Cardiovascular Disease Prevention in Rheumatoid Arthritis: Compliance with Diabetes Screening Guidelines

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ABSTRACT. ***Objective.*** To evaluate compliance with diabetes screening guidelines for cardiovascular disease (CVD) prevention in rheumatoid arthritis (RA) compared to the general population.

Methods. We conducted the first longitudinal study of a population-based RA cohort including all prevalent RA cases in British Columbia between 1996 and 2006 and followed until 2010, with matched general population comparators. Using administrative data, we measured compliance with general population guidelines [i.e., testing plasma glucose (PG) at least once every 3 years after age 45] after excluding individuals with previous diabetes. Followup was divided into 3-year eligibility periods. Compliance was measured as the proportion of periods with ≥ 1 PG test performed. OR (95% CI) of compliance in RA (vs general population) was calculated using generalized estimating equation models, adjusting for age and sex. Mean compliance rate per patient was also calculated and compared using the Mann-Whitney U test.

Results. Analysis included 22,624 individuals with RA, contributing 48,724 three-year eligibility periods; and 22,579 people in a general population group, contributing 51,081 three-year eligibility periods. PG was measured in 72.3% (SD 37%) of the eligible time periods in the RA sample and in 70.4% (SD 38%) for the general population (OR 1.05, 95% CI 1.02–1.09, $p < 0.0001$). RA individuals met recommended screening guidelines in 71.4% of their eligible periods, compared to 70.6% ($p < 0.001$). Screening improved over time in RA relative to the general population. Family physicians ordered nearly all the PG tests.

Conclusion. Compliance with general population guidelines for diabetes screening in RA was suboptimal, with little difference relative to the general population, despite a higher risk of CVD and diabetes. (J Rheumatol First Release July 15 2018; doi:10.3899/jrheum.170973)

Key Indexing Terms:
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Rheumatoid arthritis (RA) is associated with a substantial increase in the risk of cardiovascular events and of mortality from cardiovascular diseases (CVD)[1,2,3,4]. Risk factors for CVD in RA include traditional ones such as age, sex, hypertension, diabetes, hyperlipidemia, and smoking, as well as RA-specific risk factors related to inflammation and RA severity[5,6,7,8]. Further, studies suggest that individuals with RA may have an increased risk of diabetes mellitus (DM), perhaps related to inflammation from RA[9,10,11].

In recognition of this risk, attention has been drawn to the need for CVD risk management as an integral part of the care of people living with RA[12,13,14,15,16]. Given that DM is an important CV risk factor, and that individuals with RA may also have an increased risk of developing DM, it is important that plasma glucose (PG) testing be performed according to recommendations. This is needed to avoid delays in treatment of DM, to prevent complications of uncontrolled DM such as CVD, and to perform CV risk assessment, which requires the measurement of blood glucose. Despite this, few studies

have evaluated DM screening in RA[13,17,18,19,20]. They reported suboptimal testing.

The aim of our study was to evaluate the provision of screening for DM in a population-based RA cohort compared to general population comparators. Specifically, we measured and compared compliance with general population guidelines for DM screening; i.e., whether individuals ≥ 45 years had at least 1 PG test every 3 years[21]. As secondary objectives, we examined secular trends in DM screening, and the extent to which PG tests were ordered by family physicians (FP) or rheumatologists. Finally, in the RA population, we identified predictors of compliance with DM screening.

MATERIALS AND METHODS

Study design. We conducted a longitudinal study of a population-based RA cohort with matched comparators, randomly selected from the general population, using administrative health data from the province of British Columbia (BC). Ethics board approval for this study was obtained from the University of British Columbia Research Ethics Board (REB No. H00-80305).

