

A Longitudinal Study of Ambulatory Physician Encounters, Emergency Room Visits, and Hospitalizations by Patients with Rheumatoid Arthritis: A 13-year Population Health Study

John G. Hanly, Kara Thompson, and Chris Skedgel

ABSTRACT. *Objective.* To determine total physician encounters, emergency room (ER) visits, and hospitalizations in an incident cohort of rheumatoid arthritis (RA) cases and matched control patients over 13 years. *Methods.* A retrospective cohort study was performed using administrative healthcare data from about 1 million people with access to universal healthcare. Using the International Classification of Diseases, 9th ed (ICD-9) and ICD-10 diagnostic codes, 7 RA case definitions were used. Each case was matched by age and sex to 4 randomly selected controls. Data included physician billings, ER visits, and hospital discharges over 13 years. *Results.* The number of incident RA cases varied from 3497 to 27,694, depending on the case definition. The mean age varied from 54.3 to 65.0 years, and the proportion of women from 67.8% to 71.3%. The number of physician encounters by patients with RA was significantly higher than by controls. It was highest in the index year and declined promptly thereafter for all case definitions and by 12.2%–46.8% after 10 years. Encounters with subspecialty physicians fell by 61% (rheumatologists) and 34% (internal medicine). In contrast, clinical encounters with family physicians and other physicians fell by only 9%. Visits to the ER and hospital admissions were also significantly higher in RA cases, particularly early in the disease, and fell significantly over the followup. *Conclusion.* In patients with RA, healthcare use is highest in the first year following the diagnosis, which is also the time of maximal involvement by rheumatologists. Use declines over time, and encounters with patients' family physicians predominate over other physician groups. (J Rheumatol First Release August 1 2017; doi:10.3899/jrheum.170056)

Key Indexing Terms:

RHEUMATOID ARTHRITIS

HEALTHCARE USE

Rheumatoid arthritis (RA) is the most frequent chronic autoimmune inflammatory rheumatic disease, with a higher frequency in women. Although it has the potential to affect

any organ system in the body, the predominant manifestations are in the musculoskeletal system. This inflammatory arthropathy runs a variable and unpredictable course, but usually leads to significant morbidity and premature mortality if left untreated. The clinical outcome for both mild and severe cases is improved by a prompt and accurate diagnosis, appropriate access to healthcare providers, and institution of evidence-based treatments.

Planning for the provision of future health resources required for the diagnosis and treatment of patients with RA starts with an assessment of previous and current resource use. Different research methodologies have been used to address this, including case-control strategies in tertiary referral centers¹, observational cohorts^{2,3}, and mining of population health administrative datasets^{4,5,6}. Resource use and associated costs have been examined in various geographic locations including the United States^{1,7}, Canada^{5,8}, and other countries^{2,9}. This is appropriate because findings are influenced by healthcare system delivery, which is highly variable. Due to the rapid pace of reform of healthcare delivery and the chronicity of RA, which extends over a patient's lifetime, it is necessary to periodically update

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use in representative geographic locations. As part of an overall evaluation of healthcare resource use by patients with RA in our region, we examined the clinical encounters with primary care and subspecialty physicians, emergency room (ER) visits, and hospitalizations in RA and control patients over 13 years using a validated population health dataset.

MATERIALS AND METHODS

Study populations and controls. This was a retrospective cohort study of patients with a diagnosis of RA within the Nova Scotia Medical Services Insurance (MSI) program. Nova Scotia is a Canadian province of about 1 million inhabitants. There are 3500 physicians in Nova Scotia, of whom about 50% work in primary care, 7% are general internists, and 0.3% are adult rheumatologists. Healthcare services including acute and elective hospitalizations, and ambulatory physician visits are universally provided as specified under the Canada Health Act. The eligible population for the study was Nova Scotia residents who were enrolled in the MSI program between April 1, 1997, and March 31, 2011. This excludes First Nation Canadians and members of the Canadian armed forces. Incident cases of RA were defined as those without a physician billing for the same diagnosis in the 5 years preceding 1997⁵. Prevalent cases included both incident and non-incident cases. Patients with RA were matched 1 to 4 by age and sex to a control cohort of patients who were also enrolled in the MSI program at the time of their matched case's date of diagnosis and who never had a diagnosis of RA or other connective tissue disease (CTD).

