.8)	52 (46.4)	0.55
White	8 (5.8)	7 (6.3)	0.73
Declined	25 (18.1)	25 (22.3)	0.14
Hispanic	40 (29)	28 (25)	0.97
Public insurance	122 (88)	102 (91)	0.50
Charlson Comorbidity Index, median (IQR)	1 (1–3)	2 (1–3)	0.41
Individual disease comorbidity			
Diabetes mellitus	28 (20)	32 (29)	0.13
Cardiovascular disease	13 (9)	7 (6)	0.37
Cerebrovascular disease	3 (2)	1 (1)	0.44
Chronic pulmonary disease	37 (27)	29 (26)	0.87
Liver disease	13 (9)	15 (13)	0.33
Renal disease	7 (5)	8 (7)	0.50
Malignancies	5 (4)	4 (4)	0.98

* Values are the number (%) unless indicated otherwise. IQR = interquartile range.

Table 2. Lipid screening rates and prevalence of hyperlipidemia, hypertension, and obesity*

	Preimplementation Jan-Jun 2012 (n = 138)	Postimplementation Jan-Jun 2014 (n = 112)	*P*
Lipid screening, no. (%)			
Overall screening rates	69 (50)	52 (46)	0.58
Lipid panel, mg/dl			
High LDL (>100)	33 (51)	22 (44)	0.48
Low HDL (men <40; women <50)	29 (43)	19 (37)	0.52
Hypertriglyceridemia (>150)	22 (34)	15 (30)	0.67
Total cholesterol (>200)	18 (26)	17 (33)	0.44
Blood pressure (BP), mm Hg			
Systolic BP at index visit	125.5 ± 19.4	128.4 ± 18.7	0.21
Systolic BP ≥140, no. (%)	30 (21.7)	29 (26.1)	0.11
Systolic BP at latest visit	127.8 ± 18.7	128.1 ± 18.9	0.89
Systolic BP ≥140, no. (%)	35 (25.4)	29 (25.9)	0.92
Change in systolic BP	2.3 ± 19.2	−0.1 ± 19.6	0.48
Diastolic BP at index visit	75.2 ± 12	76.1 ± 9.2	0.55
Diastolic BP ≥90, no. (%)	16 (11.6)	8 (7.1)	0.72
Diastolic BP at latest visit	74.7 ± 8.4	74.8 ± 10.7	0.23
Diastolic BP ≥90, no. (%)	5 (3.6)	10 (8.9)	0.75
Change in diastolic BP	−0.3 ± 11.8	−1.1 ± 10.4	0.16
Body mass index (BMI), kg/m^2			
Index visit	31.1 ± 8	30.2 ± 6	0.04
Latest visit	30.6 ± 8	29.9 ± 6	0.04
Change between visits	−0.6 ± 2.9	−0.5 ± 2.3	0.18
BMI >30 kg/m^2 at index visit, no. (%)	57 (46)	51 (47)	0.95
BMI >30 kg/m^2 at latest visit, no. (%)	65 (51)	43 (42)	0.20

* Values are the mean ± SD unless indicated otherwise. LDL = low-density lipoprotein; HDL = high-density lipoprotein.

BP management. The latest mean ± SD systolic BP postimplementation was 128 ± 19 mm Hg, and the mean ± SD diastolic BP was 75 ± 11 mm Hg (Table 2). The mean ± SD change in systolic BP was −0.1 ± 19.6 ($P = 0.95$) and the mean ± SD change in diastolic BP was −1.1 ± 10.4 ($P = 0.25$). At the last followup visit postimplementation, 29 patients (26%) had a systolic BP ≥140 mm Hg, 10 (8.9%) had diastolic BP ≥90 mm Hg, and 8 (7.1%) had

Table 3. Univariate analyses comparing subjects with and without lipid measurements postimplementation of the electronic reminder*

	2014 screened, (n = 52)	2014 nonscreened, (n = 60)	*P*
Age, mean ± SD years	62.6 ± 12	56.7 ± 15	0.02
Women	48 (92)	54 (90)	0.75
Black	12 (23)	12 (20)	0.83
Hispanic	11 (21)	17 (28)	0.63
Public insurance	48 (92)	54 (90)	> 0.99
Blood pressure (BP), mm Hg			
Systolic BP at index visit, mean ± SD	130.7 ± 18	126.4 ± 20	0.21
Systolic BP ≥140 mm Hg	17 (33)	12 (20)	0.11
Diastolic BP at index visit, mean ± SD	76.8 ± 8	75.4 ± 10	0.55
Diastolic BP ≥90	3 (5.9)	5 (8.3)	0.72
Body mass index at index visit, kg/m^2	30.3 (5)	30.2 (6)	0.69
Charlson Comorbidity Index, median (IQR)	2 (1–3)	1.5 (1–2)	0.14
Individual disease comorbidity			
Diabetes mellitus	20 (39)	12 (20)	0.03
Cardiovascular disease	3 (6)	4 (7)	> 0.99
Cerebrovascular disease	0	1 (2)	> 0.99
Chronic pulmonary disease	14 (27)	15 (25)	0.82
Liver disease	8 (15)	7 (12)	0.56
Renal disease	5 (10)	3 (5)	0.47
Malignancies	1 (2)	3 (5)	0.62

