Access to rheumatologists among patients with newly diagnosed rheumatoid arthritis in a Canadian universal public health care system

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TITLE PAGE

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ABSTRACT

Our objective was to estimate the percent of incident rheumatoid arthritis (RA) patients who saw a rheumatologist within 3, 6 and 12 months of suspected diagnosis by a family physician, and assess what factors may influence the time frame with which patients are seen.

Methods:

Over 2000-2009, we studied incident RA patients who were initially diagnosed by a family physician. We assessed secular trends in rheumatology encounters and differences between patients who saw vs. did not see a rheumatologist. We performed hierarchical logistic regression analyses to determine whether receipt of rheumatology care was associated with patient, primary care physician, and geographic factors.

Results:

Among 19,760 incident RA patients, 59%, 75% and 84% of patients saw a rheumatologist within 3, 6 and 12 months, respectively. The prevalence of initial consultations within 3 months did not increase overtime, however, access within 6 and 12 months increased overtime. Factors positively associated with timely consultations included higher regional rheumatology supply [adjusted Odds Ratio, aOR 1.35(95% CI 1.13,1.60)] and higher socioeconomic status [aOR 1.18(95%CI 1.07,1.30)]. Conversely, factors inversely associated with timely consultations included remote patient residence [aOR 0.51(95% CI 0.41,0.64)], and male family physicians [aOR 0.88(95% CI 0.81,0.95)].

Conclusion:

Increasing access to rheumatologists within 6 and 12 months occurred overtime, however consultations within 3 months did not change overtime. Measures of poor access (such as proximity to and density of rheumatologists) were negatively associated with timely consultations. Additional factors that contributed to disparities in access included patient socioeconomic status and physician sex.

N=247

Article focus:

- In a large population-based cohort of patients with newly diagnosed rheumatoid arthritis (RA) in Canada, our study's aim was to determine the percent of incident RA patients who saw a rheumatologist within 3, 6 and 12 months of suspected diagnosis by a family physician, and assessed what factors may influence the time frame with which patients are seen.

Key messages:

- We found increasing access to rheumatologists within 6 and 12 months have occurred overtime, however consultations within 3 months did not change overtime.

- Overall, 41% of patients are still not seen within 3 months of a primary care diagnosis as recommended by current guidelines. Thus, an important proportion of patients are not receiving optimal care. However, we only studied a proportion of the total delay from the onset of the patients' symptoms to rheumatology care. It is unknown how long patients have symptoms before seeking medical care, or remain in primary care before their RA is recognized. Therefore the delays between onset of symptoms to rheumatology care may be larger than reported here.

- Measures of poor access (such as proximity to and density of rheumatologists) were negatively associated with timely consultations. Additional factors that contributed to disparities in access included patient socioeconomic status and physician sex. Strategies to facilitate more timely access, such as improving proximity to and density of rheumatologists along with family physician education on initiating more timely referrals, are acutely needed.

Strengths and limitations of this study:

- Strengths of our study include its large sample and the use of a validated population-based RA cohort.
- Our main limitation is that our cohort definition requires patients whose family physician strongly suspects that the patient has RA, thus, our analyses are likely restricted to patients with a more homogeneous clinical presentation (such as rheumatoid factor positive patients) or those with more active disease.

Rheumatoid arthritis (RA) is a progressive inflammatory arthritis associated with joint damage and functional deterioration, work disability and premature mortality.[1] At disease onset, RA is considered an urgent medical condition[1,2] requiring prompt referral to a rheumatologist.[3-5] Timely rheumatology care is important as it increases early exposure to treatment,[6] improves patient outcomes,[7],[8] decreases the need for costly surgical interventions,[9] and thus reduces the global disease burden. Furthermore, the sooner a patient is seen and managed by rheumatologists results in superior clinical responses and increases the chance of disease remission[10],[11],[12],[13],[14] than if the same care is administered later in the disease course.[15]

In Canada, access to specialists often depends on referral by a family physician. For optimal RA care to occur, a patient must seek care by a family physician, who, in turn, must suspect RA and initiate referral to a rheumatologist, who will undertake the appropriate diagnostic tests and initiate early treatment.[16] Delays that occur at any of these stages prevent patients from receiving timely care.

Ontario has approximately 13 million residents and 10,000 family physicians.[17] There are approximately 150 rheumatologists (1.5 rheumatologists per 100,000 population), however, they are concentrated most heavily in southern Ontario,[18] which may be a potential barrier to equitable, timely rheumatology care.[19] Accordingly, we set out to determine the percent of incident RA patients who saw a rheumatologist within 3, 6 and 12 months of suspected diagnosis by a family physician, and assessed what factors may influence the time frame with which patients are seen.

SUBJECTS AND METHODS:

Setting and Design. We performed a retrospective, population-based study of newly diagnosed RA patients within Ontario, in which all residents are covered by universal public health insurance for

physician and hospital services. The study was approved by the Research Ethics Board at Sunnybrook Health Sciences Centre, Toronto, Canada.

Data sources. We used the Ontario Rheumatoid Arthritis administrative Database (ORAD), a population-based RA cohort generated from administrative databases using a validated case definition. RA patients are included in ORAD if they have 3 Ontario Health Insurance (OHIP) physician service claims over a two-year period in which RA is the recorded diagnosis, with at least 1 of these claims made by a musculoskeletal specialist. ORAD has been validated and shown to have a high sensitivity (78%), specificity (100%), and positive predictive value (78%) for identifying RA patients based on medical record reviews.[20] [21] Validation of RA onset within administrative data has also shown to be highly accurate.[21] Records for individuals in ORAD are also linked to the following administrative datasets. The Ontario Registered Persons Database was used to identify demographic information on age, sex, place of residence, death, and emigration. Physician specialty was obtained by linking the Institute for Clinical Evaluative Sciences Physician Database with the OHIP database.[22] We used the Client Agency Program Enrolment Database to identify the primary care delivery model of the family physician at the time the patient entered the cohort. These datasets are linked in an anonymous fashion using encrypted health insurance numbers for residents and encrypted license numbers for physicians, and they have very little missing information.[23]

Cohort definition. We identified all incident RA patients from April 1, 2000 to March 31, 2010. Analyses were restricted to patients whose initial RA diagnosis codes were assigned by a family physician in an outpatient setting. Cohort entry (suspected RA diagnosis date) was the date of the first RA diagnosis code, and patients were followed up until one year or until outmigration, death, or the end of study period.

Covariate information. Covariates for patient demographics included age, sex, socioeconomic status (SES), and year of suspected diagnosis. SES was defined as the patient's neighbourhood median household income quintile from the Statistics Canada Census. We also identified whether patients were subsequently admitted to hospital with an RA diagnosis following a primary care diagnosis, as patients who are seen in a hospital setting for their RA may have poorer access to health care providers and/or more severe disease. As a measure of co-morbidity, we used the Johns Hopkins Adjusted Diagnostic Groups (ADG) Case-Mix System derived from both outpatient and inpatient data in the two years preceding cohort entry.[24] We categorized ADGs into low (<5), moderate (5-9), and high co-morbidity (10+). We chose this risk adjustment method as patients using the most health care resources are not typically those with single diseases but rather those with multiple and sometimes unrelated conditions. This clustering of morbidity can be a better predictor of health care use than the presence of specific diseases.[25] Geographic characteristics included patient residence, regional health service planning areas (Local Health Integration Networks, LHINs[26]), rheumatology supply and distance to the closest rheumatologist. Rurality was based upon each patient's postal code and a community population size of less than 10,000. Rheumatology supply was defined as the number of rheumatologists per 100,000 adults in the planning area (LHIN) of patient residence, and distance to the closest rheumatologist was the linear distance from the centre of patient's postal code area to that of the closest rheumatologist, with 'remote residence' defined as 100 or more kilometers (km) to the nearest rheumatologist. Family physician characteristics included sex, years since graduation (as a proxy for experience), and type of primary care delivery model the family physician was working in at the time of patient's cohort entry. We categorized each practice type as (1) *blended capitation models* [Family Health Networks (FHNs), Family Health Organizations (FHOs), Family Health Teams (FHTs)], and (2) *enhanced fee-for-service models* (Family Health Groups or FHGs) and other groups and *traditional fee-for-service practitioners*.[27] The main difference between the models is how physicians are reimbursed (e.g., through age-and-sex-adjusted capitation payments versus being paid

on a per visit basis). Capitation models often include interdisciplinary teams involving allied healthcare providers and require physicians to maintain a list or 'roster' of enrolled patients to whom they are committed to providing primary care.[28] Including primary care model type enabled us to explore if there was an effect regarding different primary care practice models and/or how the physicians are paid as a facilitator to timely rheumatology care.

Outcome Measurements. We followed incident patients, determining whether they had a visit to a rheumatologist at three, six and 12 months.

Statistical analysis. Descriptive statistics were used to characterize the study population. We assessed secular trends (as the percentage of each annual incident RA cohort who saw a rheumatologist within each time period) and differences among patients who received vs. did not receive rheumatology care. We performed hierarchical logistic regression analyses to determine whether receipt of rheumatology care was associated with patient demographics, co-morbidity, geographic characteristics, and family physician characteristics. Crude and adjusted odds ratio (aOR) estimates with 95% confidence intervals (CIs) were generated. Separate analyses were performed for each outcome end date (benchmarks): three, six and 12 months.

All analyses were performed at the ICES on anonymized data using SAS version 9.2 (SAS Institute, Cary, North Carolina).

RESULTS:

Between 2000 and 2009, we identified 19,670 incident RA patients (figure 1). Overall, the mean (standard deviation, SD) age at time of cohort entry was 54 (16) years, 71% were female, 16% resided in rural areas and 5% resided in areas remote (≥100 km) from the nearest rheumatologist (table 1).

Most patients were seen by male family physicians (70%). Few (5%) physicians were practicing under a newer capitation model.

Over one year of follow-up, the average time from the first RA diagnosis code to first rheumatologist visit was 77 days (table 1). Overall, 59%, 75% and 84% of patients saw a rheumatologist within 3, 6 and 12 months, respectively. The prevalence of initial rheumatology encounters within 3 months did not increase over the study period. However, the percentage of patients who saw a rheumatologist within 6 and 12 months increased gradually overtime, from 72% and 81% in 2000 to 81% and 89% in 2009, respectively (figure 2).

Table 2 compares the characteristics of patients who saw vs. did not see a rheumatologist within 3 months of cohort entry. More patients who were not seen by a rheumatologist lived in a rural area (19% vs 14%) and remote areas.

Independent determinants of receiving rheumatology care within 3 months of RA diagnosis are reported in Table 2. Factors associated with prompt rheumatology care included increasing rheumatology supply [aOR 1.35 (95% CI 1.13,1.60)] and higher SES [aOR 1.18 (95% CI 1.07,1.30)]. The strongest independent factor negatively associated with lower frequency of rheumatology visits was for patients who lived at remote distances to rheumatologists [aOR 0.51 (95% CI 0.41,0.64)]. The likelihood of not having prompt rheumatology consultations was also reduced for patients of male family physicians [aOR 0.87 (95% CI 0.81,0.95)]. There was no calendar-year effect illustrating an increasing likelihood of seeing a rheumatologist within 3 months overtime. However, improvements overtime were demonstrated for patients being seen by a rheumatologist within 6 and 12 months (table 3).

We observed similar associations when we studied the effects of factors on the odds of receiving rheumatology care within 6 and 12 months (table 3). The effect of proximity on access became stronger as the time to rheumatology visit was lengthened: 6 months, aOR 0.56 (95% CI 0.36,0.59); 12 months, aOR 0.33 (95% CI 0.26,0.43). Patients who were hospitalized for RA subsequent to an initial diagnosis in an outpatient primary care setting were almost half as likely to been seen by a rheumatologist at 6 and 12 months.

Discussion

In a publicly-funded universal healthcare system, we studied trends in encounters with rheumatologists over the past decade and observed increasing rates of access to rheumatologists within 6 months and 12 months after diagnosis by a family physician. However, no such improvements were observed among patients seen within 3 months, a more favorable benchmark. We also explored whether receipt of rheumatology care was associated with patient and family physician characteristics, and measures of rheumatology supply. We found that patients of higher SES were more likely to receive timely rheumatology care, which has also been demonstrated in other Canadian provinces.[29],[30] Further, proximity to and density of rheumatologists were important determinants of timely rheumatology care.

While our results appear encouraging, 41% of patients are still not seen within 3 months of a primary care diagnosis as recommended by current guidelines. Thus, an important proportion of patients are not receiving optimal care. When interpreting the results it is important to recognize that the delay in rheumatology consultation being studied represents only a proportion of the total delay from the onset of the patients' symptoms. It is unknown how long patients have symptoms before seeking medical care, or remain in primary care before their RA is recognized. Therefore the delays between onset of symptoms to rheumatology care may be larger than reported here.

Given the high economic impact of RA[31], rheumatologists are key to an integrated healthcare delivery system.[32] However, not all patients are receiving the right care at the right time. Delays in timely consultations may reflect the growing burden of RA relative to rheumatology supply. During our study period, the number of rheumatologists in Ontario remained relatively stable (1.5 rheumatologists per 100,000 population).[18] While most RA patients were seen by a rheumatologist within 1 year, delays in more timely benchmarks may also be indicative of the need to educate primary care physicians to initiate rheumatology referrals sooner. Ultimately, delays in access to timely, quality care and treatment result in increasing disability for RA patients as well as increasing costs to the healthcare system.[31]

Geographic variation in receipt of timely rheumatology care may be indicative of problems with access. Considering the geographic size and features of Ontario, approximately one-quarter of Ontarians resides in communities with 30,000 or fewer residents.[33] However, few rheumatologists practice in rural communities.[18] Consequently, the threshold for referral to rheumatologists may be higher in remote versus urban communities (i.e., rural patients who are referred have substantially more active disease than their urban counterparts).[6],[34] Thus, there is a need to address the low rheumatology supply among remote communities.