The data were obtained from existing databases accessed through the Population Health Research Unit [PHRU; now Health Data Nova Scotia (HDNS)] in the Department of Community Health and Epidemiology at Dalhousie University in Halifax, Nova Scotia, Canada. Within this unit there are secure research computing facilities on site, and access to data is governed by PHRU/HDNS Data Access Guidelines and Procedures. Electronic use data from the Nova Scotia Senior Pharmacare Program for seniors (age ≥ 65), the Canadian Institute of Health Information (CIHI) Hospital Discharge Abstracts database, and the MSI Physician Billings database were linked through the MSI number. The study protocol was reviewed and approved by the Capital Health (now Nova Scotia Health Authority, central zone) Research Ethics Board (CDHA-RS/2010-118). Informed consent from individual patients was not required because the study used secondary administrative data.

Case definitions for identification of RA cases and validation. The following 7 individual case definitions, 3 of which are based upon previously published work, were used to identify cases of RA in the administrative databases. We have previously validated these case definitions against a clinical dataset of patients with RA and controls¹⁰. The diversity of the decision rules provides a range of sensitivity and specificity for case ascertainment, thus permitting a sensitivity analysis of healthcare use.

1. Any encounter: Any single diagnostic code for RA by a physician.
2. MacLean, *et al*¹¹: Two physician visits for RA at least 2 months apart.
3. MacLean/Lacaille, *et al*⁵: MacLean-like algorithm with Lacaille variation; excluded individuals with at least 2 visits, at least 2 months apart, subsequent to the second RA visit, with 2 identical diagnoses of other inflammatory arthritides and CTD [psoriatic arthritis (PsA), ankylosing spondylitis (AS), and other spondyloarthropathies (SpA), systemic lupus erythematosus (SLE), scleroderma, Sjögren syndrome (SS), dermatomyositis (DM), polymyositis (PM), other CTD, primary systemic vasculitis], and those where a diagnosis of RA by a non-rheumatologist was not confirmed if/when the individual saw a rheumatologist.
4. Shipton-like: Three RA diagnostic billing codes, over any time period, rather than in 3 consecutive years as described by Shipton, *et al*¹².
5. Hospitalization: At least 1 hospitalization in which RA was in the diagnostic codes.
6. Rheumatologist: At least 1 RA code contributed by a rheumatologist.
7. Combination: MacLean-like algorithm (2 non-rheumatology

physician visits for RA at least 2 mos apart, within a 2-yr period) or at least 1 RA code contributed by a rheumatologist or at least 1 hospitalization where RA was in the diagnostic codes and Lacaille variation, i.e., excluding individuals with at least 2 visits, at least 2 months apart, subsequent to the second visit, with 2 identical diagnoses of other inflammatory arthritides and CTD (PsA, AS, and other SpA, SLE, scleroderma, SS, DM, PM, other CTD, primary systemic vasculitis) and excluding those in whom a diagnosis of RA by a non-rheumatologist was not confirmed if/when the individual saw a rheumatologist.

Data collection. Individual level data were obtained. Computerized claims were linked by encrypted health card number to the CIHI Hospital Discharge Abstracts and MSI Physician Billings for fiscal years from April 1, 1997, to March 31, 2011.

The following International Classification of Diseases, 9th ed (ICD-9) and ICD-10 diagnostic codes were used:

- RA (ICD-9: 714.0, 714.1, 714.2. ICD-10: MO5–MO5.9, MO6.0, MO6.8, MO6.9)
- PsA (ICD-9: 696.0. ICD-10: L40.5)
- AS (ICD-9: 720.0. ICD-10: M45)
- Other SpA (ICD-9: 720.1, 720.2, 720.8, 720.9. ICD-10: M46.0, M46.1, M46.2, M46.3, M46.4, M46.5, M46.8, M46.9)
- SLE (ICD-9: 710.0. ICD-10: M32, M32.1, M32.8, M32.9)
- Scleroderma (ICD-9: 710.1. ICD-10: M34)
- SS (ICD-9: 710.2. ICD-10: M35.0)
- DM (ICD-9: 710.3. ICD-10: M33.1, M33.9)
- PM (ICD-9: 710.4. ICD-10: M33.2)
- Other CTD (ICD-9: 710.5, 710.8, 710.9. ICD-10: M35.1, M35.2, M35.8, M35.9)
- Primary systemic vasculitis: (ICD-9: 446.0, 446.2, 446.4, 446.5, 446.7, 447.6. ICD-10: D69.0, M31.0, M30.0, M31.3, M31.4, M31.5, M31.6, M31.7, M31.8, M31.9).