* Values are the number (%) unless indicated otherwise. IQR = interquartile range.

both. These numbers were similar in the preimplementation period. Together, these findings indicate that implementing the decision support tool did not improve BP management among RA patients.

Change in BMI. At the index visit in the postimplementation period, mean ± SD BMI was 30.2 ± 6 kg/m^2, compared to the preimplementation mean ± SD BMI of 31.1 ± 8 kg/m^2 ($P = 0.04$). The last BMI at the postimplementation period was on average 29.9 ± 6.1 kg/m^2, compared with the preimplementation period of 30.6 ± 7.6 ($P = 0.04$). There was a statistically significant reduction in BMI between the index and latest visits during both the pre- and postimplementation periods: 0.6 ± 2.9 ($P = 0.02$) and −0.5 ± 2.3 ($P = 0.03$), respectively. However, 42.2% of RA patients postimplementation and 50.8% of RA patients preimplementation had a BMI ≥30 kg/m^2 ($P = 0.20$).

Factors associated with the lipid screening. To identify patient characteristics associated with the higher screening rates for dyslipidemia, we compared patients who had lipid screening in 2014 with patients who were not screened (Table 3). Screened patients were older, mean ± SD age 62.6 ± 11.7 years, compared to those not screened, mean ± SD age 56.7 ± 14.7 years, unadjusted odds ratio (OR) 1.04 (95% confidence interval [95% CI] 1.004–1.070) per each year ($P = 0.03$). A higher proportion of screened patients had a history of diabetes mellitus, 20 (39%) in the screened group compared with 12 (20%) in the nonscreened (unadjusted OR 2.5 [95% CI 1.08–5.80], $P = 0.03$). There was no statistically significant association between BP, BMI, or CCI ($P = 0.27$). When age and diabetes mellitus were both assessed in a logistic regression, the association between older age and screening remained significant (OR 1.03 [95% CI 1.001–1.070] per year, $P = 0.046$), while the association between diabetes mellitus and screening was attenuated by adjusting for age (OR 2.3 [95% CI 0.96–5.4], $P = 0.06$). Framingham scores were calculated for only 8 of 112 (7%) in the 2014 group and ranged between 1% and 27%. Six of these 8 patients were screened for lipids. Two unscreened patients had Framingham risk scores of 1% and 8%.

Sensitivity analyses. To evaluate the robustness of our findings, we conducted several sensitivity analyses. First, we compared lipid screening rates pre- and postimplementation for all RA patients ages >18 years with at least 2 rheumatology visits (continuity clinics or faculty practice) in the 6-month period using DMARDs. There were 325 patients who satisfied the above criteria postimplementation. Of those patients, 164 (50%) had a lipid screen in the 12 months following the index visit. There were 289 patients who met the above criteria preimplementation. Of those, 151 (52%) had a lipid screen in the 12 months from the index visit.

We also compared the frequency of lipid screening in the 12 months following the index visit between patients with at least 1 ICD-9 code 714.0 by any physician in the preimplementation period (n = 1,160), and in the postimplementation period (n = 1,448). The lipid screening rates were 57% and 48%, respectively. Finally, we compared lipid screening, BP, BMI, and obesity rates in the subset of patients (n = 76) who were followed pre- and postimplementation. The results were similar to the main results presented in the article (data not shown).

DISCUSSION

In an effort to improve CVD screening, we implemented an electronic reminder and decision support tool to increase provider awareness of the importance of assessing and managing CVD risk in RA. This self-populated electronic reminder also included detailed information about normal BP, BMI, and lipid ranges, as well as a built-in Framingham score calculator. Therefore, the form provided an efficient way of viewing and assessing the details of a patient's traditional CVD risks. However, implementing the electronic reminder did not improve CVD screening in RA patients in a large tertiary care center, and lipid screening rates remained low.