Population-based RA cohort and definition of RA case. The study sample was derived from a previously assembled population-based cohort including all prevalent RA cases treated in BC between January 1996 and March 2006, with followup until December 2010. Patients with RA were identified using previously published criteria[22]. Individuals were identified as having RA if they had at least 2 physician visits at least 2 months apart within a 5-year period with an International Classification of Diseases, 9th ed. (ICD-9) code for rheumatoid arthritis (714.X)[23]. To improve specificity, individuals were excluded if they had at least 2 subsequent visits with ICD-9 codes for other forms of inflammatory arthritis (systemic lupus erythematosus, other connective tissue diseases, psoriatic arthritis, ankylosing spondylitis, and other spondyloarthropathies). Cases were also excluded if a diagnosis of RA by a non-rheumatologist was never confirmed when the individual saw a rheumatologist; or if they had no subsequent RA diagnosis over more than 5 years of followup. These criteria have been validated in a subsample of subjects who participated in an RA survey. Using the opinion of an independent rheumatologist reviewing medical records from their treating physicians as the gold standard, we estimated the positive predictive value at 0.82[24]. The cohort includes 36,458 patients with RA [mean age 64.7 (SD 17) yrs, 68% female], with 29,417 live prevalent RA cases in 2006, yielding a prevalence rate of 0.82% for BC.

RA study sample. RA cases eligible for the general population screening guidelines were selected (individuals ≥ 45 yrs), excluding individuals who met criteria for DM prior to the onset of their RA, or prior to attaining the eligible age (whichever occurred first). DM was defined as having at least 1 physician visit or hospitalization with a diagnostic code for DM (ICD-9 codes: 250.X and ICD-10 codes: E11.X) and at least 1 medication for diabetes dispensed (oral hypoglycemic or insulin). Individuals with followup time shorter than 3 years were excluded because they could not contribute a complete 3-year eligibility period.

General population sample. A comparator sample from the general population was assembled by randomly selecting individuals from the general population (without any diagnosis of RA or other inflammatory arthritis) who were eligible for DM screening guidelines (i.e., age ≥ 45 yrs during followup and who did not meet criteria for DM prior to index date or age 45), matched 1:1 to each RA case on sex, birth, and index year, to ensure age and calendar time period match. Comparators were excluded from the study sample if their followup was shorter than 3 years (Figure 1).

Data collection. Data for the RA cohort and general population were obtained from administrative databases of the Ministry of Health of British Columbia on all provincially funded health care services used since January 1990, including all physician visits, with 1 diagnostic code per visit representing the reason for the visit, and all investigations ordered, from the Medical Service Plan[25], as well as Hospital Discharge Data[26]. PharmaNet data[27] included information on all medications dispensed from pharmacies for all individuals, regardless of the source of funding, since January 1996. Data were obtained until December 2010.

General population screening guidelines for DM. We measured compliance with general population screening guidelines published by the Canadian Diabetes Association in 1998[21]. The guidelines recommend performing a fasting PG test in individuals ≥ 45 years old every 3 years. This guideline was selected and applied over the entire followup time, as a representation of the minimum standard of care for DM screening, applicable to both RA and the general population. More recent guidelines have similar recommendations, both in Canada[28,29] and the United States[30], although recommendations have been expanded by including younger individuals (ages 40+) and increasing the frequency of screening if other risk factors are present. Therefore, the guidelines we tested represent the minimum recommendation over the time period studied.

Compliance with general population DM screening guidelines. Compliance was defined using eligibility periods[23]. Individuals' followup time was divided into 3-year eligible periods, starting from the first time they became eligible for PG tests (age ≥ 45 yrs), or index date, whichever occurred later. Individuals were censored when they developed DM, died, or followup ended, whichever occurred first. Incomplete eligibility periods were excluded from the analysis. Individuals who received a PG test at least once during the eligible period were considered to have met the recommended guideline. Our data do not allow the differentiation between fasting and random glucose tests or PG tests ordered as part of an oral glucose tolerance test. Therefore, any PG test performed was accepted as meeting the guideline. We also assessed, in sensitivity analysis, whether the results differed if having a hemoglobin A1c or a PG test was accepted as meeting the guideline. Compliance was measured as the proportion of eligible periods when the recommendation was met. Proportions were calculated in 2 ways: (1) per patient, where the proportion was calculated for each patient and the mean compliance rate per patient was calculated for each cohort; and (2) using eligibility periods as the unit of analysis (i.e., pooling all the eligible periods for each cohort).

Physicians responsible for ordering PG tests. Physician type responsible for ordering PG tests was evaluated using a variable available in the Medical Service Plan (MSP) data, indicating the practitioner type who ordered the test. PG tests were categorized according to whether they were ordered by rheumatologists, FP, or other physician types, to measure the proportion of compliant periods in which PG tests were ordered by each professional type, separately (e.g., number of periods with a PG test ordered by rheumatologists divided by number of eligible periods with a PG test ordered by any professional type).