Using chapter sections from ICD manuals, selected comorbidities over the study period were expressed as a proportion of affected RA cases and controls using the following ICD-9 and ICD-10 diagnostic codes:

- Cancer: all malignancies except lymphoma (ICD-9: 140–208, excluding 200–203. ICD-10: C00–D48, excluding C81–C85)
- Coronary heart disease (CHD; ICD-9: 410–414. ICD-10: I20–I25)
- Cardiovascular disease (CVD) excluding CHD (ICD-9: 390–459, excluding 410–414. ICD-10: I100–I99, excluding I20–I25)
- Diabetes (ICD-9: 250. ICD-10: E10–E14)
- Infection (ICD-9: 001–139, 465, 480–488. ICD-10: A00–B99, J06, J10–J18)
- Lymphoma (ICD-9: 200–203. ICD-10: C81–C85)
- Mental health (ICD-9: 290–319. ICD-10: F00–F99)
- Renal impairment (ICD-9: 580–589. ICD-10: N00–N19)

Statistical analysis. The data were analyzed with SAS software v8.3 and SAS/Stat software 12.1 v9.3 (SAS Institute Inc.). Descriptive statistics were used to characterize the RA and control cohorts and variables included age, sex, number of ambulatory visits, number of ER visits, number of hospitalizations, and diagnosing physician groups. Censorship of data was addressed by using patient-year exposures, which was defined by each individual's use or eligibility for use in number of years between their incident diagnosis or matching and the last contact with the health service (i.e., physician contact, ER visit, and hospitalization). Linear regression and negative binomial models at the aggregate data level were run to examine differences in use between cases and controls and use over time. Models were also adjusted for the interaction of index year of use and case/control group. The log of patient-year exposure was used as the offset in negative binomial models. The relationship between individual comorbidities and case definition group was examined using the chi-square test for independence. The analysis was run separately for each case definition. Finally, multivariate models were run to investigate the relative effects of covariates on use measures. Age, sex, year of diagnosis, comorbidities, and access to care as measured by rural residence were modeled. Rural was identified as having a residential postal

code with a "0" as the second character. All observations for each year were pooled with a dummy included to distinguish cases versus controls. This analysis was run for the combination case definition (#7) only.

RESULTS

Patients and controls. The number of RA cases identified in the administrative datasets and available for study over the 13 years of observation varied with the 7 case definitions used (Table 1). As previously described¹⁰, the definition with the greatest sensitivity was #1 (a single encounter with any physician) and the most specific definition was #5 (hospitalization for which RA was listed as one of the diagnostic codes). Using these 2 definitions, the number of incident cases of RA varied from 3497 to 27,694, and the number of prevalent cases varied from 15,328 to 81,866 over the period of study. Cases had a comparable mean age and sex distribution regardless of the case definition for patients with RA with the exception of patients identified through a hospital admission (case definition #5; Table 1), who were older. There was no significant difference between RA cases and controls in the number of patient-year exposures.

Physician consultations. Starting from the index year (i.e., yr of diagnosis of RA in this incident cohort), the number of physician encounters per patient per year for cases and controls over the duration of followup is illustrated in Figure 1. RA cases were identified using the 7 case definitions for RA. Use reflects the combination of outpatient ambulatory assessments and inpatient consultations by family physicians, general internists, rheumatologists, and other physician groups. For all case definitions, there was significantly higher

use by RA cases compared to controls ($p < 0.001$). In RA cases, the use was highest in the index year and fell thereafter. There was a significant fall in use by RA cases over time ($p < 0.001$) with all case definitions. For 4 RA case definitions, the use curves dipped substantially during the last 3 years of observation. The same observation occurred for the matched control group which suggests that the cause was unrelated to RA.