Additionally, there was a low likelihood of being seen by a rheumatologist within 6 or 12 months subsequent to a hospital encounter for RA after a patient was initially diagnosed in a primary care setting. In areas with few rheumatologists, family physicians may have no choice but to encourage patients to seek hospital-based specialty care. In addition, while most rheumatologists have a hospital appointment, not all hospitals have rheumatologists.[35] Thus, our findings reinforce the need for strategies to not only improve access to rheumatologists but also to encourage proper follow-up for

these patients.

Our results showed that patients of female family physicians were more likely to receive rheumatology care earlier. While there is conflicting data on the influence of physician gender on practice styles,[36],[37] female physicians have been shown to engage in more preventive services and to communicate differently with their patients.[38] Male physicians may have more confidence in managing RA in primary care, such as starting glucocorticoids prior to rheumatology encounters. Similarly, patients have also reported to have more confidence in male physicians[39] and thus may be more hesitant to seek secondary care. Together, this may explain why RA patients of female family physicians are more likely to be seen by rheumatologists earlier and that the influence of physician gender was attenuated at 1-year post-RA diagnosis.

We also sought to evaluate the influence of primary care models on rheumatology encounters. We hypothesized that patients of capitation models, which involve interdisciplinary teams, allied health providers and where patient enrollment is most strongly encouraged, could improve continuity of care with their patients that could ultimately affect the quality of care that these patients receive. While we found no association, it may be too soon to determine an effect as many physicians changed models overtime and few physicians were practicing under a capitation model during the study period.[40]

Strengths of our study include its large sample and the use of a validated population-based RA cohort.[21] Our main limitation is that our cohort definition requires patients to have had their first RA diagnosis code provided by a family physician (i.e. those whose physician strongly suspects that the patient has RA). While others have used this approach,[9] our analyses are likely restricted to patients with a more homogeneous clinical presentation (such as rheumatoid factor positive patients) or those with more active disease in which the family physician was able to accurately diagnose the condition

and/or more likely to use an RA billing code as a reason for visit. Therefore we may be over-estimating the proportion of patients with timely rheumatology encounters. These related caveats are owing to the absence of both symptom onset and date of referral in administrative databases. Future research is required to develop and validate algorithms to better predict RA onset from administrative data. However, previous researchers have also used physician service claims to sample RA patients from rheumatology practices in order to calculate wait times on a smaller scale, and these studies may be subjected to similar biases (inclusion of early RA patients with a more homogenous clinical presentation).[41],[42]

In conclusion, we found increasing access to rheumatologists within 6 and 12 months overtime, however rheumatology encounters within 3 months did not change overtime. Measures of poor access negatively impacted rates of encounters with a rheumatologist. Factors that contributed to disparities in rheumatology access included SES and physician sex. Strategies to facilitate more timely access, such as improving proximity to and density of rheumatologists along with family physician education on initiating more timely referrals, are acutely needed.

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This study was performed in the context on the Ontario Best Practices Research Initiative (OBRI), a unique collaboration of rheumatologists, primary care physicians, researchers, patients and other stakeholders seeking to improve the quality of care and clinical outcomes of patients with arthritis across the spectrum of care.
Dr. Tu holds a CIHR Fellowship Award in Primary Care Research (2011-2013). Dr. Ivers holds a CIHR Fellowship Award in Clinical Research and a Fellowship Award from the Department of Family and Community Medicine, University of Toronto. Dr. Bombardier holds a Canada Research Chair in Knowledge Transfer for Musculoskeletal Care (2002-2016) and a Pfizer Research Chair in Rheumatology.

Contributorship

All authors contributed substantially to conception and design, or acquisition of data, or analysis and interpretation of data and were involved in drafting the article and gave final approval of the version to be published.

Data sharing

There are no additional unpublished data other than that presented in the manuscript. Questions regarding the data presented in the manuscript can be directed to the corresponding author.

Competing Interests

None

Figure 1. Flow diagram of selection of study participants

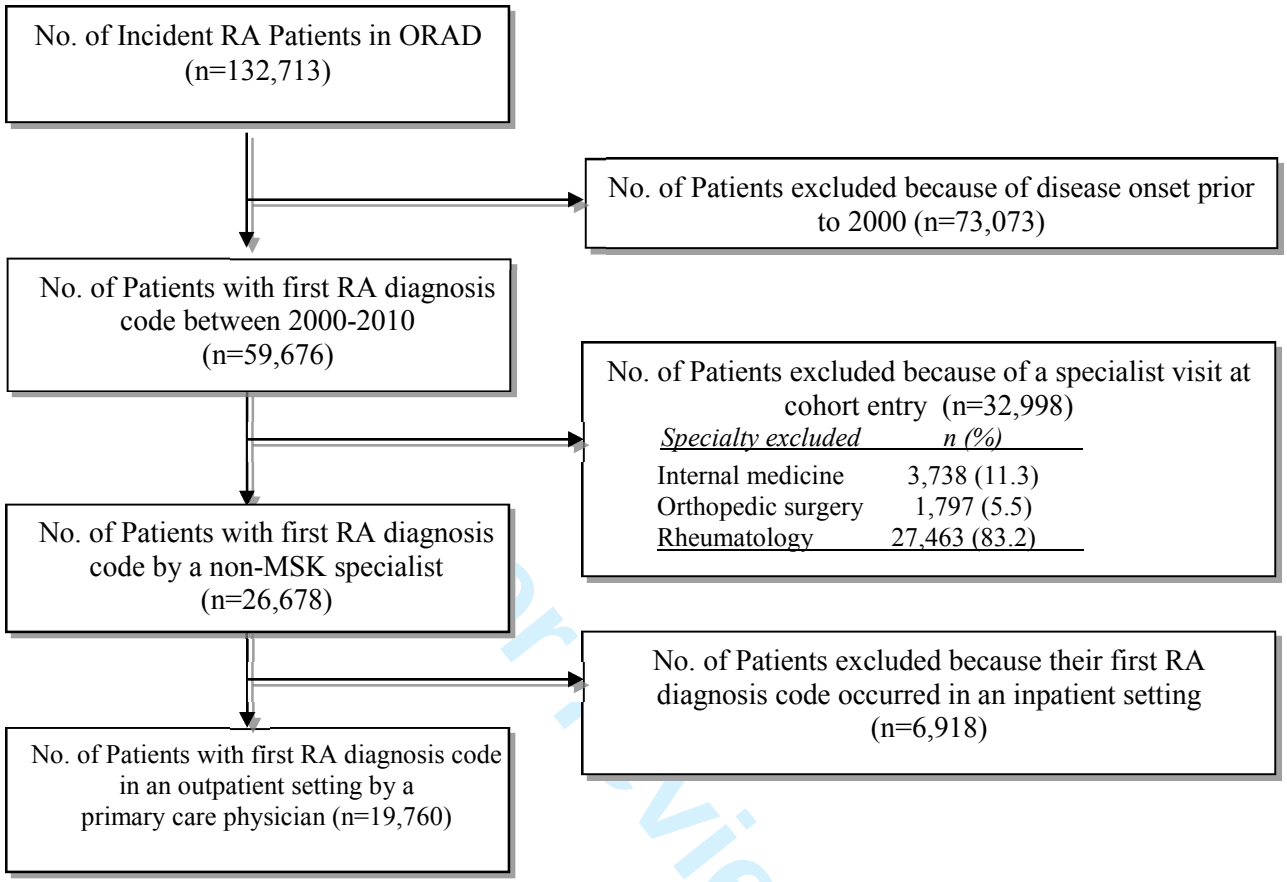

Figure 2: Percentage of patients with newly diagnosed RA who are seen by a rheumatologist within 3, 6 and 12 months of suspected diagnosis by a primary care physician.

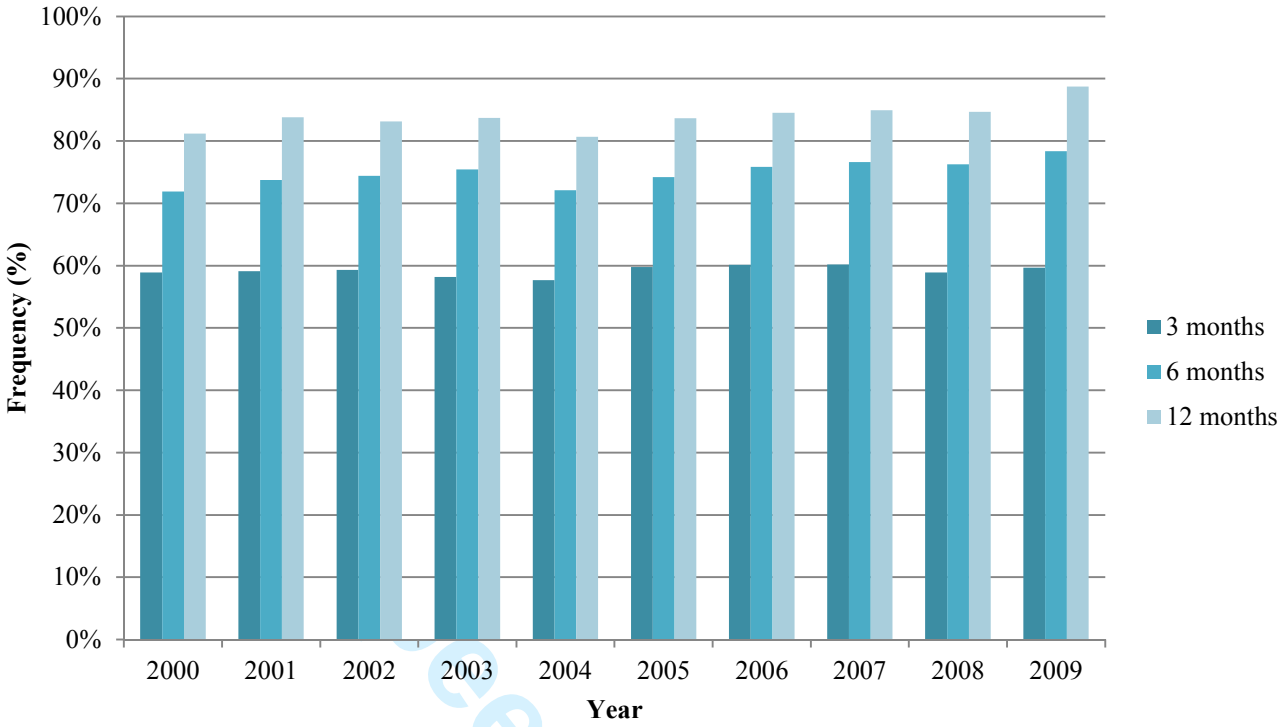

Table 1: Selected cohort characteristics of 19,670 newly diagnosed RA patients that met our criteria

Characteristic	Newly diagnosed

	RA n=19,670
Patient Demographics	
Age at cohort entry, mean (SD)	53.7 (16.3)
Female, n (%)	14,091 (71.1)
Rural residence, n (%)	3,196 (16.2)
Patient Co-morbidity	
Number of Hopkins ADGs* in the 2 years prior to entry, n (%)	
< 5	5,229 (26.5)
5-9	9,790 (49.5)
10+	4,741 (24.0)
Rheumatology Access Measures	
Time (days) from first diagnosis code to first rheumatologist visit, mean (SD)	76.7 (76.9)
Time (days) from first diagnosis code to first rheumatologist visit, median (IQR)	50 (22-104)
Rheumatology supply per 100 000 adults†, mean (SD)	1.5 (1.1)
Distance to closest rheumatologist	
Kilometers, mean (SD)	24.2 (69.7)
Remote (≥100 km), n (%)	1,047 (5.3)
Primary care physician characteristics	
Male, n (%)	13,872 (70.2)
Years since graduation, mean (SD)	24.5 (10.5)
Practice type, n (%)	
Blended capitation models†† (FHO / FHN)	976 (4.9)
Traditional fee-for-service and enhanced fee-for-service (FHG/Other)	18,784 (95.1)

* Ambulatory diagnostic groups

†in patient Local Health Integration Networks, LHINs (regional health service planning areas)

††Practice types: *blended capitation models* [Family Health Networks (FHNs), Family Health Organizations (FHOs), Family Health Teams (FHTs), an interprofessional team model composed of FHNs and FHOs], *enhanced fee-for-service models* [Family Health Groups (FHGs) and other groups],

Table 2: Descriptive characteristics for RA patients that do and do not receive rheumatology care and influence of various factors on receipt of rheumatology care within THREE months of suspected diagnosis by a primary care physician