Limitations to our study include single-center design and lack of information regarding patient-related factors or visit-level factors that might be associated with screening. Because the ordering provider information was not collected in the Clinical Looking Glass until 2015, we were not able to determine whether there were screening differences between rheumatologists and primary care providers. In addition, we were only able to determine the number of lipid screens that were completed, but we did not have information regarding how many lipid screens were ordered before and after the implementation. Lastly, the short duration of the study might have limited the ability to observe an impact, although one could argue that success would be more likely to be higher in the short term when the awareness of the study is higher. However, the effects of any intervention on changes in BMI and BP may take years. Therefore, lack of short-term changes in BMI and BP may not accurately reflect the long-term changes, and re-evaluating these measures after a longer followup period is necessary.

Studies across different institutions both similar to and different from ours have shown that CVD risks are seldom assessed for patients with RA. The overall lipid screening rate of 46% in our study is similar to the rate reported in a study of Medicare beneficiaries but higher than the 27% reported by a population-based cohort study of patients with RA in Rochester, Minnesota (12,29). We showed that almost half of the patients seen postimplementation had LDL levels >100 mg/dl, and one-third had a total cholesterol level >200 mg/dl. Since screening likely drives management, this result further supports the evidence that there is room for significant improvement in CVD screening and management in RA both among primary care providers and rheumatologists.

Possible barriers to CVD screening in RA include low awareness of RA being an independent risk factor for CVD and mortality, and of the EULAR guidelines. At present, RA is not considered an independent CVD risk factor by the American College of Cardiology/American Heart Association (30). A recent review of 30 high-quality general population guidelines on CVD prevention also showed

that less than a quarter of these studies (7 of 30) recognized RA as an independent risk for CVD (31). We found that patients with diabetes mellitus had higher odds of being screened, suggesting that physicians' unfamiliarity with the RA-associated CVD risks is a significant barrier to CVD screening. A recent study also showed that although rheumatologists, in comparison to primary care providers, seemed more aware of the CVD risk posed by RA, rheumatologists were also not systematically assessing for CVD risks (32).

Another barrier may be the dichotomy of roles whereby the rheumatologist might assume or expect the primary care provider to screen for and manage the patient's cardiovascular risk and diseases (7,8). Patients, however, might visit the rheumatologist more often than the primary care clinic, making the role of the rheumatologist in patient's care crucial. Improving communication between rheumatologists and primary care providers is therefore important in ensuring optimal screening and management of these patients.

Time constraints in a busy outpatient clinic might also limit CVD screening. As demonstrated in a similar study of an intervention directed at improving colorectal screening rates in a tertiary center, provider education and electronic reminders had minimal impact on screening rates. However, the use of a medical assistant to review patients' colorectal screening status and enter a preliminary order in the EMR for colonoscopy that could be signed by an attending physician led to a significant increase in screening rates (33).

There are multiple approaches that could help improve the CVD risk screening; 11 quality improvement indicators for CVD care in patients with RA have been identified. These include screening for dyslipidemia, hypertension, diabetes mellitus, and obesity; assessing smoking status and exercise; minimizing the use of steroids; and effective communication with patients about the risks and benefits of antiinflammatory agents. Health care institutions can improve performance on these indicators by measuring and reporting the CVD risk screening rates in patients with RA. Although reminders and/or decision support tools have been cited as an effective strategy for raising awareness about the recommendations of guidelines (34), our study suggests that electronic reminders are not sufficient.

The Pathman model of guideline implementation proposes 4 stages for successful implementation of any guideline: awareness, agreement, adoption, and adherence (35). Raising awareness and gathering support for any recommendation will ultimately determine the rates of adoption into practice but will not necessarily guarantee adherence. Despite embedding a reminder in the EMR, we found no significant difference in lipid screening rates. Increasing education and raising awareness of the CVD risk in RA is likely to be central to the successful implementation of the screening guidelines. Use of multifaceted strategies: education, decision support tools reminders, audit, and feedback will be crucial to the successful adoption of regular CVD screening of RA patients (36). System-level changes, such as creating multidisciplinary teams (rheumatology, primary care, and cardiology) and methods for the successful implementation and dissemination of guidelines should also be explored (7). Future research needs to be conducted on barriers to CVD screening in RA and on educating patients and health care providers about CVD in RA.

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AUTHOR CONTRIBUTIONS

All authors were involved in drafting the article or revising it critically for important intellectual content, and all authors approved the final version to be submitted for publication. Dr. Broder had full access to all of the data in the study and takes responsibility for the integrity of the data and the accuracy of the data analysis.

Study conception and design. Broder.

Acquisition of data. Akenroye, Kumthekar, Alevizos, Mowrey, Broder.

Analysis and interpretation of data. Akenroye, Kumthekar, Alevizos, Mowrey.

ROLE OF THE STUDY SPONSOR

Pfizer had no role in the study design or in the collection, analysis, or interpretation of the data, the writing of the manuscript, or the decision to submit the manuscript for publication. Publication of this article was not contingent upon approval by Pfizer.

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