The breakdown in physician encounters by specialty group and the change over time is illustrated in Figure 2 using RA case definition #7 (Combination). For all case definitions, the use of all physician groups was significantly higher for RA cases than for their matched controls ($p < 0.01$). This was apparent both at the initial encounter and over time. There was a significant fall in the use of all physician groups by RA cases over time ($p < 0.001$) with all case definitions, with the exception of use of other physician groups using case definition #1. Subspecialty encounters were most frequent early in the disease course, and by the fourth assessment the frequency fell by 61% (rheumatologists), 34% (internal medicine), and 14% (other physicians). In contrast, the frequency of visits to family physicians fell by only 9% over the same time and remained high for the duration of the study. **ER visits.** Use of the ER by RA cases and controls is illustrated in Figure 3. Regardless of which case definition for RA was used, visits to the ER were significantly more frequent by RA cases ($p < 0.001$), which was most apparent early in the disease. There was a significant fall in emergency visits by RA cases over time ($p < 0.01$) with all case definitions.

Table 1. The percentage of RA incident cases and controls with selected comorbidities.

Variables	Any Encounter	Maclean, <i>et al</i> ¹¹	MacLean/Lacaille ⁵	Shipton, <i>et al</i> ¹²	Rheumatologist	Hospital	Combination
Cases, n	27,694	13,344	4726	12,280	9976	3497	15,976
Age, yrs, mean	55.5	56.5	55.3	56.5	54.3	65.0	55.8
Female, %	67.8	70.4	71.3	70.2	70.1	70.3	69.4
Comorbidity, %							
Cancer	34.7	35.2	21.2	35.3	34.4	43.8	35.0
CHD	30.3	30.2	18.0	30.3	29.1	43.0	30.4
CVD	79.0	80.1	71.5	80.2	78.4	88.0	79.4
Diabetes	24.8	24.1	19.4	24.1	23.6	27.2	24.6
Infection	84.0	84.8	78.4	84.7	84.2	86.3	84.0
Lymphoma	3.8	4.3	2.2	4.4	4.4	6.7	4.3
Mental health	73.4	71.7	68.9	71.4	72.3	68.4	71.9
Renal	11.6	12.0	6.2	12.1	11.1	18.0	12.1
Controls, n	109,598	52,562	18,729	48,356	39,491	13,550	63,023
Comorbidity, %							
Cancer	27.0	27.6	24.0	27.7	26.6	33.7	27.4
CHD	22.1	22.4	18.6	22.4	20.5	29.7	22.1
CVD	64.9	65.7	61.2	65.8	64.1	75.9	65.3
Diabetes	19.4	19.7	17.6	19.9	19.1	24.1	19.6
Infection	64.5	64.5	63.4	64.4	63.4	67.3	64.3
Lymphoma	2.2	2.2	1.7	2.1	2.0	2.6	2.1
Mental health	58.7	58.7	58.9	58.8	59.1	60.7	58.8
Renal	7.2	7.3	5.8	7.4	6.6	10.3	7.2

RA: rheumatoid arthritis; cancer: all malignancies except lymphoma; CHD: coronary heart disease; CVD: cardiovascular disease excluding CHD.

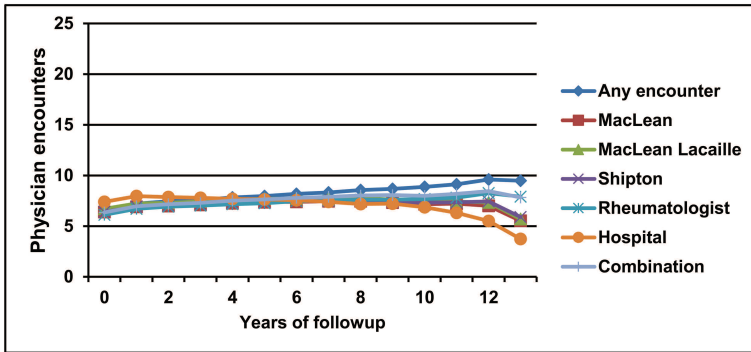
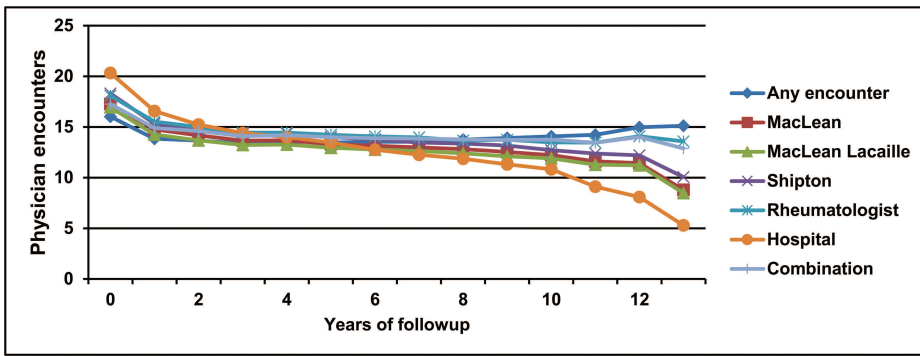


Figure 1. Total physician encounters per year in patients with RA (top panel) and controls (bottom panel) in the index year and over the following 13 years using 7 definitions for RA to identify cases in administrative datasets. RA cases were matched 1 to 4 by age and sex to a control cohort of patients who were enrolled in the same datasets, but without a diagnosis of RA or other connective tissue diseases. RA: rheumatoid arthritis.