Romano comorbidity score. The Romano modification of the Charlson comorbidity score for use with administrative data, excluding RA as a comorbidity, was determined for each individual, using MSP and hospital discharge data in the year prior to the start of each eligibility period, to measure the overall burden of comorbidities[31,32].

Predictors of PG testing. Potential predictive variables were selected *a priori*, including sex, age, whether residence was urban or rural (from postal codes), the patient's Health Authority (Interior, Coastal, Northern, Fraser, and Island, from local health area), socioeconomic status (SES; divided into quartiles), Romano comorbidity score (dichotomized as 0 vs ≥ 1), whether individuals had a hospitalization in the prior year (yes/no), a rheumatologist visit in the prior 5 years (yes/no), ≥ 1 physician visit in the prior year (yes/no), calendar year (measured at the start of each eligibility period), and whether glucocorticosteroids were taken during the eligibility period. SES was determined using a previously validated SES index based on Local Health Area[33].

Statistical analysis. Baseline descriptive characteristics for the RA cohort and general population comparators were compared using chi-square test for categorical variables and Student t test for continuous variables with normal distribution.

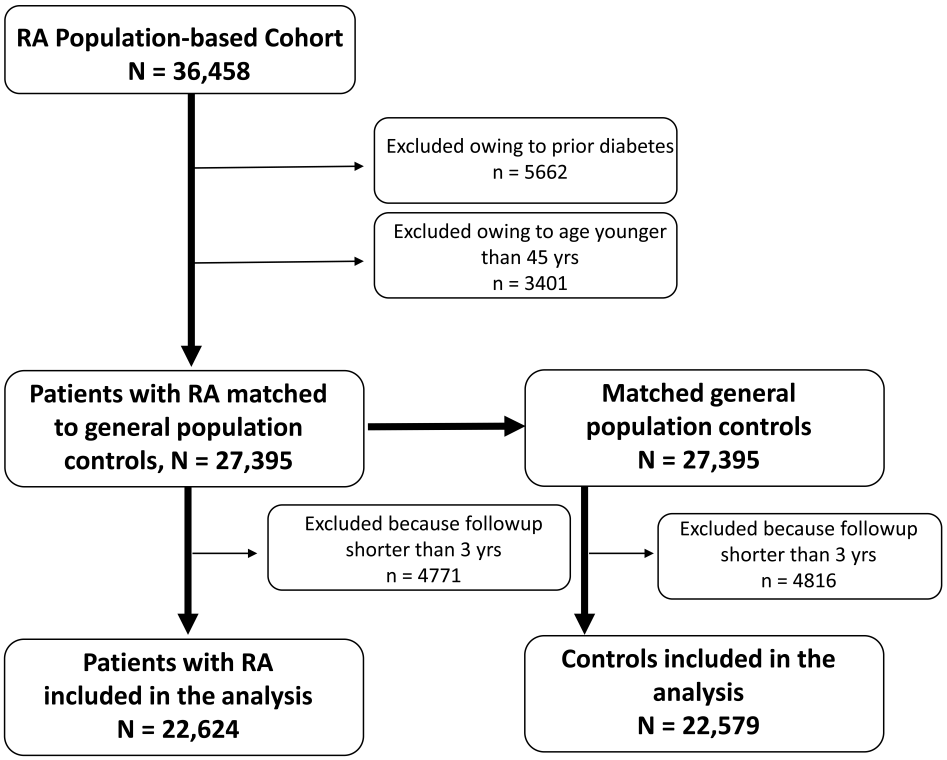

Figure 1. Flow diagram of eligible patients with RA and matched general population comparators included in the analysis. RA: rheumatoid arthritis.

Generalized estimating equation (GEE) models were used to estimate the OR and 95% CI of compliance with screening guidelines in RA relative to the general population. A multivariable GEE model was used to adjust for potential confounders, including age, sex, Romano comorbidity score, and the year in which the eligibility period began. We analyzed compliance with DM screening over 2 separate time periods: 1996–2000 and 2001–2007. The cutoff of 2001 was selected *a priori* for evaluating whether compliance had improved over time, because DM screening guidelines were published in 1998, allowing time for awareness and implementation of guidelines[21,28]; this also corresponds to the timing of increased recognition of the excess CV risk in RA[34,35]. A Mann-Whitney U test was used to compare compliance rate per patient between the RA cohort and comparator sample.