Characteristic	Seen by a rheumatologist		Multivariate analysis	
	Yes n=**11,694**	**No** N=**8,066**	**Crude OR*** [95% CI]**	**Adjusted† OR** [95% CI]
Demographics				
Age, mean (SD)	53.8 (15.9)	53.6 (16.7)	1.00 [1.00, 1.00]	1.00 [1.00, 1.00]
Male sex, n (%) [REF=Female]	3,341 (28.6)	2,328 (28.9)	1.01 [0.95, 1.07]	1.04 [0.97, 1.11]
Income quintile, n(%) [REF = 1 – low]	59 (0.5)	50 (0.6)	REF	REF
2	2,197 (18.8)	1,693 (21)	1.10 [1.00, 1.20]	1.08 [0.98, 1.18]
3	2,359 (20.2)	1,657 (20.5)	1.12 [1.03, 1.23]	1.11 [1.01, 1.22]
4	2,407 (20.6)	1,627 (20.2)	1.12 [1.02, 1.23]	1.09 [0.99, 1.20]
5	2,305 (19.7)	1,581 (19.6)	1.22 [1.11, 1.34]	1.18 [1.07, 1.30]
Calendar Year of Cohort Entry [REF=2000]				
2000	1,110	774	REF	REF
2001	1,110	768	0.99 [0.87, 1.13]	0.99 [0.87, 1.14]
2002	1,074	736	1.00 [0.87, 1.14]	1.00 [0.87, 1.15]
2003	1,154	830	0.96 [0.85, 1.10]	0.99 [0.87, 1.13]
2004	1,187	872	0.94 [0.83, 1.08]	0.99 [0.87, 1.14]
2005	1,231	828	1.05 [0.92, 1.20]	1.12 [0.98, 1.28]
2006	1,179	782	1.07 [0.94, 1.22]	1.13 [0.98, 1.29]
2007	1,237	818	1.07 [0.94, 1.23]	1.14 [0.99, 1.31]
2008	1,268	885	1.01 [0.89, 1.16]	1.10 [0.96, 1.26]
2009	1,144	773	1.03 [0.90, 1.18]	1.10 [0.95, 1.27]
Co-morbidity: Number of Hopkins ADGs in the 2 years prior to entry, n (%) (REF=<5)				
< 5	3,031 (25.9)	2,198 (27.3)	REF	REF
5-9	5,802 (49.6)	3,988 (49.4)	1.04 [0.97, 1.12]	1.04 [0.97, 1.12]
10+	2,861 (24.5)	1,880 (23.3)	1.08 [0.99, 1.18]	1.07 [0.98, 1.17]
Hospitalization for RA prior to rheumatologist visit / end of study period, n(%)	71 (0.6)	41 (0.5)	1.24 [0.84, 1.84]	1.34 [0.89, 2.02]
Geographic				
Patient Rural residence, n(%); [REF=urban]	1,636 (14.0)	1,560 (19.3)	0.70 [0.64, 0.76]	0.92 [0.83, 1.01]
Rheumatology supply per 100 000 adults, mean (SD)	1.6 (1.1)	1.4 (1.0)	1.16 [1.12, 1.19]	1.35 [1.13, 1.60]
Distance to rheumatologist (km), mean (SD)	17.8 (64.24)	33.6 (75.89)	n/a	n/a
Remote Distance (≥100 km to rheumatologist), n(%)	312 (2.7)	735 (9.1)	0.29 [0.25, 0.34]	0.51 [0.41, 0.64]
Primary Care physician				
Male sex, n (%) (REF=Female)	8,069 (69.0)	5,803 (71.9)	0.83 [0.77, 0.89]	0.87 [0.81, 0.95]
Years since graduation, mean (SD)	24.3 (10.48)	24.6 (10.53)	1.00 [0.99, 1.00]	1.00 [0.99, 1.00]
Practice type††, n (%) (REF=fee-for-service)				
Traditional and Enhanced fee-for-service	11,085 (94.8)	7,699 (95.5)	REF	REF
Blended capitation models	609 (5.2)	367 (4.5)	1.14 [0.98, 1.32]	1.15 [0.99, 1.34]

*OR = Odds Ratio; **95% CI = 95% confidence interval

†Adjusted for all covariates including: patient demographics, clinical factors, primary care physician characteristics, provider continuity, and geographic characteristics [including regional variation by regional health service planning areas Local Health Integration Networks (LHINs) not reported here.]

††Practice types: *blended capitation models* [Family Health Networks (FHNs), Family Health Organizations (FHOs), Family Health Teams (FHTs), an interprofessional team model composed of FHNs and FHOs], *enhanced fee-for-service models* [Family Health Groups (FHGs) and other groups], and *solo fee-for-service practitioners* (those who did not belong to a model).

Table 3: Influence of patient demographics, co-morbidity, geographic characteristics, and primary care physician characteristics on receipt of rheumatology care within 6 and 12 months

Characteristic	6 months		12 months	
	Crude OR* [95% CI]**	Adjusted† OR [95% CI]	Crude OR [95% CI]	Adjusted OR [95% CI]
Demographics				
Age, mean (± SD)	1.00 [1.00, 1.00]	1.00 [1.00, 1.00]	1.00 [1.00, 1.00]	1.00 [1.00, 1.00]
Male sex [REF=Female]	0.97 [0.90, 1.04]	0.98 [0.91, 1.06]	0.92 [0.85, 1.00]	0.94 [0.86, 1.02]
Income quintile [REF = 1 – low]	REF	REF	REF	REF
2	1.15 [1.04, 1.27]	1.14 [1.03, 1.26]	1.07 [0.96, 1.21]	1.06 [0.94, 1.20]
3	1.22 [1.10, 1.35]	1.20 [1.08, 1.33]	1.17 [1.04, 1.32]	**1.16 [1.03, 1.31]**
4	1.15 [1.04, 1.27]	1.11 [1.00, 1.24]	1.15 [1.02, 1.30]	1.12 [0.99, 1.27]
5	1.30 [1.17, 1.44]	1.26 [1.13, 1.40]	1.35 [1.19, 1.53]	**1.31 [1.15, 1.49]**
Calendar Year of Cohort Entry [REF=2000]	REF	REF	REF	REF
2001	1.07 [0.92, 1.23]	1.07 [0.92, 1.24]	1.13 [0.96, 1.34]	1.13 [0.95, 1.35]
2002	1.12 [0.97, 1.30]	1.12 [0.96, 1.31]	1.12 [0.95, 1.33]	1.14 [0.95, 1.36]
2003	1.19 [1.02, 1.38]	1.22 [1.04, 1.42]	1.18 [0.99, 1.40]	1.21 [1.01, 1.44]
2004	1.01 [0.87, 1.17]	1.04 [0.89, 1.21]	0.97 [0.82, 1.15]	1.01 [0.84, 1.20]
2005	1.15 [1.00, 1.34]	1.21 [1.04, 1.41]	1.22 [1.02, 1.45]	1.30 [1.08, 1.56]
2006	1.25 [1.07, 1.45]	1.30 [1.11, 1.52]	1.28 [1.07, 1.53]	1.33 [1.10, 1.60]
2007	1.29 [1.11, 1.50]	1.37 [1.17, 1.60]	1.33 [1.11, 1.59]	1.42 [1.18, 1.72]
2008	1.26 [1.09, 1.47]	1.35 [1.16, 1.58]	1.30 [1.09, 1.55]	1.41 [1.17, 1.70]
2009	1.42 [1.21, 1.66]	1.49 [1.26, 1.76]	1.83 [1.51, 2.22]	1.96 [1.60, 2.40]
Co-morbidity				
No. of Hopkins ADGs[REF=<5]	REF	REF	REF	REF
5-9	1.02 [0.94, 1.10]	1.03 [0.95, 1.12]	1.03 [0.94, 1.13]	1.07 [0.97, 1.18]
10+	1.02 [0.93, 1.12]	1.05 [0.95, 1.16]	1.04 [0.93, 1.16]	1.09 [0.97, 1.23]
Hospitalization for RA prior to rheumatologist visit / end of study period	0.60 [0.42, 0.85]	0.63 [0.44, 0.91]	0.51 [0.36, 0.71]	0.54 [0.38, 0.76]
Geographic				
Patient rural residence [REF=urban]	0.74 [0.68, 0.81]	1.00 [0.89, 1.11]	0.80 [0.72, 0.89]	1.09 [0.96, 1.24]
Rheumatology supply per 100 000 adults	1.15 [1.11, 1.20]	1.19 [0.97, 1.45]	1.16 [1.11, 1.22]	1.25 [0.98, 1.61]
Remote Distance (≥100 km to rheumatologist)	0.28 [0.24, 0.33]	0.46 [0.36, 0.59]	0.26 [0.22, 0.31]	0.33 [0.26, 0.43]
Primary Care physician				
Male sex [REF=Female]	0.81 [0.74, 0.89]	0.89 [0.81, 0.97]	0.81 [0.73, 0.90]	0.91 [0.81, 1.01]
Years since graduation	1.00 [0.99, 1.00]	0.99 [0.99, 1.00]	1.00 [0.99, 1.00]	0.99 [0.99, 1.00]
Practice type†† [REF=fee-for-service]				
Capitation model	1.22 [1.01, 1.47]	1.13 [0.93, 1.36]	1.22 [0.99, 1.51]	1.09 [0.87, 1.35]

*OR = Odds Ratio; **95% CI = 95% confidence interval †Adjusted for all covariates including: patient demographics, clinical factors, primary care physician characteristics, provider continuity, and geographic characteristics [including regional variation by regional health service planning areas Local Health Integration Networks (LHINs) not reported here.] ††Practice types: *blended capitation models* [Family Health Networks (FHNs), Family Health Organizations (FHOs), Family Health Teams (FHTs), an interprofessional team model composed of FHNs and FHOs], *enhanced fee-for-service models* [Family Health Groups (FHGs) and other groups], and traditional *fee-for-service*

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STROBE Statement—Checklist of items that should be included in reports of ***cohort studies***

	Item No	Recommendation
Title and abstract	1	√(*a*) Indicate the study's design with a commonly used term in the title or the abstract
		√(*b*) Provide in the abstract an informative and balanced summary of what was done and what was found
Introduction		
Background/rationale	2	√Explain the scientific background and rationale for the investigation being reported
Objectives	3	√State specific objectives, including any prespecified hypotheses
Methods		
Study design	4	√Present key elements of study design early in the paper
Setting	5	√Describe the setting, locations, and relevant dates, including periods of recruitment, exposure, follow-up, and data collection
Participants	6	√(*a*) Give the eligibility criteria, and the sources and methods of selection of participants. Describe methods of follow-up
		(*b*) For matched studies, give matching criteria and number of exposed and unexposed
Variables	7	√Clearly define all outcomes, exposures, predictors, potential confounders, and effect modifiers. Give diagnostic criteria, if applicable
Data sources/ measurement	8*	√ For each variable of interest, give sources of data and details of methods of assessment (measurement). Describe comparability of assessment methods if there is more than one group
Bias	9	√Describe any efforts to address potential sources of bias
Study size	10	Explain how the study size was arrived at n/a – population-based study
Quantitative variables	11	√Explain how quantitative variables were handled in the analyses. If applicable, describe which groupings were chosen and why
Statistical methods	12	√(*a*) Describe all statistical methods, including those used to control for confounding
		√(*b*) Describe any methods used to examine subgroups and interactions
		(*c*) Explain how missing data were addressed
		√(*d*) If applicable, explain how loss to follow-up was addressed
		√(*e*) Describe any sensitivity analyses
Results		
Participants	13*	√(a) Report numbers of individuals at each stage of study—eg numbers potentially eligible, examined for eligibility, confirmed eligible, included in the study, completing follow-up, and analysed
		(b) Give reasons for non-participation at each stage n/a
		√(c) Consider use of a flow diagram
Descriptive data	14*	√(a) Give characteristics of study participants (eg demographic, clinical, social) and information on exposures and potential confounders
		(b) Indicate number of participants with missing data for each variable of interest
		(c) Summarise follow-up time (eg, average and total amount)
Outcome data	15*	√Report numbers of outcome events or summary measures over time
Main results	16	√(*a*) Give unadjusted estimates and, if applicable, confounder-adjusted estimates and their precision (eg, 95% confidence interval). Make clear which confounders were adjusted for and why they were included

		√(*b*) Report category boundaries when continuous variables were categorized
		(*c*) If relevant, consider translating estimates of relative risk into absolute risk for a meaningful time period
Other analyses	17	√Report other analyses done—eg analyses of subgroups and interactions, and sensitivity analyses
Discussion		
Key results	18	√Summarise key results with reference to study objectives
Limitations	19	√Discuss limitations of the study, taking into account sources of potential bias or imprecision. Discuss both direction and magnitude of any potential bias
Interpretation	20	√Give a cautious overall interpretation of results considering objectives, limitations, multiplicity of analyses, results from similar studies, and other relevant evidence
Generalisability	21	√Discuss the generalisability (external validity) of the study results
Other information		
Funding	22	√Give the source of funding and the role of the funders for the present study and, if applicable, for the original study on which the present article is based

*Give information separately for exposed and unexposed groups.

Note: An Explanation and Elaboration article discusses each checklist item and gives methodological background and published examples of transparent reporting. The STROBE checklist is best used in conjunction with this article (freely available on the Web sites of PLoS Medicine at http://www.plosmedicine.org/, Annals of Internal Medicine at http://www.annals.org/, and Epidemiology at http://www.epidem.com/). Information on the STROBE Initiative is available at http://www.strobe-statement.org.

Access to rheumatologists among patients with newly diagnosed rheumatoid arthritis in a Canadian universal public health care system

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TITLE PAGE

TITLE: Access to rheumatologists among patients with newly diagnosed rheumatoid arthritis in a Canadian universal public health care system.

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ABSTRACT

Our objective was to estimate the percent of incident rheumatoid arthritis (RA) patients who saw a rheumatologist within 3, 6 and 12 months of suspected diagnosis by a family physician, and assess what factors may influence the time frame with which patients are seen.

Methods:

Over 2000-2009, we studied incident RA patients who were initially diagnosed by a family physician. We assessed secular trends in rheumatology encounters and differences between patients who saw vs. did not see a rheumatologist. We performed hierarchical logistic regression analyses to determine whether receipt of rheumatology care was associated with patient, primary care physician, and geographic factors.

Results:

Among 19,760 incident RA patients, 59%, 75% and 84% of patients saw a rheumatologist within 3, 6 and 12 months, respectively. The prevalence of initial consultations within 3 months did not increase over time, however, access within 6 and 12 months increased over time. Factors positively associated with timely consultations included higher regional rheumatology supply [adjusted Odds Ratio, aOR 1.35(95% CI 1.13,1.60)] and higher patient socioeconomic status [aOR 1.18(95%CI 1.07,1.30)]. Conversely, factors inversely associated with timely consultations included remote patient residence [aOR 0.51(95% CI 0.41,0.64)], and male family physicians [aOR 0.88(95% CI 0.81,0.95)].

Conclusion:

Increasing access to rheumatologists within 6 and 12 months occurred over time, however consultations within 3 months did not change over time. Measures of poor access (such as proximity to and density of rheumatologists) were negatively associated with timely consultations. Additional factors that contributed to disparities in access included patient socioeconomic status and physician sex.