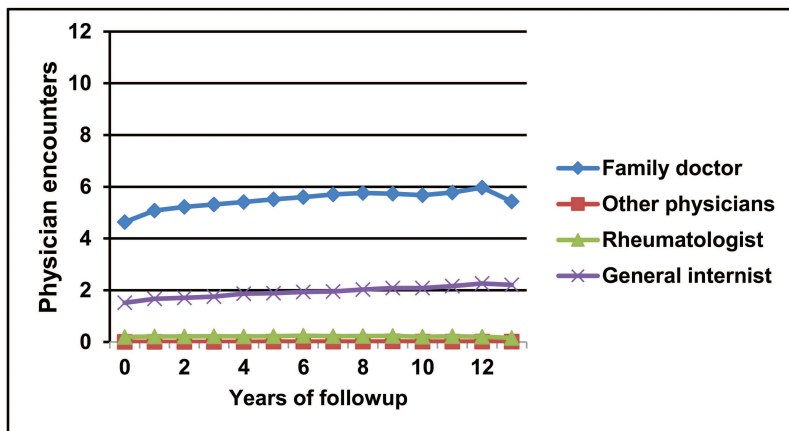
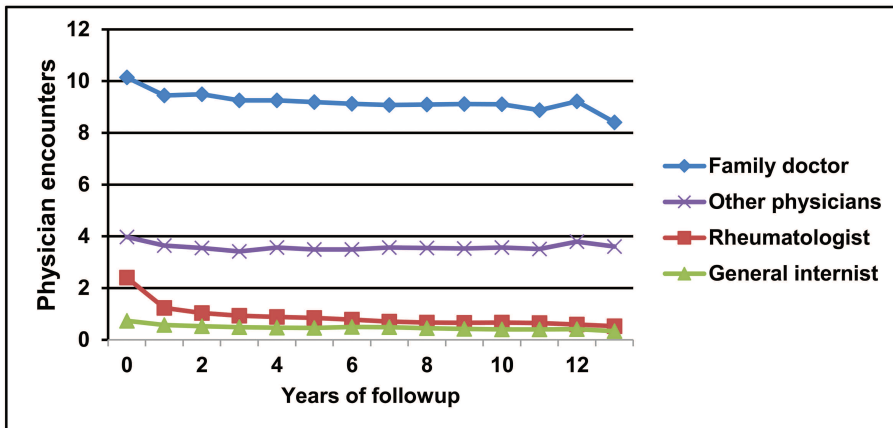


Figure 2. Physician encounters per year by specialty in patients with RA (top panel) in the index year and over 13 years of followup using case definition #7 (Combination) to identify RA cases. These were matched 1 to 4 by age and sex to a control cohort of patients (bottom panel) who were enrolled in the same datasets, but without a diagnosis of RA or other connective tissue diseases. RA: rheumatoid arthritis.