GEE models were also used to identify the predictors of compliance with screening guidelines in the RA cohort. Potential predictive variables were selected *a priori* and evaluated in univariate analyses by measuring the compliance rate for each category of categorical variables, and converting continuous variables to categorical variables. Reverse stepwise removal of variables was performed based on the significance of the association (removal if p value > 0.20) and the lowest quasi-likelihood information criterion. Adjusted OR and 95% CI were estimated for each predictor. Age-squared was used to test for a nonlinear relationship between screening and age, and to avoid residual confounding.

SAS V9.3 (SAS Institute) was used for all analyses. Ethics approval was obtained from the University of British Columbia. No personal identifying information was provided. All procedures were compliant with BC's Freedom of Information and Privacy Protection Act.

RESULTS

The BC population-based RA cohort included 36,458 patients with RA. Of these, 9063 (24.9%) were excluded: 5662 (15.5%) with prior DM and 3401 (9.3%) who never reached the eligible age (45 yrs and older). Therefore, 27,395 patients with RA were matched 1:1 to comparators from the general population. There were 4771 patients with RA and 4816 comparators with followup shorter than 3 years who were excluded from the analysis, yielding 22,624 patients with RA and 22,579 general population members eligible for the analysis (Figure 1), contributing 48,724 and 51,081 complete 3-year periods, respectively. The RA sample had a mean age of 63.1 (SD 11.6) years, and 70% were female, similar to the general population, but with more comorbidities (Table 1).

Compliance with DM screening guideline. Frequency of plasma glucose testing in RA and comparators is described in Supplementary Table 1 (available with the online version of this article). Using patients as the unit of analysis, those with RA had PG tests in 72.3% of their eligible periods, compared to 70.4% for general population ($p < 0.0001$; Table 2). Table 3 shows the compliance with PG testing stratified by the number of eligible windows individuals had and shows the proportion of their windows with compliance. There were 15% of patients with RA and 17.1% of general population comparators who did not receive a PG test in any of their eligible periods, and only 56.9% of patients with RA and 55.1% of comparators were compliant in all their eligible periods (Table 3).

Table 1. Sample characteristics. Values are n (%) unless otherwise specified.

Characteristics	RA	General Population
No. individuals included in analyses	22,624	22,579
Total no. 3-yr periods	48,724	51,081
No. periods starting after 2001 (% of total periods)	31,766 (65.2)	32,787 (64.2)
Number of 3-yr periods per individual†		
Individuals with 1 period	8063 (35.6)	7347 (32.5)
Individuals with 2 periods	7050 (31.2)	6740 (29.9)
Individuals with 3 periods	3483 (15.4)	3714 (16.4)
Individuals with 4 periods	4028 (17.8)	4778 (21.2)
Age, yrs, mean (SD)	63.1 (11.6)	64.3 (11.2)
Sex, % female	70	70
Romano comorbidity score, % with score ≥ 1*	46†	14†
Predictors of PG testing evaluated in RA cohort		
Living in rural area	4178 (18.5)	N/A††
Health authority		
Interior	5222 (23.2)	N/A††
Fraser	6649 (29.5)	N/A††
Coastal	4495 (19.9)	N/A††
Island	4676 (20.7)	N/A††
Northern	1499 (6.7)	N/A††
SES index		
Lowest 25%	5875 (26.1)	N/A††
25%–50%	5840 (25.9)	N/A††
50%–75%	5871 (26.0)	N/A††
Highest 25%	4955 (22.0)	N/A††
Having a hospitalization in the prior year**	5242 (23.3)	3557 (15.8) †
Seeing a rheumatologist in the prior 5 yrs**	9972 (44.2)	1597 (7.1) †
Rate of physician visits in the prior year, mean (SD)*	14 (11)	8.4 (9.1) †
GC use within eligibility period	8892 (18.2)	4564 (8.9)

*Romano comorbidity score and rate of physician visits measured at the start of each eligibility period. **Having a hospitalization in the prior year and having seen a rheumatologist in the prior 5 years were measured at the start of each eligibility period and was considered a "yes" for the purpose of reporting in this table, if it was true for at least 1 in the subject's eligibility period. † P value < 0.05 comparing RA versus general population. †† Variable only calculated in RA, owing to unavailability of data in general population comparators. RA: rheumatoid arthritis; PG: plasma glucose; SES: socioeconomic status; GC: glucocorticosteroids; N/A: not available.