N=252

Article focus:

- In a large population-based cohort of patients with newly diagnosed rheumatoid arthritis (RA) in Canada, our study's aim was to determine the percent of incident RA patients who saw a rheumatologist within 3, 6 and 12 months of suspected diagnosis by a family physician, and assessed what factors may influence the time frame with which patients are seen.

Key messages:

- We found increasing access to rheumatologists within 6 and 12 months have occurred over time, however consultations within 3 months did not change over time.

- Overall, 41% of patients are still not seen within 3 months of a primary care diagnosis as recommended by current guidelines. Thus, an important proportion of patients are not receiving optimal care. However, we studied only a proportion of the total delay from the onset of the patients' symptoms to rheumatology care. It is unknown how long patients have symptoms before seeking medical care, or remain in primary care before their RA is recognized. Therefore the delays between onset of symptoms to rheumatology care may be larger than reported here.

- Measures of poor access (such as proximity to and density of rheumatologists) were negatively associated with timely consultations. Additional factors that contributed to disparities in access included patient socioeconomic status and physician sex. Strategies to facilitate more timely access, such as improving proximity to and density of rheumatologists along with family physician education on initiating more timely referrals, are acutely needed.

Strengths and limitations of this study:

- Strengths of our study include its large sample and the use of a validated population-based RA cohort.
- Our main limitation is that our cohort definition requires patients whose family physician strongly suspects that the patient has RA, thus, our analyses are likely restricted to patients with a more homogeneous clinical presentation (such as rheumatoid factor positive patients) or those with more active disease.

Rheumatoid arthritis (RA) is a progressive inflammatory arthritis associated with joint damage and functional deterioration, work disability and premature mortality.[1] At disease onset, RA is considered an urgent medical condition[1 2] requiring prompt referral to a rheumatologist.[3-5] Timely rheumatology care is important as it increases early exposure to treatment,[6] improves patient outcomes,[7],[8] decreases the need for costly surgical interventions,[9] and thus reduces the global disease burden. Furthermore, the sooner a patient is seen and managed by rheumatologists results in superior clinical responses and increases the chance of disease remission[10],[11],[12],[13],[14] than if the same care is administered later in the disease course.[15]

In Canada, access to specialists often depends on referral by a family physician. For optimal RA care to occur, a patient must seek care by a family physician, who, in turn, must suspect RA and initiate referral to a rheumatologist, who will undertake the appropriate diagnostic tests and initiate early treatment.[16] Delays that occur at any of these stages prevent patients from receiving timely care.

Ontario has approximately 13 million residents and 10,000 family physicians.[17] There are approximately 150 rheumatologists (1.5 rheumatologists per 100,000 population), however, they are concentrated most heavily in southern Ontario[18], which may be a potential barrier to equitable, timely rheumatology care.[19] Accordingly, we set out to determine the percent of incident RA patients who saw a rheumatologist within 3, 6 and 12 months of suspected diagnosis by a family physician, and assessed what factors may influence the time frame with which patients are seen.

SUBJECTS AND METHODS:

Setting and Design. We performed a retrospective, population-based cohort study of newly diagnosed RA patients within Ontario, in which all residents are covered by universal public health insurance for

physician and hospital services. The study was approved by the Research Ethics Board at Sunnybrook Health Sciences Centre, Toronto, Canada.

Data sources. We used the Ontario Rheumatoid Arthritis administrative Database (ORAD), a population-based RA cohort generated from health administrative databases using a validated case definition. RA patients are included in ORAD if they have 3 Ontario Health Insurance (OHIP) physician service claims over a two-year period in which RA is the recorded diagnosis, with at least 1 of these claims made by a musculoskeletal specialist. ORAD has been validated and shown to have a high sensitivity (78%), specificity (100%), and positive predictive value (78%) for identifying RA patients based on medical record reviews.[20],[21] Validation of RA onset within administrative data has also shown to be highly accurate.[21] Records for individuals in ORAD are also linked to the following administrative datasets. The Ontario Registered Persons Database was used to identify demographic information on age, sex, place of residence, death, and emigration. Physician specialty was obtained by linking the Institute for Clinical Evaluative Sciences (ICES) Physician Database with the OHIP database.[22] We used the Client Agency Program Enrolment Database to identify the primary care delivery model of the family physician at the time the patient entered the cohort. These datasets are linked in an anonymous fashion using encrypted health insurance numbers for residents and encrypted license numbers for physicians, and they have very little missing information.[23]

Cohort definition. We identified all incident RA patients from April 1, 2000 to March 31, 2010. Analyses were restricted to patients whose initial RA diagnosis codes were assigned by a family physician in an outpatient setting. Cohort entry (suspected RA diagnosis date) was the date of the first RA diagnosis code, and patients were followed up until one year or until outmigration, death, or the end of study period.

Covariate information. Covariates for patient demographics included age, sex, socioeconomic status (SES), and year of suspected diagnosis. SES was defined as the patient's neighbourhood median household income quintile from the Statistics Canada Census. We also identified whether patients were subsequently admitted to hospital with an RA diagnosis following a primary care diagnosis, as patients who are seen in a hospital setting for their RA may have poorer access to health care providers and/or more severe disease. As a measure of co-morbidity, we used the Johns Hopkins Adjusted Diagnostic Groups (ADG) Case-Mix System derived from both outpatient and inpatient data in the two years preceding cohort entry.[24] We categorized ADGs into low (<5), moderate (5-9), and high co-morbidity (10+). We chose this risk adjustment method as patients using the most health care resources are not typically those with single diseases but rather those with multiple and sometimes unrelated conditions. This clustering of morbidity can be a better predictor of health care use than the presence of specific diseases.[25] Geographic characteristics included patient residence, regional health service planning areas (Local Health Integration Networks, LHINs[26]), rheumatology supply and distance to the closest rheumatologist. Rurality was based upon each patient's postal code and a community population size of less than 10,000. Rheumatology supply was defined as the number of rheumatologists per 100,000 adults in the planning area (LHIN) of patient residence, and distance to the closest rheumatologist was the linear distance from the centre of patient's postal code area to that of the closest rheumatologist, with 'remote residence' defined as 100 or more kilometers (km) to the nearest rheumatologist. Family physician characteristics included sex, years since graduation (as a proxy for experience), and type of primary care delivery model the family physician was working in at the time of patient's cohort entry. We categorized each practice type as (1) *blended capitation models* [Family Health Networks (FHNs), Family Health Organizations (FHOs), Family Health Teams (FHTs)], and (2) *enhanced fee-for-service models* (Family Health Groups or FHGs) and other groups and *traditional fee-for-service practitioners*.[27] The main difference between the models is how physicians are reimbursed (e.g., through age-and-sex-adjusted capitation payments versus being paid

on a per visit basis). Capitation models often include interdisciplinary teams involving allied healthcare providers and require physicians to maintain a list or 'roster' of enrolled patients to whom they are committed to providing primary care.[28] Including primary care model type enabled us to explore if there was an effect regarding different primary care practice models and/or how the physicians are paid as a facilitator to timely rheumatology care.

Outcome Measurements. We followed incident patients, determining whether they had a visit to a rheumatologist at three, six and 12 months.

Statistical analysis. Descriptive statistics were used to characterize the study population. We assessed secular trends (as the percentage of each annual incident RA cohort who saw a rheumatologist within each time period) and differences among patients who received vs. did not receive rheumatology care. We performed hierarchical logistic regression analyses to determine whether receipt of rheumatology care was associated with patient demographics, co-morbidity, geographic characteristics, and family physician characteristics. Crude and adjusted odds ratio (aOR) estimates with 95% confidence intervals (CIs) were generated. Separate analyses were performed for each outcome end date (benchmarks): three, six and 12 months.

All analyses were performed at the ICES on anonymized data using SAS version 9.2 (SAS Institute, Cary, North Carolina).

RESULTS:

Between 2000 and 2009, we identified 19,670 incident RA patients (figure 1). Overall, the mean (standard deviation, SD) age at time of cohort entry was 54 (16) years, 71% were female, 16% resided in rural areas and 5% resided in areas remote (≥100 km) from the nearest rheumatologist (table 1).

Most patients were seen by male family physicians (70%). Few (5%) physicians were practicing under a newer capitation model.

Over one year of follow-up, the average time from the first RA diagnosis code to first rheumatologist visit was 77 days (table 1). Over all, 59%, 75% and 84% of patients saw a rheumatologist within 3, 6 and 12 months, respectively. The prevalence of initial rheumatology encounters within 3 months did not increase over the study period. However, the percentage of patients who saw a rheumatologist within 6 and 12 months increased gradually over time, from 72% and 81% in 2000 to 81% and 89% in 2009, respectively (figure 2).

Table 2 compares the characteristics of patients who saw vs. did not see a rheumatologist within 3 months of cohort entry. More patients who were not seen by a rheumatologist lived in a rural area (19% vs 14%) and remote areas.

Independent determinants of receiving rheumatology care within 3 months of RA diagnosis are reported in Table 2. Factors associated with prompt rheumatology care included increasing rheumatology supply [aOR 1.35 (95% CI 1.13,1.60)] and higher patient SES [aOR 1.18 (95% CI 1.07,1.30)]. The strongest independent factor negatively associated with lower frequency of rheumatology visits was for patients who lived at remote distances to rheumatologists [aOR 0.51 (95% CI 0.41,0.64)]. The likelihood of not having prompt rheumatology consultations was also reduced for patients of male family physicians [aOR 0.87 (95% CI 0.81,0.95)]. There was no calendar-year effect illustrating an increasing likelihood of seeing a rheumatologist within 3 months over time. However, improvements over time were demonstrated for patients being seen by a rheumatologist within 6 and 12 months (table 3).

We observed similar associations when we studied the effects of factors on the odds of receiving rheumatology care within 6 and 12 months (table 3). The effect of proximity on access became stronger as the time to rheumatology visit was lengthened: 6 months, aOR 0.56 (95% CI 0.36,0.59); 12 months, aOR 0.33 (95% CI 0.26,0.43). Patients who were hospitalized for RA subsequent to an initial diagnosis in an outpatient primary care setting were almost half as likely to been seen by a rheumatologist at 6 and 12 months.

Discussion

In a publicly-funded universal healthcare system, we studied trends in encounters with rheumatologists over the past decade and observed increasing rates of access to rheumatologists within 6 months and 12 months after diagnosis by a family physician. However, no such improvements were observed among patients seen within 3 months, a more favorable benchmark. We also explored whether receipt of rheumatology care was associated with patient and family physician characteristics, and measures of rheumatology supply. We found that patients of higher SES were more likely to receive timely rheumatology care, which has also been demonstrated in other Canadian provinces.[29],[30] Further, proximity to and density of rheumatologists were important determinants of timely rheumatology care.

While our results appear encouraging, 41% of patients are still not seen within 3 months of a primary care diagnosis as recommended by current guidelines. Thus, an important proportion of patients are not receiving optimal care. When interpreting the results it is important to recognize that the delay in rheumatology consultation being studied represents only a proportion of the total delay from the onset of the patients' symptoms. While a previous study reported that the patient delay is very small relative to the family physician delay[31], in our study, it is unknown how long patients have symptoms before seeking medical care, or remain in primary care before their RA is recognized. Therefore the delays

between onset of symptoms to rheumatology care may be larger than reported here. Conversely, we are also unaware of the disease activity and functional status of the subgroup of patients who do not receive timely rheumatology care within three months. Recent data from a large early arthritis clinic indicated that 60% of patients had self-limited symptoms.[32] Therefore, a delay of three months in receipt of rheumatology care may not always be as deleterious to the likelihood of a good response or remission.[33]

Given the high economic impact of RA[34], rheumatologists are key to an integrated healthcare delivery system.[35] However, not all patients are receiving the right care at the right time. Delays in timely consultations may reflect the growing burden of RA relative to rheumatology supply. During our study period, the number of rheumatologists in Ontario remained relatively stable (1.5 rheumatologists per 100,000 population).[18 36] While most RA patients were seen by a rheumatologist within 1 year, delays in more timely benchmarks may also be indicative of the need to educate primary care physicians to initiate rheumatology referrals sooner. Ultimately, delays in access to timely, quality care and treatment result in increasing disability for RA patients as well as increasing costs to the healthcare system.[34]

Geographic variation in receipt of timely rheumatology care may be indicative of problems with access. Considering the geographic size and features of Ontario, approximately one-quarter of Ontarians resides in communities with 30,000 or fewer residents.[37] However, few rheumatologists practice in rural communities.[18] Consequently, the threshold for referral to rheumatologists may be higher in remote versus urban communities (i.e., rural patients who are referred have substantially more active disease than their urban counterparts).[36],[6] Thus, there is a need to address the low rheumatology supply among remote communities.

Additionally, there was a low likelihood of being seen by a rheumatologist within 6 or 12 months subsequent to a hospital encounter for RA after a patient was initially diagnosed in a primary care setting. In areas with few rheumatologists, family physicians may have no choice but to encourage patients to seek hospital-based specialty care. In addition, while most rheumatologists have a hospital appointment, not all hospitals have rheumatologists.[38] Thus, our findings reinforce the need for strategies to not only improve access to rheumatologists but also to encourage proper follow-up for these patients.

Our results showed that patients of female family physicians were more likely to receive rheumatology care earlier. While there is conflicting data on the influence of physician gender on practice styles,[39],[40] female physicians have been shown to engage in more preventive services and to communicate differently with their patients.[41] Male physicians may have more confidence in managing RA in primary care, such as starting glucocorticoids prior to rheumatology encounters. Similarly, patients have also reported to have more confidence in male physicians[42] and thus may be more hesitant to seek secondary care. Together, this may explain why RA patients of female family physicians are more likely to be seen by rheumatologists earlier and that the influence of physician gender was attenuated at 1-year post-initial RA diagnosis.

We also sought to evaluate the influence of primary care models on rheumatology encounters. We hypothesized that patients of capitation models, which involve interdisciplinary teams, allied health providers and where patient enrollment is most strongly encouraged, could improve continuity of care with their patients that could ultimately affect the quality of care that these patients receive. While we found no association, it may be too soon to determine an effect as many physicians changed models over time and few physicians were practicing under a capitation model during the study period.[43]

Strengths of our study include its large sample and the use of a validated population-based RA cohort.[21] Our main limitation is that our cohort definition requires patients to have had their first RA diagnosis code provided by a family physician (i.e. those whose physician strongly suspects that the patient has RA). While others have used this approach,[9] our analyses are likely restricted to patients with a more homogeneous clinical presentation (such as rheumatoid factor positive patients) or those with more active disease in which the family physician was able to accurately diagnose the condition and/or more likely to use an RA billing code as a reason for visit. Therefore we may be over-estimating the proportion of patients with timely rheumatology encounters. These related caveats are owing to the absence of both symptom onset and date of referral in health administrative databases. Future research is required to develop and validate algorithms to better predict RA onset from administrative data. However, previous researchers have also used physician service claims to sample RA patients from rheumatology practices in order to calculate wait times on a smaller scale, and these studies may be subjected to similar biases (inclusion of early RA patients with a more homogenous clinical presentation).[9],[44]

In conclusion, we found increasing access to rheumatologists within 6 and 12 months over time, however rheumatology encounters within 3 months did not change over time. Measures of poor access negatively impacted rates of encounters with a rheumatologist. Factors that contributed to disparities in rheumatology access included SES and physician sex. Strategies to facilitate more timely access, such as improving proximity to and density of rheumatologists along with family physician education on initiating more timely referrals, are acutely needed.

Figure legends

Figure 1. Flow diagram of selection of study participants

Figure 2: Percentage of patients with newly diagnosed RA who are seen by a rheumatologist within 3, 6 and 12 months of suspected diagnosis by a primary care physician.

Table 1: Selected cohort characteristics of 19,670 newly diagnosed RA patients that met our criteria

Characteristic	Newly diagnosed RA n=19,670
Patient Demographics	
Age at cohort entry, mean (SD)	53.7 (16.3)
Female, n (%)	14,091 (71.1)
Rural residence, n (%)	3,196 (16.2)
Patient Co-morbidity	
Number of Hopkins ADGs* in the 2 years prior to entry, n (%)	
< 5	5,229 (26.5)
5-9	9,790 (49.5)
10+	4,741 (24.0)
Rheumatology Access Measures	
Time (days) from first diagnosis code to first rheumatologist visit, mean (SD)	76.7 (76.9)
Time (days) from first diagnosis code to first rheumatologist visit, median (IQR)	50 (22-104)
Rheumatology supply per 100 000 adults†, mean (SD)	1.5 (1.1)
Distance to closest rheumatologist	
Kilometers, mean (SD)	24.2 (69.7)
Remote (≥100 km), n (%)	1,047 (5.3)
Primary care physician characteristics	
Male, n (%)	13,872 (70.2)
Years since graduation, mean (SD)	24.5 (10.5)
Practice type, n (%)	
Blended capitation models†† (FHO / FHN)	976 (4.9)
Traditional fee-for-service and enhanced fee-for-service (FHG/Other)	18,784 (95.1)

* Ambulatory diagnostic groups

†in patient Local Health Integration Networks, LHINs (regional health service planning areas)

††Practice types: *blended capitation models* [Family Health Networks (FHNs), Family Health Organizations (FHOs), Family Health Teams (FHTs), an interprofessional team model composed of FHNs and FHOs], *enhanced fee-for-service models* [Family Health Groups (FHGs) and other groups],

Table 2: Descriptive characteristics for RA patients that do and do not receive rheumatology care and influence of various factors on receipt of rheumatology care within THREE months of suspected diagnosis by a primary care physician

Characteristic	Seen by a rheumatologist		Multivariate analysis	
	Yes n=**11,694**	**No** N=**8,066**	**Crude OR*** [95% CI]**	**Adjusted† OR** [95% CI]
Demographics				
Age, mean (SD)	53.8 (15.9)	53.6 (16.7)	1.00 [1.00, 1.00]	1.00 [1.00, 1.00]
Male sex, n (%) [REF=Female]	3,341 (28.6)	2,328 (28.9)	1.01 [0.95, 1.07]	1.04 [0.97, 1.11]
Income quintile, n(%) [REF = 1 – low]	59 (0.5)	50 (0.6)	REF	REF
2	2,197 (18.8)	1,693 (21)	1.10 [1.00, 1.20]	1.08 [0.98, 1.18]
3	2,359 (20.2)	1,657 (20.5)	1.12 [1.03, 1.23]	1.11 [1.01, 1.22]
4	2,407 (20.6)	1,627 (20.2)	1.12 [1.02, 1.23]	1.09 [0.99, 1.20]
5	2,305 (19.7)	1,581 (19.6)	1.22 [1.11, 1.34]	1.18 [1.07, 1.30]
Calendar Year of Cohort Entry [REF=2000]				
2000	1,110	774	REF	REF
2001	1,110	768	0.99 [0.87, 1.13]	0.99 [0.87, 1.14]
2002	1,074	736	1.00 [0.87, 1.14]	1.00 [0.87, 1.15]
2003	1,154	830	0.96 [0.85, 1.10]	0.99 [0.87, 1.13]
2004	1,187	872	0.94 [0.83, 1.08]	0.99 [0.87, 1.14]
2005	1,231	828	1.05 [0.92, 1.20]	1.12 [0.98, 1.28]
2006	1,179	782	1.07 [0.94, 1.22]	1.13 [0.98, 1.29]
2007	1,237	818	1.07 [0.94, 1.23]	1.14 [0.99, 1.31]
2008	1,268	885	1.01 [0.89, 1.16]	1.10 [0.96, 1.26]
2009	1,144	773	1.03 [0.90, 1.18]	1.10 [0.95, 1.27]
Co-morbidity: Number of Hopkins ADGs in the 2 years prior to entry, n (%) (REF=<5)				
< 5	3,031 (25.9)	2,198 (27.3)	REF	REF
5-9	5,802 (49.6)	3,988 (49.4)	1.04 [0.97, 1.12]	1.04 [0.97, 1.12]
10+	2,861 (24.5)	1,880 (23.3)	1.08 [0.99, 1.18]	1.07 [0.98, 1.17]
Hospitalization for RA prior to rheumatologist visit / end of study period, n(%)	71 (0.6)	41 (0.5)	1.24 [0.84, 1.84]	1.34 [0.89, 2.02]
Geographic				
Patient Rural residence, n(%); [REF=urban]	1,636 (14.0)	1,560 (19.3)	0.70 [0.64, 0.76]	0.92 [0.83, 1.01]
Rheumatology supply per 100 000 adults, mean (SD)	1.6 (1.1)	1.4 (1.0)	1.16 [1.12, 1.19]	1.35 [1.13, 1.60]
Distance to rheumatologist (km), mean (SD)	17.8 (64.24)	33.6 (75.89)	n/a	n/a
Remote Distance (≥100 km to rheumatologist), n(%)	312 (2.7)	735 (9.1)	0.29 [0.25, 0.34]	0.51 [0.41, 0.64]
Primary Care physician				
Male sex, n (%) (REF=Female)	8,069 (69.0)	5,803 (71.9)	0.83 [0.77, 0.89]	0.87 [0.81, 0.95]
Years since graduation, mean (SD)	24.3 (10.48)	24.6 (10.53)	1.00 [0.99, 1.00]	1.00 [0.99, 1.00]
Practice type††, n (%) (REF=fee-for-service)				
Traditional and Enhanced fee-for-service	11,085 (94.8)	7,699 (95.5)	REF	REF
Blended capitation models	609 (5.2)	367 (4.5)	1.14 [0.98, 1.32]	1.15 [0.99, 1.34]

*OR = Odds Ratio; **95% CI = 95% confidence interval

†Adjusted for all covariates including: patient demographics, clinical factors, primary care physician characteristics, provider continuity, and geographic characteristics [including regional variation by regional health service planning areas Local Health Integration Networks (LHINs) not reported here.]

††Practice types: *blended capitation models* [Family Health Networks (FHNs), Family Health Organizations (FHOs), Family Health Teams (FHTs), an interprofessional team model composed of FHNs and FHOs], *enhanced fee-for-service models* [Family Health Groups (FHGs) and other groups], and *solo fee-for-service practitioners* (those who did not belong to a model).

Table 3: Influence of patient demographics, co-morbidity, geographic characteristics, and primary care physician characteristics on receipt of rheumatology care within 6 and 12 months

Characteristic	6 months		12 months	
	Crude OR* [95% CI]**	Adjusted† OR [95% CI]	Crude OR [95% CI]	Adjusted OR [95% CI]
Demographics				
Age, mean (± SD)	1.00 [1.00, 1.00]	1.00 [1.00, 1.00]	1.00 [1.00, 1.00]	1.00 [1.00, 1.00]
Male sex [REF=Female]	0.97 [0.90, 1.04]	0.98 [0.91, 1.06]	0.92 [0.85, 1.00]	0.94 [0.86, 1.02]
Income quintile [REF = 1 – low]	REF	REF	REF	REF
2	1.15 [1.04, 1.27]	1.14 [1.03, 1.26]	1.07 [0.96, 1.21]	1.06 [0.94, 1.20]
3	1.22 [1.10, 1.35]	1.20 [1.08, 1.33]	1.17 [1.04, 1.32]	**1.16 [1.03, 1.31]**
4	1.15 [1.04, 1.27]	1.11 [1.00, 1.24]	1.15 [1.02, 1.30]	1.12 [0.99, 1.27]
5	1.30 [1.17, 1.44]	1.26 [1.13, 1.40]	1.35 [1.19, 1.53]	**1.31 [1.15, 1.49]**
Calendar Year of Cohort Entry [REF=2000]	REF	REF	REF	REF
2001	1.07 [0.92, 1.23]	1.07 [0.92, 1.24]	1.13 [0.96, 1.34]	1.13 [0.95, 1.35]
2002	1.12 [0.97, 1.30]	1.12 [0.96, 1.31]	1.12 [0.95, 1.33]	1.14 [0.95, 1.36]
2003	1.19 [1.02, 1.38]	1.22 [1.04, 1.42]	1.18 [0.99, 1.40]	1.21 [1.01, 1.44]
2004	1.01 [0.87, 1.17]	1.04 [0.89, 1.21]	0.97 [0.82, 1.15]	1.01 [0.84, 1.20]
2005	1.15 [1.00, 1.34]	1.21 [1.04, 1.41]	1.22 [1.02, 1.45]	1.30 [1.08, 1.56]
2006	1.25 [1.07, 1.45]	1.30 [1.11, 1.52]	1.28 [1.07, 1.53]	1.33 [1.10, 1.60]
2007	1.29 [1.11, 1.50]	1.37 [1.17, 1.60]	1.33 [1.11, 1.59]	1.42 [1.18, 1.72]
2008	1.26 [1.09, 1.47]	1.35 [1.16, 1.58]	1.30 [1.09, 1.55]	1.41 [1.17, 1.70]
2009	1.42 [1.21, 1.66]	1.49 [1.26, 1.76]	1.83 [1.51, 2.22]	1.96 [1.60, 2.40]
Co-morbidity				
No. of Hopkins ADGs[REF=<5]	REF	REF	REF	REF
5-9	1.02 [0.94, 1.10]	1.03 [0.95, 1.12]	1.03 [0.94, 1.13]	1.07 [0.97, 1.18]
10+	1.02 [0.93, 1.12]	1.05 [0.95, 1.16]	1.04 [0.93, 1.16]	1.09 [0.97, 1.23]
Hospitalization for RA prior to rheumatologist visit / end of study period	0.60 [0.42, 0.85]	0.63 [0.44, 0.91]	0.51 [0.36, 0.71]	0.54 [0.38, 0.76]
Geographic				
Patient rural residence [REF=urban]	0.74 [0.68, 0.81]	1.00 [0.89, 1.11]	0.80 [0.72, 0.89]	1.09 [0.96, 1.24]
Rheumatology supply per 100 000 adults	1.15 [1.11, 1.20]	1.19 [0.97, 1.45]	1.16 [1.11, 1.22]	1.25 [0.98, 1.61]
Remote Distance (≥100 km to rheumatologist)	0.28 [0.24, 0.33]	0.46 [0.36, 0.59]	0.26 [0.22, 0.31]	0.33 [0.26, 0.43]
Primary Care physician				
Male sex [REF=Female]	0.81 [0.74, 0.89]	0.89 [0.81, 0.97]	0.81 [0.73, 0.90]	0.91 [0.81, 1.01]
Years since graduation	1.00 [0.99, 1.00]	0.99 [0.99, 1.00]	1.00 [0.99, 1.00]	0.99 [0.99, 1.00]
Practice type†† [REF=fee-for-service]				
Capitation model	1.22 [1.01, 1.47]	1.13 [0.93, 1.36]	1.22 [0.99, 1.51]	1.09 [0.87, 1.35]

*OR = Odds Ratio; **95% CI = 95% confidence interval †Adjusted for all covariates including: patient demographics, clinical factors, primary care physician characteristics, provider continuity, and geographic characteristics [including regional variation by regional health service planning areas Local Health Integration Networks (LHINs) not reported here.] ††Practice types: *blended capitation models* [Family Health Networks (FHNs), Family Health Organizations (FHOs), Family Health Teams (FHTs), an interprofessional team model composed of FHNs and FHOs], *enhanced fee-for-service models* [Family Health Groups (FHGs) and other groups], and traditional *fee-for-service*

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Contributorship Statement

All authors contributed substantially to conception and design, or acquisition of data, or analysis and interpretation of data and were involved in drafting the article and gave final approval of the version to be published.