Table 2. Compliance with screening guidelines for DM in RA compared to general population comparators.

	RA, n = 22,624	General Population, n = 22,579	OR (95% CI) ††, RA vs controls	aOR (95% CI) ‡, RA vs controls
Compliance per patient*, %, mean (SD)	72.3 (37) †	70.4 (38) †		
Compliance per period**, n (%)	34,804/48,724 (71.4)	36,067/51,081 (70.6)	1.05 (1.02–1.09) §	1.05 (1.02–1.09) §§
Compliance per period before 2001‡‡, n (%)	10,287/16,958 (60.7)	11,291/18,294 (61.7)	0.96 (0.92–1.01) ¶	0.89 (0.85–0.94) §§
Compliance per period after 2001‡‡, n (%)	24,519/31,766 (77.2)	24,776/32,787 (75.6)	1.10 (1.06–1.15) §§	1.10 (1.06–1.15) §§

*Measured as the mean % of eligible periods per patient with ≥ 1 PG test. ** Measured with periods as the unit of analysis (i.e., as the no. periods with ≥ 1 PG test divided by the no. eligible periods in each cohort) and corresponding percentage. † Difference between compliance in RA and general population, statistically significant p < 0.0001, using the Mann-Whitney U test. †† Unadjusted OR from generalized estimating equation (GEE) model estimating the odds of receiving a PG test within a period in the RA cohort relative to general population, measured in separate models for the periods before and after 2001. ‡ Adjusted OR from multivariable GEE adjusting for sex, age, and Romano comorbidity score measured at start of period, and start year of period (as a continuous variable), measured in separate models for the periods before and after 2001. ‡‡ Compliance per period was stratified according to whether the date at the beginning of the period was before or after January 1, 2001. § p = 0.0003. §§ p < 0.0001. ¶ p = 0.1184. DM: diabetes mellitus; RA: rheumatoid arthritis; aOR: adjusted OR; PG: plasma glucose.

Using eligible periods as the unit of analysis, PG tests were performed in 71.4% of eligible periods in the RA cohort and in 70.6% in comparators (p = 0.004). In the adjusted GEE model, individuals with RA were slightly more likely to receive a glucose test (OR 1.05, 95% CI 1.02–1.09; Table 2). Although statistically significant, the clinical relevance of this difference is unclear.

Compliance results were essentially unchanged when

Table 3. Compliance with DM screening in RA and general population, stratified according to no. periods eligible for screening per individual.

No. Periods Eligible for Screening	Proportion of Eligible Periods with a PG Test	% of RA Cases	% of General Population
Individuals with 1 period, RA n = 8063; general population n = 7347	0/1	27.2	31.6
	1/1	72.3	68.4
Individuals with 2 periods, RA n = 7050; general population n = 6740	0/2	11	13.1
	1/2	29.1	27.6
	2/2	59.9	59.2
Individuals with 3 periods, RA n = 3483; general population n = 3714	0/3	6.8	9.3
	1/3	16.5	16
	2/3	31.1	28.6
	3/3	45.6	46.1
Individuals with 4 periods, RA n = 4028; general population n = 4778	0/4	4.5	6.4
	1/4	11.4	9.4
	2/4	21.8	18.7
	3/4	32.6	29.9
	4/4	29.6	35.7
All individuals, RA n = 22,624; general population n = 22,579	0/n (compliant in 0% of periods)	15	17.1
	n/n (compliant in 100% of periods)	56.9	55.1

DM: diabetes mellitus; RA: rheumatoid arthritis; PG: plasma glucose.

hemoglobin A1c was included as an acceptable screening test.

A secular trend in DM screening was observed. Compliance with screening guidelines improved over time in both RA and comparators, with greater improvement observed in RA (from 61% to 77%, before and after 2001). In the earlier time period, RA individuals were less likely to receive a PG test (11% lower odds) relative to the general population; whereas after 2001, patients with RA had 10% higher odds of receiving a PG test (Table 2). The difference in compliance in RA relative to comparators between the earlier and later time period was statistically significant ($p < 0.0001$ for the interaction between the start year of periods and the odds of having a PG test in RA).