Competing Interests

None

Data Sharing Statement

There are no additional unpublished data other than that presented in the manuscript. Questions regarding the data presented in the manuscript can be directed to the corresponding author.

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TITLE PAGE

TITLE: Access to rheumatologists among patients with newly diagnosed rheumatoid arthritis in a Canadian universal public health care system.

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ABSTRACT

Our objective was to estimate the percent of incident rheumatoid arthritis (RA) patients who saw a rheumatologist within 3, 6 and 12 months of suspected diagnosis by a family physician, and assess what factors may influence the time frame with which patients are seen.

Methods:

Over 2000-2009, we studied incident RA patients who were initially diagnosed by a family physician. We assessed secular trends in rheumatology encounters and differences between patients who saw vs. did not see a rheumatologist. We performed hierarchical logistic regression analyses to determine whether receipt of rheumatology care was associated with patient, primary care physician, and geographic factors.

Results:

Among 19,760 incident RA patients, 59%, 75% and 84% of patients saw a rheumatologist within 3, 6 and 12 months, respectively. The prevalence of initial consultations within 3 months did not increase over time, however, access within 6 and 12 months increased over time. Factors positively associated with timely consultations included higher regional rheumatology supply [adjusted Odds Ratio, aOR 1.35(95% CI 1.13,1.60)] and higher patient socioeconomic status [aOR 1.18(95%CI 1.07,1.30)]. Conversely, factors inversely associated with timely consultations included remote patient residence [aOR 0.51(95% CI 0.41,0.64)], and male family physicians [aOR 0.88(95% CI 0.81,0.95)].

Conclusion:

Increasing access to rheumatologists within 6 and 12 months occurred over time, however consultations within 3 months did not change over time. Measures of poor access (such as proximity to and density of rheumatologists) were negatively associated with timely consultations. Additional factors that contributed to disparities in access included patient socioeconomic status and physician sex.

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Article focus:

- In a large population-based cohort of patients with newly diagnosed rheumatoid arthritis (RA) in Canada, our study's aim was to determine the percent of incident RA patients who saw a rheumatologist within 3, 6 and 12 months of suspected diagnosis by a family physician, and assessed what factors may influence the time frame with which patients are seen.

Key messages:

- We found increasing access to rheumatologists within 6 and 12 months have occurred over time, however consultations within 3 months did not change over time.
- Overall, 41% of patients are still not seen within 3 months of a primary care diagnosis as recommended by current guidelines. Thus, an important proportion of patients are not receiving optimal care. However, we ~~only~~ studied only a proportion of the total delay from the onset of the patients' symptoms to rheumatology care. It is unknown how long patients have symptoms before seeking medical care, or remain in primary care before their RA is recognized. Therefore the delays between onset of symptoms to rheumatology care may be larger than reported here.
- Measures of poor access (such as proximity to and density of rheumatologists) were negatively associated with timely consultations. Additional factors that contributed to disparities in access included patient socioeconomic status and physician sex. Strategies to facilitate more timely access, such as improving proximity to and density of rheumatologists along with family physician education on initiating more timely referrals, are acutely needed.

Strengths and limitations of this study:

- Strengths of our study include its large sample and the use of a validated population-based RA cohort.
- Our main limitation is that our cohort definition requires patients whose family physician strongly suspects that the patient has RA, thus, our analyses are likely restricted to patients with a more homogeneous clinical presentation (such as rheumatoid factor positive patients) or those with more active disease.

Rheumatoid arthritis (RA) is a progressive inflammatory arthritis associated with joint damage and functional deterioration, work disability and premature mortality.[1] At disease onset, RA is considered an urgent medical condition[1 2] requiring prompt referral to a rheumatologist.[3-5] Timely rheumatology care is important as it increases early exposure to treatment,[6] improves patient outcomes,[7],[8] decreases the need for costly surgical interventions,[9] and thus reduces the global disease burden. Furthermore, the sooner a patient is seen and managed by rheumatologists results in superior clinical responses and increases the chance of disease remission[10],[11],[12],[13],[14] than if the same care is administered later in the disease course.[15]

In Canada, access to specialists often depends on referral by a family physician. For optimal RA care to occur, a patient must seek care by a family physician, who, in turn, must suspect RA and initiate referral to a rheumatologist, who will undertake the appropriate diagnostic tests and initiate early treatment.[16] Delays that occur at any of these stages prevent patients from receiving timely care.

Ontario has approximately 13 million residents and 10,000 family physicians.[17] There are approximately 150 rheumatologists (1.5 rheumatologists per 100,000 population), however, they are concentrated most heavily in southern Ontario[18], which may be a potential barrier to equitable, timely rheumatology care.[19] Accordingly, we set out to determine the percent of incident RA patients who saw a rheumatologist within 3, 6 and 12 months of suspected diagnosis by a family physician, and assessed what factors may influence the time frame with which patients are seen.

SUBJECTS AND METHODS:

Setting and Design. We performed a retrospective, population-based cohort study of newly diagnosed RA patients within Ontario, in which all residents are covered by universal public health insurance for

physician and hospital services. The study was approved by the Research Ethics Board at Sunnybrook Health Sciences Centre, Toronto, Canada.

Data sources. We used the Ontario Rheumatoid Arthritis administrative Database (ORAD), a population-based RA cohort generated from health administrative databases using a validated case definition. RA patients are included in ORAD if they have 3 Ontario Health Insurance (OHIP) physician service claims over a two-year period in which RA is the recorded diagnosis, with at least 1 of these claims made by a musculoskeletal specialist. ORAD has been validated and shown to have a high sensitivity (78%), specificity (100%), and positive predictive value (78%) for identifying RA patients based on medical record reviews.[20][21] Validation of RA onset within administrative data has also shown to be highly accurate.[21] Records for individuals in ORAD are also linked to the following administrative datasets. The Ontario Registered Persons Database was used to identify demographic information on age, sex, place of residence, death, and emigration. Physician specialty was obtained by linking the Institute for Clinical Evaluative Sciences (ICES) Physician Database with the OHIP database.[22] We used the Client Agency Program Enrolment Database to identify the primary care delivery model of the family physician at the time the patient entered the cohort. These datasets are linked in an anonymous fashion using encrypted health insurance numbers for residents and encrypted license numbers for physicians, and they have very little missing information.[23]

Cohort definition. We identified all incident RA patients from April 1, 2000 to March 31, 2010. Analyses were restricted to patients whose initial RA diagnosis codes were assigned by a family physician in an outpatient setting. Cohort entry (suspected RA diagnosis date) was the date of the first RA diagnosis code, and patients were followed up until one year or until outmigration, death, or the end of study period.

Covariate information. Covariates for patient demographics included age, sex, socioeconomic status (SES), and year of suspected diagnosis. SES was defined as the patient's neighbourhood median household income quintile from the Statistics Canada Census. We also identified whether patients were subsequently admitted to hospital with an RA diagnosis following a primary care diagnosis, as patients who are seen in a hospital setting for their RA may have poorer access to health care providers and/or more severe disease. As a measure of co-morbidity, we used the Johns Hopkins Adjusted Diagnostic Groups (ADG) Case-Mix System derived from both outpatient and inpatient data in the two years preceding cohort entry.[24] We categorized ADGs into low (<5), moderate (5-9), and high co-morbidity (10+). We chose this risk adjustment method as patients using the most health care resources are not typically those with single diseases but rather those with multiple and sometimes unrelated conditions. This clustering of morbidity can be a better predictor of health care use than the presence of specific diseases.[25] Geographic characteristics included patient residence, regional health service planning areas (Local Health Integration Networks, LHINs[26]), rheumatology supply and distance to the closest rheumatologist. Rurality was based upon each patient's postal code and a community population size of less than 10,000. Rheumatology supply was defined as the number of rheumatologists per 100,000 adults in the planning area (LHIN) of patient residence, and distance to the closest rheumatologist was the linear distance from the centre of patient's postal code area to that of the closest rheumatologist, with 'remote residence' defined as 100 or more kilometers (km) to the nearest rheumatologist. Family physician characteristics included sex, years since graduation (as a proxy for experience), and type of primary care delivery model the family physician was working in at the time of patient's cohort entry. We categorized each practice type as (1) *blended capitation models* [Family Health Networks (FHNs), Family Health Organizations (FHOs), Family Health Teams (FHTs)], and (2) *enhanced fee-for-service models* (Family Health Groups or FHGs) and other groups and *traditional fee-for-service practitioners*.[27] The main difference between the models is how physicians are reimbursed (e.g., through age-and-sex-adjusted capitation payments versus being paid

on a per visit basis). Capitation models often include interdisciplinary teams involving allied healthcare providers and require physicians to maintain a list or 'roster' of enrolled patients to whom they are committed to providing primary care.[28] Including primary care model type enabled us to explore if there was an effect regarding different primary care practice models and/or how the physicians are paid as a facilitator to timely rheumatology care.

Outcome Measurements. We followed incident patients, determining whether they had a visit to a rheumatologist at three, six and 12 months.

Statistical analysis. Descriptive statistics were used to characterize the study population. We assessed secular trends (as the percentage of each annual incident RA cohort who saw a rheumatologist within each time period) and differences among patients who received vs. did not receive rheumatology care. We performed hierarchical logistic regression analyses to determine whether receipt of rheumatology care was associated with patient demographics, co-morbidity, geographic characteristics, and family physician characteristics. Crude and adjusted odds ratio (aOR) estimates with 95% confidence intervals (CIs) were generated. Separate analyses were performed for each outcome end date (benchmarks): three, six and 12 months.

All analyses were performed at the ICES on anonymized data using SAS version 9.2 (SAS Institute, Cary, North Carolina).

RESULTS:

Between 2000 and 2009, we identified 19,670 incident RA patients (figure 1). Overall, the mean (standard deviation, SD) age at time of cohort entry was 54 (16) years, 71% were female, 16% resided in rural areas and 5% resided in areas remote (≥100 km) from the nearest rheumatologist (table 1).

Most patients were seen by male family physicians (70%). Few (5%) physicians were practicing under a newer capitation model.

Over one year of follow-up, the average time from the first RA diagnosis code to first rheumatologist visit was 77 days (table 1). Over all, 59%, 75% and 84% of patients saw a rheumatologist within 3, 6 and 12 months, respectively. The prevalence of initial rheumatology encounters within 3 months did not increase over the study period. However, the percentage of patients who saw a rheumatologist within 6 and 12 months increased gradually over time, from 72% and 81% in 2000 to 81% and 89% in 2009, respectively (figure 2).

Table 2 compares the characteristics of patients who saw vs. did not see a rheumatologist within 3 months of cohort entry. More patients who were not seen by a rheumatologist lived in a rural area (19% vs 14%) and remote areas.

Independent determinants of receiving rheumatology care within 3 months of RA diagnosis are reported in Table 2. Factors associated with prompt rheumatology care included increasing rheumatology supply [aOR 1.35 (95% CI 1.13,1.60)] and higher patient SES [aOR 1.18 (95% CI 1.07,1.30)]. The strongest independent factor negatively associated with lower frequency of rheumatology visits was for patients who lived at remote distances to rheumatologists [aOR 0.51 (95% CI 0.41,0.64)]. The likelihood of not having prompt rheumatology consultations was also reduced for patients of male family physicians [aOR 0.87 (95% CI 0.81,0.95)]. There was no calendar-year effect illustrating an increasing likelihood of seeing a rheumatologist within 3 months over time. However, improvements over time were demonstrated for patients being seen by a rheumatologist within 6 and 12 months (table 3).

We observed similar associations when we studied the effects of factors on the odds of receiving rheumatology care within 6 and 12 months (table 3). The effect of proximity on access became stronger as the time to rheumatology visit was lengthened: 6 months, aOR 0.56 (95% CI 0.36,0.59); 12 months, aOR 0.33 (95% CI 0.26,0.43). Patients who were hospitalized for RA subsequent to an initial diagnosis in an outpatient primary care setting were almost half as likely to been seen by a rheumatologist at 6 and 12 months.

Discussion

In a publicly-funded universal healthcare system, we studied trends in encounters with rheumatologists over the past decade and observed increasing rates of access to rheumatologists within 6 months and 12 months after diagnosis by a family physician. However, no such improvements were observed among patients seen within 3 months, a more favorable benchmark. We also explored whether receipt of rheumatology care was associated with patient and family physician characteristics, and measures of rheumatology supply. We found that patients of higher SES were more likely to receive timely rheumatology care, which has also been demonstrated in other Canadian provinces.[29][30] Further, proximity to and density of rheumatologists were important determinants of timely rheumatology care.

While our results appear encouraging, 41% of patients are still not seen within 3 months of a primary care diagnosis as recommended by current guidelines. Thus, an important proportion of patients are not receiving optimal care. When interpreting the results it is important to recognize that the delay in rheumatology consultation being studied represents only a proportion of the total delay from the onset of the patients' symptoms. While a previous study reported that the patient delay is very small relative to the family physician delay[31], in our study, it is unknown how long patients have symptoms before seeking medical care, or remain in primary care before their RA is recognized. Therefore the

delays between onset of symptoms to rheumatology care may be larger than reported here. Conversely, we are also unaware of the disease activity and functional status of the subgroup of patients who do not receive timely rheumatology care within three months. Recent data from a large early arthritis clinic indicated that 60% of patients had self-limited symptoms.[32] Therefore, a delay of three months in receipt of rheumatology care may not always be as deleterious to the likelihood of a good response or remission.[33]

Given the high economic impact of RA[34], rheumatologists are key to an integrated healthcare delivery system.[35] However, not all patients are receiving the right care at the right time. Delays in timely consultations may reflect the growing burden of RA relative to rheumatology supply. During our study period, the number of rheumatologists in Ontario remained relatively stable (1.5 rheumatologists per 100,000 population).[18 36] While most RA patients were seen by a rheumatologist within 1 year, delays in more timely benchmarks may also be indicative of the need to educate primary care physicians to initiate rheumatology referrals sooner. Ultimately, delays in access to timely, quality care and treatment result in increasing disability for RA patients as well as increasing costs to the healthcare system.[34]

Geographic variation in receipt of timely rheumatology care may be indicative of problems with access. Considering the geographic size and features of Ontario, approximately one-quarter of Ontarians resides in communities with 30,000 or fewer residents.[37] However, few rheumatologists practice in rural communities.[18] Consequently, the threshold for referral to rheumatologists may be higher in remote versus urban communities (i.e., rural patients who are referred have substantially more active disease than their urban counterparts).[36]'[6] Thus, there is a need to address the low rheumatology supply among remote communities.