Health professional type ordering PG tests in RA. Among patients with RA who had a PG test ordered in an eligibility period, at least 1 PG test was ordered by an FP in 97.5% of the periods, and by a rheumatologist in 6.4% of them (some eligibility periods had PG tests ordered by both rheumatologists and FP; Table 4).

Predictors of compliance with DM screening guidelines. We identified a number of significant predictors of not receiving DM screening in the RA sample (Table 5). Being male, having a higher SES, living in the Northern, Coastal, and Interior Health Authority, having more comorbidities (a Romano comorbidity score ≥ 1), seeing a rheumatologist in the prior 5 years, and having no physician visits in the prior year, were all associated with lower odds of receiving a PG test in an eligible period. Having a hospitalization in the prior year, receiving glucocorticosteroids during the eligible period, and calendar year > 2001, were associated with a greater likelihood of receiving DM screening. The odds of receiving a PG test also increased as age increased, up until age 69, after which time the odds decreased. Univariate compliance rates stratified for each variable are reported in Supplementary Table 2 (available with the online version of this article).

DISCUSSION

We conducted a population-based study of all individuals with RA in the province of BC, with matched general population comparators, using administrative data, over a long followup, to evaluate compliance with general population screening guidelines for DM in RA compared to the general population. General population guidelines, which recommend screening every 3 years after age 45, represent the minimum standard of care for DM screening and CVD prevention in RA. Overall, we found that compliance with guidelines was suboptimal, at 71.4% for the entire study period, with little difference with the general population (aOR 1.05), despite the higher risk of CVD in RA. Further, 15% of patients with RA had no PG test in any of their eligible periods (up to 12 yrs), and only half of those with RA received PG testing in all their eligible periods. Although compliance improved over time in RA to a greater extent than in the general population, compliance remained suboptimal, even after 2001, at 77.2% for RA.

Table 4. Type of health professional ordering DM screening tests in RA.

Physician Type	Proportion (%) of Compliant Periods*
Proportion (%) of compliant periods with ≥ 1 PG test ordered by a rheumatologist	2219/34,804 (6.4)
Proportion (%) of compliant periods with ≥ 1 PG test ordered by a family physician	33,918/34,804 (97.5)
Proportion (%) of compliant periods with ≥ 1 PG test ordered by other health professionals	511/34,804 (1.5)

*Calculated as no. periods with ≥ 1 glucose test ordered by a given physician type divided by the total no. periods during which a test was performed. DM: diabetes mellitus; RA: rheumatoid arthritis; PG: plasma glucose.

Table 5. Multivariable GEE model estimating the odds of receiving a plasma glucose test within an eligible period, for the RA cohort.

Predictive Variable	aOR (95% CI)*	p
Male vs female	0.91 (0.87–0.96)	0.0003
Rural vs urban	0.99 (0.93–1.05)	0.7689
Northern, Coastal, and Interior vs Island and Fraser Health Authorities	0.93 (0.88–0.97)	0.0022
SES index, highest quartile vs others	0.88 (0.84–0.93)	< 0.0001
Romano comorbidity score, ≥ 1 vs 0	0.94 (0.90–0.99)	0.0099
Having a hospitalization in the prior year†	1.06 (1.01–1.11)	0.0278
Seeing a rheumatologist in the prior 5 yrs**	0.78 (0.75–0.82)	< 0.0001
Having no physician visits in the prior year†	0.53 (0.45–0.62)	< 0.0001
Timing of periods, starting < 2001 vs ≥ 2001	0.49 (0.47–0.51)	0.0002
GC use within the eligibility period, yes vs no	1.12 (1.05–1.19)	< 0.0001

*Adjusted OR from GEE model estimating the odds of receiving a PG test for each categorical variable, adjusted for all variables listed and for age and age-squared. ** Measured in the 5 years prior to the start of period. † Measured in the year prior to the start of period. RA: rheumatoid arthritis; SES: socioeconomic status; GC: glucocorticosteroids; PG: plasma glucose; GEE: generalized estimating equation.

Our findings have important clinical implications. They represent an important deficiency in the care provided to people with RA. Regular CV risk assessment and screening for CVD risk factors such as DM are essential first steps in the primary prevention of CVD in RA. It is of utmost relevance, given the excess risk of incident CV events, such as myocardial infarcts and ischemic strokes, and mortality from CVD in RA[1,2]. Further, a few studies, including 1 from our group, have found an increased risk of incident DM in RA relative to the general population[9,10,11]. This further enhances the importance of screening for DM, to ensure prompt treatment before complications of hyperglycemia occur. Our results point to the need to communicate the increased risk of CVD and DM in RA to FP, as suggested in quality indicators for CV care in RA[14], because FP order most of the PG tests and are responsible for primary prevention care, including prevention of RA comorbidities such as CVD and DM[15,36]. However, how to best share the responsibility for CV risk management between FP and rheumatologists still needs to be determined, because rheumatologists are most aware of the increased risk, but they are not the ones performing primary prevention. Interventions aimed at improving DM screening in RA need to be developed, targeting FP. The emphasis should be on people less likely to receive PG testing, such as men, people living in more isolated local health areas, those with more comorbidities, those not seeing a physician, and people under the care of rheumatologists (such people are perhaps less likely to see their FP regularly). That people with higher SES and with more comorbidities were less likely to be screened was unexpected. It is possible that in people with more comorbidities, care is more focused on treating chronic medical conditions and less attention is paid to preventive care.

To our knowledge, this is the first population-based study evaluating compliance with DM screening guidelines. Because of the population-based nature of our sample, which includes all those with RA in the entire province of BC, we were able to evaluate process of care as it occurs in real life, without any selection bias. Our study was also the first, to our knowledge, to evaluate secular trends in DM screening in RA. A small number of studies have evaluated the provision of preventive care for DM in RA[13,17,18,19,20]. Limitations of these studies include much shorter followup than ours (1 to 2 yrs[13,17,18,20]), not excluding individuals with prior DM[18,19,20], and evaluating screening performed exclusively by FP[18], or in samples from rheumatology practices[19], without general

population comparators[13]. Consistent with our findings, these studies reported low DM screening rates in RA, ranging from 24% to 67%[13,17,18,19,20]. All studies, including ours, point to a suboptimal rate of DM screening in RA, despite an increased risk of CVD and of DM. Studies with general population comparators report less frequent[17] or no difference[18,20] in testing in RA relative to the general population. Finally, we and others[17] found that FP order most of the PG tests.

We acknowledge that this study has limitations, including those inherent to observational studies with administrative health data. Uncertainty exists around diagnoses identified with administrative data. Patients with RA were identified using previously published criteria[22,37], which have been previously validated in a subsample who participated in an RA survey, with a positive predictive value of 0.82[24]. Nonetheless, inclusion of non-RA cases in the RA cohort is possible and would bias the results toward the null. PG tests refer to tests performed and may differ from tests ordered because of compliance issues. The general population screening guidelines call for fasting PG tests. However, our data do not differentiate between fasting PG tests and random glucose tests. The inclusion of random PG tests in our DM screening outcome definition may explain why the screening rates we observed were higher than those reported in previous studies, and our results may represent an overestimation of screening rates in both patients and general population. Despite this, screening was suboptimal. Although our data include complete capture of glucose tests ordered as outpatients, it does not include glucose tests that were point-of-care tests or ordered during hospitalizations. This may have led to underestimation of testing. Although it would apply to both patients with RA and general population comparators, it may lead to a greater underestimation in patients with RA given their higher rate of hospitalizations.

In our population-based RA cohort, compliance with general population guidelines, which recommend DM screening at least once every 3 years after the age of 45, was poor, at 71.4% for the entire study period, with little difference relative to the general population, despite the high risk of and mortality from CVD[1,2] and a higher risk of DM[9,10,11]. Over time, screening improved more in RA than in the general population. Compliance with screening guidelines was slightly lower in RA than the general population before 2001 and slightly greater after that year, although still suboptimal. Our study findings emphasize the need to raise awareness about the increased risk of CVD and of DM in RA, and of the importance of CV risk management, including screening for DM. CVD prevention efforts in RA should involve FP, because they order most of the glucose tests and they play a central role in primary prevention care.

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ONLINE SUPPLEMENT

Supplementary material accompanies the online version of this article.

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