Additionally, there was a low likelihood of being seen by a rheumatologist within 6 or 12 months subsequent to a hospital encounter for RA after a patient was initially diagnosed in a primary care setting. In areas with few rheumatologists, family physicians may have no choice but to encourage patients to seek hospital-based specialty care. In addition, while most rheumatologists have a hospital appointment, not all hospitals have rheumatologists.[38] Thus, our findings reinforce the need for strategies to not only improve access to rheumatologists but also to encourage proper follow-up for these patients.

Our results showed that patients of female family physicians were more likely to receive rheumatology care earlier. While there is conflicting data on the influence of physician gender on practice styles,[39][40] female physicians have been shown to engage in more preventive services and to communicate differently with their patients.[41] Male physicians may have more confidence in managing RA in primary care, such as starting glucocorticoids prior to rheumatology encounters. Similarly, patients have also reported to have more confidence in male physicians[42] and thus may be more hesitant to seek secondary care. Together, this may explain why RA patients of female family physicians are more likely to be seen by rheumatologists earlier and that the influence of physician gender was attenuated at 1-year post-initial RA diagnosis.

We also sought to evaluate the influence of primary care models on rheumatology encounters. We hypothesized that patients of capitation models, which involve interdisciplinary teams, allied health providers and where patient enrollment is most strongly encouraged, could improve continuity of care with their patients that could ultimately affect the quality of care that these patients receive. While we found no association, it may be too soon to determine an effect as many physicians changed models over time and few physicians were practicing under a capitation model during the study period.[43]

Strengths of our study include its large sample and the use of a validated population-based RA cohort.[21] Our main limitation is that our cohort definition requires patients to have had their first RA diagnosis code provided by a family physician (i.e. those whose physician strongly suspects that the patient has RA). While others have used this approach,[9] our analyses are likely restricted to patients with a more homogeneous clinical presentation (such as rheumatoid factor positive patients) or those with more active disease in which the family physician was able to accurately diagnose the condition and/or more likely to use an RA billing code as a reason for visit. Therefore we may be over-estimating the proportion of patients with timely rheumatology encounters. These related caveats are owing to the absence of both symptom onset and date of referral in health administrative databases. Future research is required to develop and validate algorithms to better predict RA onset from administrative data. However, previous researchers have also used physician service claims to sample RA patients from rheumatology practices in order to calculate wait times on a smaller scale, and these studies may be subjected to similar biases (inclusion of early RA patients with a more homogenous clinical presentation).[9],[44]

In conclusion, we found increasing access to rheumatologists within 6 and 12 months over time, however rheumatology encounters within 3 months did not change over time. Measures of poor access negatively impacted rates of encounters with a rheumatologist. Factors that contributed to disparities in rheumatology access included SES and physician sex. Strategies to facilitate more timely access, such as improving proximity to and density of rheumatologists along with family physician education on initiating more timely referrals, are acutely needed.

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This study was performed in the context on the Ontario Best Practices Research Initiative (OBRI), a unique collaboration of rheumatologists, primary care physicians, researchers, patients and other stakeholders seeking to improve the quality of care and clinical outcomes of patients with arthritis across the spectrum of care.
Dr. Tu holds a CIHR Fellowship Award in Primary Care Research (2011-2013). Dr. Ivers holds a CIHR Fellowship Award in Clinical Research and a Fellowship Award from the Department of Family and Community Medicine, University of Toronto. Dr. Bombardier holds a Canada Research Chair in Knowledge Transfer for Musculoskeletal Care (2002-2016) and a Pfizer Research Chair in Rheumatology.

Figure 1. Flow diagram of selection of study participants

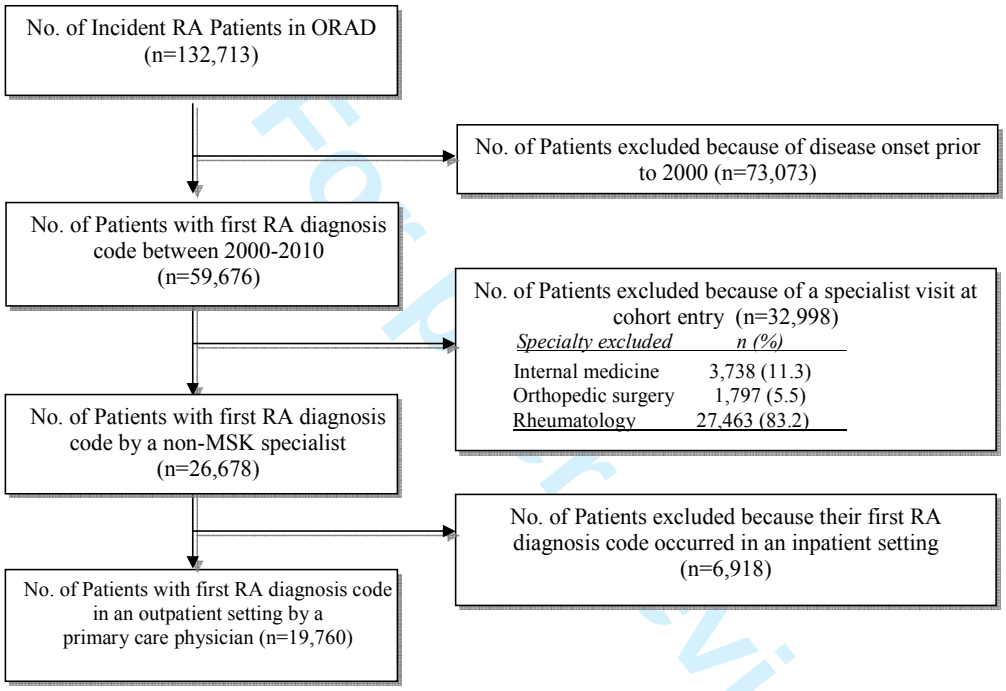

Figure 2: Percentage of patients with newly diagnosed RA who are seen by a rheumatologist within 3, 6 and 12 months of suspected diagnosis by a primary care physician.

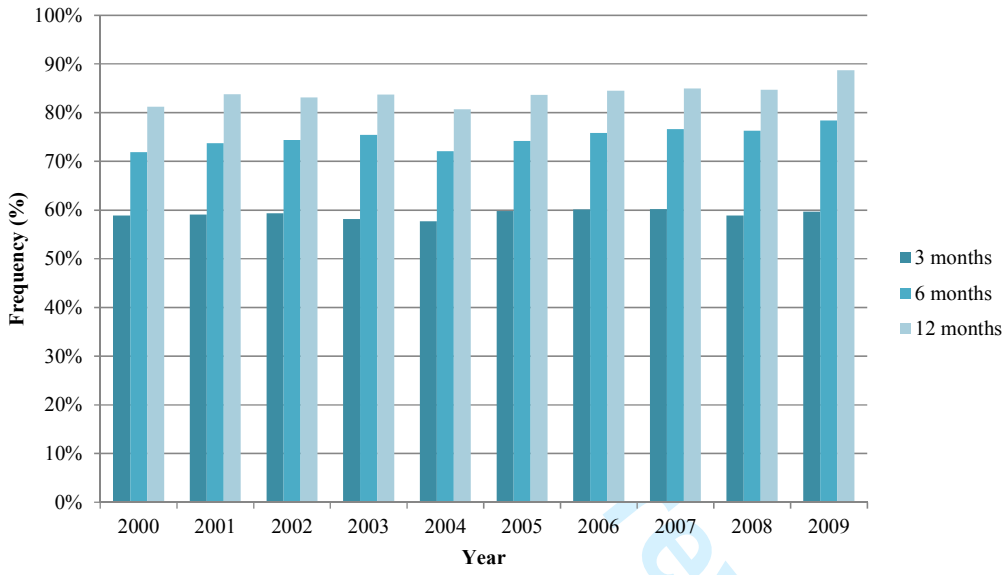

Table 1: Selected cohort characteristics of 19,670 newly diagnosed RA patients that met our criteria

Characteristic	Newly diagnosed RA n=19,670
Patient Demographics	
Age at cohort entry, mean (SD)	53.7 (16.3)
Female, n (%)	14,091 (71.1)
Rural residence, n (%)	3,196 (16.2)
Patient Co-morbidity	
Number of Hopkins ADGs* in the 2 years prior to entry, n (%)	
< 5	5,229 (26.5)
5-9	9,790 (49.5)
10+	4,741 (24.0)
Rheumatology Access Measures	
Time (days) from first diagnosis code to first rheumatologist visit, mean (SD)	76.7 (76.9)
Time (days) from first diagnosis code to first rheumatologist visit, median (IQR)	50 (22-104)
Rheumatology supply per 100 000 adults†, mean (SD)	1.5 (1.1)
Distance to closest rheumatologist	
Kilometers, mean (SD)	24.2 (69.7)
Remote (≥100 km), n (%)	1,047 (5.3)
Primary care physician characteristics	
Male, n (%)	13,872 (70.2)
Years since graduation, mean (SD)	24.5 (10.5)
Practice type, n (%)	
Blended capitation models†† (FHO / FHN)	976 (4.9)
Traditional fee-for-service and enhanced fee-for-service (FHG/Other)	18,784 (95.1)

* Ambulatory diagnostic groups

†in patient Local Health Integration Networks, LHINs (regional health service planning areas)

††Practice types: *blended capitation models* [Family Health Networks (FHNs), Family Health Organizations (FHOs), Family Health Teams (FHTs), an interprofessional team model composed of FHNs and FHOs], *enhanced fee-for-service models* [Family Health Groups (FHGs) and other groups],

Table 2: Descriptive characteristics for RA patients that do and do not receive rheumatology care and influence of various factors on receipt of rheumatology care within THREE months of suspected diagnosis by a primary care physician

Characteristic	Seen by a rheumatologist		Multivariate analysis	
	Yes n=**11,694**	No N=**8,066**	Crude OR* [95% CI]**	Adjusted† OR [95% CI]
Demographics				
Age, mean (SD)	53.8 (15.9)	53.6 (16.7)	1.00 [1.00, 1.00]	1.00 [1.00, 1.00]
Male sex, n (%) [REF=Female]	3,341 (28.6)	2,328 (28.9)	1.01 [0.95, 1.07]	1.04 [0.97, 1.11]
Income quintile, n(%) [REF = 1 – low]	59 (0.5)	50 (0.6)	REF	REF
2	2,197 (18.8)	1,693 (21)	1.10 [1.00, 1.20]	1.08 [0.98, 1.18]
3	2,359 (20.2)	1,657 (20.5)	1.12 [1.03, 1.23]	1.11 [1.01, 1.22]
4	2,407 (20.6)	1,627 (20.2)	1.12 [1.02, 1.23]	1.09 [0.99, 1.20]
5	2,305 (19.7)	1,581 (19.6)	1.22 [1.11, 1.34]	1.18 [1.07, 1.30]
Calendar Year of Cohort Entry [REF=2000]				
2000	1,110	774	REF	REF
2001	1,110	768	0.99 [0.87, 1.13]	0.99 [0.87, 1.14]
2002	1,074	736	1.00 [0.87, 1.14]	1.00 [0.87, 1.15]
2003	1,154	830	0.96 [0.85, 1.10]	0.99 [0.87, 1.13]
2004	1,187	872	0.94 [0.83, 1.08]	0.99 [0.87, 1.14]
2005	1,231	828	1.05 [0.92, 1.20]	1.12 [0.98, 1.28]
2006	1,179	782	1.07 [0.94, 1.22]	1.13 [0.98, 1.29]
2007	1,237	818	1.07 [0.94, 1.23]	1.14 [0.99, 1.31]
2008	1,268	885	1.01 [0.89, 1.16]	1.10 [0.96, 1.26]
2009	1,144	773	1.03 [0.90, 1.18]	1.10 [0.95, 1.27]
Co-morbidity: Number of Hopkins ADGs in the 2 years prior to entry, n (%) (REF=<5)				
< 5	3,031 (25.9)	2,198 (27.3)	REF	REF
5-9	5,802 (49.6)	3,988 (49.4)	1.04 [0.97, 1.12]	1.04 [0.97, 1.12]
10+	2,861 (24.5)	1,880 (23.3)	1.08 [0.99, 1.18]	1.07 [0.98, 1.17]
Hospitalization for RA prior to rheumatologist visit / end of study period, n(%)	71 (0.6)	41 (0.5)	1.24 [0.84, 1.84]	1.34 [0.89, 2.02]
Geographic				
Patient Rural residence, n(%); [REF=urban]	1,636 (14.0)	1,560 (19.3)	0.70 [0.64, 0.76]	0.92 [0.83, 1.01]
Rheumatology supply per 100 000 adults, mean (SD)	1.6 (1.1)	1.4 (1.0)	1.16 [1.12, 1.19]	1.35 [1.13, 1.60]
Distance to rheumatologist (km), mean (SD)	17.8 (64.24)	33.6 (75.89)	n/a	n/a
Remote Distance (≥100 km to rheumatologist), n(%)	312 (2.7)	735 (9.1)	0.29 [0.25, 0.34]	0.51 [0.41, 0.64]
Primary Care physician				
Male sex, n (%) (REF=Female)	8,069 (69.0)	5,803 (71.9)	0.83 [0.77, 0.89]	0.87 [0.81, 0.95]
Years since graduation, mean (SD)	24.3 (10.48)	24.6 (10.53)	1.00 [0.99, 1.00]	1.00 [0.99, 1.00]
Practice type††, n (%) (REF=fee-for-service)				
Traditional and Enhanced fee-for-service	11,085 (94.8)	7,699 (95.5)	REF	REF
Blended capitation models	609 (5.2)	367 (4.5)	1.14 [0.98, 1.32]	1.15 [0.99, 1.34]

*OR = Odds Ratio; **95% CI = 95% confidence interval

†Adjusted for all covariates including: patient demographics, clinical factors, primary care physician characteristics, provider continuity, and geographic characteristics [including regional variation by regional health service planning areas Local Health Integration Networks (LHINs) not reported here.]

††Practice types: *blended capitation models* [Family Health Networks (FHNs), Family Health Organizations (FHOs), Family Health Teams (FHTs), an interprofessional team model composed of FHNs and FHOs], *enhanced fee-for-service models* [Family Health Groups (FHGs) and other groups], and *solo fee-for-service practitioners* (those who did not belong to a model).

Table 3: Influence of patient demographics, co-morbidity, geographic characteristics, and primary care physician characteristics on receipt of rheumatology care within 6 and 12 months

Characteristic	6 months		12 months	
	Crude OR* [95% CI]**	**Adjusted† OR** [95% CI]	**Crude OR** [95% CI]	**Adjusted OR** [95% CI]
Demographics				
Age, mean (± SD)	1.00 [1.00, 1.00]	1.00 [1.00, 1.00]	1.00 [1.00, 1.00]	1.00 [1.00, 1.00]
Male sex [REF=Female]	0.97 [0.90, 1.04]	0.98 [0.91, 1.06]	0.92 [0.85, 1.00]	0.94 [0.86, 1.02]
Income quintile [REF = 1 – low]	REF	REF	REF	REF
2	1.15 [1.04, 1.27]	1.14 [1.03, 1.26]	1.07 [0.96, 1.21]	1.06 [0.94, 1.20]
3	1.22 [1.10, 1.35]	1.20 [1.08, 1.33]	1.17 [1.04, 1.32]	**1.16 [1.03, 1.31]**
4	1.15 [1.04, 1.27]	1.11 [1.00, 1.24]	1.15 [1.02, 1.30]	1.12 [0.99, 1.27]
5	1.30 [1.17, 1.44]	1.26 [1.13, 1.40]	1.35 [1.19, 1.53]	**1.31 [1.15, 1.49]**
Calendar Year of Cohort Entry [REF=2000]	REF	REF	REF	REF
2001	1.07 [0.92, 1.23]	1.07 [0.92, 1.24]	1.13 [0.96, 1.34]	1.13 [0.95, 1.35]
2002	1.12 [0.97, 1.30]	1.12 [0.96, 1.31]	1.12 [0.95, 1.33]	1.14 [0.95, 1.36]
2003	1.19 [1.02, 1.38]	1.22 [1.04, 1.42]	1.18 [0.99, 1.40]	1.21 [1.01, 1.44]
2004	1.01 [0.87, 1.17]	1.04 [0.89, 1.21]	0.97 [0.82, 1.15]	1.01 [0.84, 1.20]
2005	1.15 [1.00, 1.34]	1.21 [1.04, 1.41]	1.22 [1.02, 1.45]	1.30 [1.08, 1.56]
2006	1.25 [1.07, 1.45]	1.30 [1.11, 1.52]	1.28 [1.07, 1.53]	1.33 [1.10, 1.60]
2007	1.29 [1.11, 1.50]	1.37 [1.17, 1.60]	1.33 [1.11, 1.59]	1.42 [1.18, 1.72]
2008	1.26 [1.09, 1.47]	1.35 [1.16, 1.58]	1.30 [1.09, 1.55]	1.41 [1.17, 1.70]
2009	1.42 [1.21, 1.66]	1.49 [1.26, 1.76]	1.83 [1.51, 2.22]	1.96 [1.60, 2.40]
Co-morbidity				
No. of Hopkins ADGs[REF=<5]	REF	REF	REF	REF
5-9	1.02 [0.94, 1.10]	1.03 [0.95, 1.12]	1.03 [0.94, 1.13]	1.07 [0.97, 1.18]
10+	1.02 [0.93, 1.12]	1.05 [0.95, 1.16]	1.04 [0.93, 1.16]	1.09 [0.97, 1.23]
Hospitalization for RA prior to rheumatologist visit / end of study period	0.60 [0.42, 0.85]	0.63 [0.44, 0.91]	0.51 [0.36, 0.71]	0.54 [0.38, 0.76]
Geographic				
Patient rural residence [REF=urban]	0.74 [0.68, 0.81]	1.00 [0.89, 1.11]	0.80 [0.72, 0.89]	1.09 [0.96, 1.24]
Rheumatology supply per 100 000 adults	1.15 [1.11, 1.20]	1.19 [0.97, 1.45]	1.16 [1.11, 1.22]	1.25 [0.98, 1.61]
Remote Distance (≥100 km to rheumatologist)	0.28 [0.24, 0.33]	0.46 [0.36, 0.59]	0.26 [0.22, 0.31]	0.33 [0.26, 0.43]
Primary Care physician				
Male sex [REF=Female]	0.81 [0.74, 0.89]	0.89 [0.81, 0.97]	0.81 [0.73, 0.90]	0.91 [0.81, 1.01]
Years since graduation	1.00 [0.99, 1.00]	0.99 [0.99, 1.00]	1.00 [0.99, 1.00]	0.99 [0.99, 1.00]
Practice type†† [REF=fee-for-service]				
Capitation model	1.22 [1.01, 1.47]	1.13 [0.93, 1.36]	1.22 [0.99, 1.51]	1.09 [0.87, 1.35]

*OR = Odds Ratio; **95% CI = 95% confidence interval †Adjusted for all covariates including: patient demographics, clinical factors, primary care physician characteristics, provider continuity, and geographic characteristics [including regional variation by regional health service planning areas Local Health Integration Networks (LHINs) not reported here.] ††Practice types: *blended capitation models* [Family Health Networks (FHNs), Family Health Organizations (FHOs), Family Health Teams (FHTs), an interprofessional team model composed of FHNs and FHOs], *enhanced fee-for-service models* [Family Health Groups (FHGs) and other groups], and traditional *fee-for-service*

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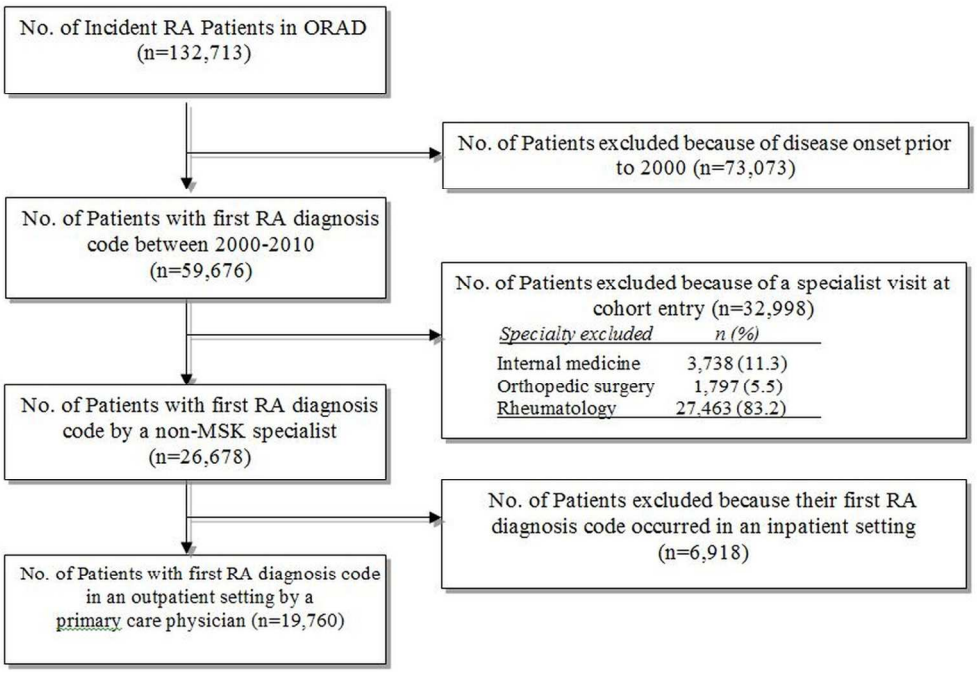

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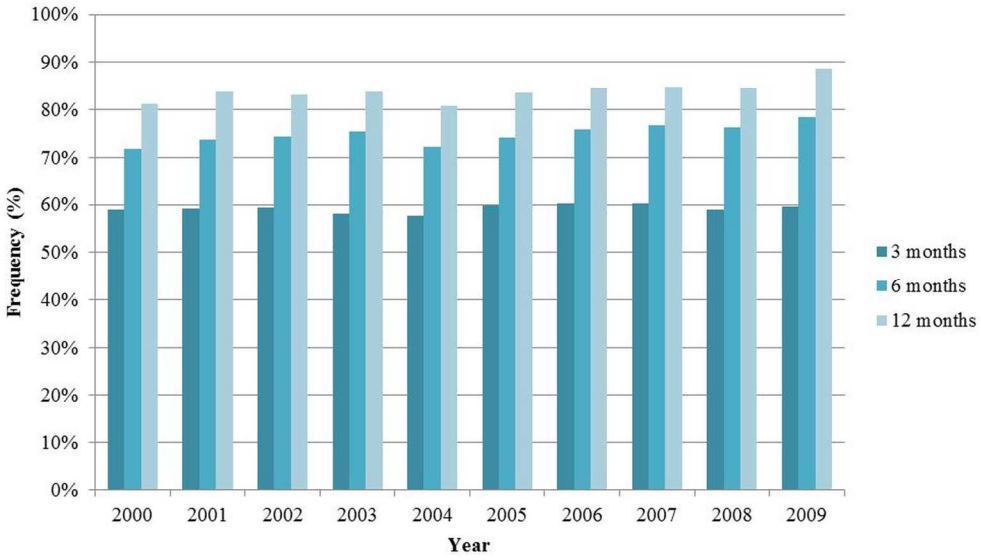

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STROBE Statement—Checklist of items that should be included in reports of ***cohort studies***

	Item No	Recommendation
Title and abstract	1	√(*a*) Indicate the study's design with a commonly used term in the title or the abstract
		√(*b*) Provide in the abstract an informative and balanced summary of what was done and what was found
Introduction		
Background/rationale	2	√Explain the scientific background and rationale for the investigation being reported
Objectives	3	√State specific objectives, including any prespecified hypotheses
Methods		
Study design	4	√Present key elements of study design early in the paper
Setting	5	√Describe the setting, locations, and relevant dates, including periods of recruitment, exposure, follow-up, and data collection
Participants	6	√(*a*) Give the eligibility criteria, and the sources and methods of selection of participants. Describe methods of follow-up
		(*b*) For matched studies, give matching criteria and number of exposed and unexposed
Variables	7	√Clearly define all outcomes, exposures, predictors, potential confounders, and effect modifiers. Give diagnostic criteria, if applicable
Data sources/ measurement	8*	√ For each variable of interest, give sources of data and details of methods of assessment (measurement). Describe comparability of assessment methods if there is more than one group
Bias	9	√Describe any efforts to address potential sources of bias
Study size	10	Explain how the study size was arrived at n/a – population-based study
Quantitative variables	11	√Explain how quantitative variables were handled in the analyses. If applicable, describe which groupings were chosen and why
Statistical methods	12	√(*a*) Describe all statistical methods, including those used to control for confounding
		√(*b*) Describe any methods used to examine subgroups and interactions
		(*c*) Explain how missing data were addressed
		√(*d*) If applicable, explain how loss to follow-up was addressed
		√(*e*) Describe any sensitivity analyses
Results		
Participants	13*	√(a) Report numbers of individuals at each stage of study—eg numbers potentially eligible, examined for eligibility, confirmed eligible, included in the study, completing follow-up, and analysed
		(b) Give reasons for non-participation at each stage n/a
		√(c) Consider use of a flow diagram
Descriptive data	14*	√(a) Give characteristics of study participants (eg demographic, clinical, social) and information on exposures and potential confounders
		(b) Indicate number of participants with missing data for each variable of interest
		(c) Summarise follow-up time (eg, average and total amount)
Outcome data	15*	√Report numbers of outcome events or summary measures over time
Main results	16	√(*a*) Give unadjusted estimates and, if applicable, confounder-adjusted estimates and their precision (eg, 95% confidence interval). Make clear which confounders were adjusted for and why they were included

		√(*b*) Report category boundaries when continuous variables were categorized
		(*c*) If relevant, consider translating estimates of relative risk into absolute risk for a meaningful time period
Other analyses	17	√Report other analyses done—eg analyses of subgroups and interactions, and sensitivity analyses
Discussion		
Key results	18	√Summarise key results with reference to study objectives
Limitations	19	√Discuss limitations of the study, taking into account sources of potential bias or imprecision. Discuss both direction and magnitude of any potential bias
Interpretation	20	√Give a cautious overall interpretation of results considering objectives, limitations, multiplicity of analyses, results from similar studies, and other relevant evidence
Generalisability	21	√Discuss the generalisability (external validity) of the study results
Other information		
Funding	22	√Give the source of funding and the role of the funders for the present study and, if applicable, for the original study on which the present article is based

*Give information separately for exposed and unexposed groups.

Note: An Explanation and Elaboration article discusses each checklist item and gives methodological background and published examples of transparent reporting. The STROBE checklist is best used in conjunction with this article (freely available on the Web sites of PLoS Medicine at http://www.plosmedicine.org/, Annals of Internal Medicine at http://www.annals.org/, and Epidemiology at http://www.epidem.com/). Information on the STROBE Initiative is available at http://www.strobe-statement.org.