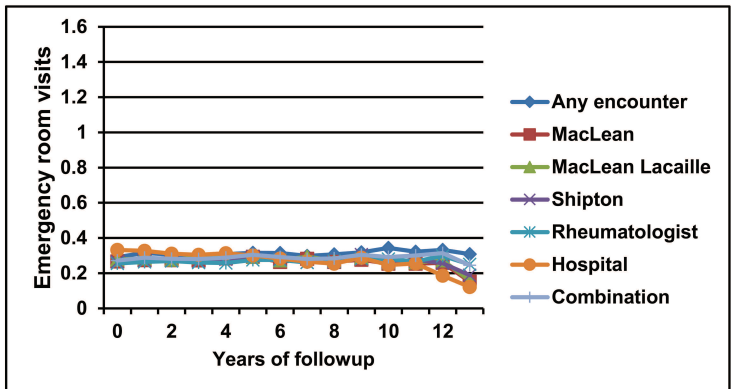
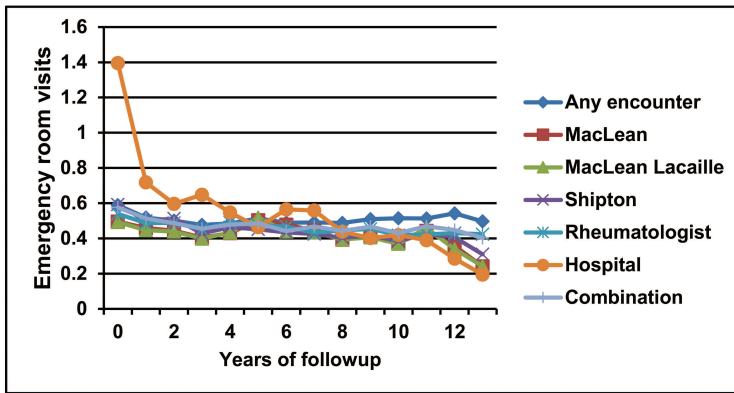


Figure 3. Use of the emergency room reflected in visits per year by RA cases (top panel) and controls (bottom panel) in the index year and over the following 13 years using 7 definitions for RA to identify cases in administrative datasets. RA cases were matched 1 to 4 by age and sex to a control cohort of patients who were enrolled in the same datasets, but without a diagnosis of RA or other connective tissue diseases. RA: rheumatoid arthritis.

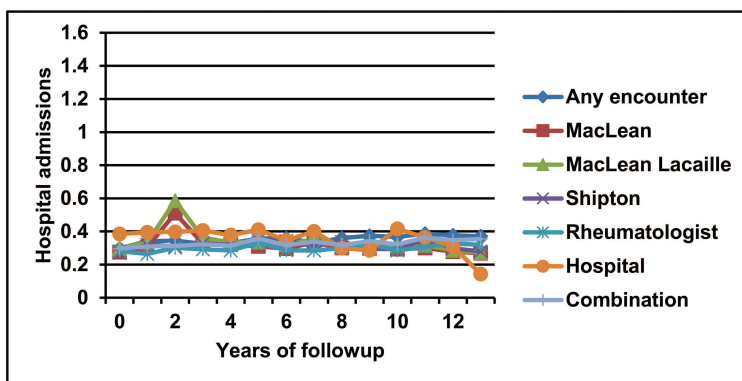
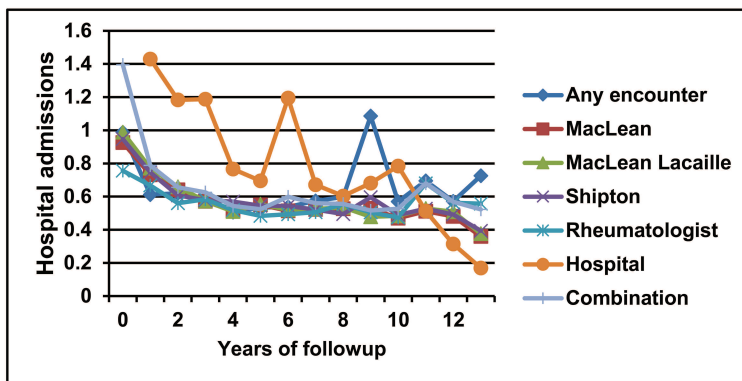


Figure 4. Hospital admissions per year for RA cases (top panel) and controls (bottom panel) in the index year and over the following 13 years using 7 definitions for RA to identify cases in administrative datasets. RA cases were matched 1 to 4 by age and sex to a control cohort of patients who were enrolled in the same datasets, but without a diagnosis of RA or other connective tissue diseases. For patients identified through a hospital admission associated with RA (case definition #5), the data point for the admission rate at the first encounter was 8.17 and was not included in the graph. RA: rheumatoid arthritis.

Hospitalizations. Hospital admission rates in RA cases and controls are illustrated in Figure 4. For RA cases, regardless of the definition, the hospital admission rate was significantly higher ($p < 0.001$) compared to controls. This was especially true early in the disease course. There was a significant fall in hospitalizations for RA cases over time ($p < 0.001$) with all case definitions with the exception of case definition #1 (encounter for RA with any physician). The spikes in hospital admissions seen among the cases most likely reflect random events among the relatively small numbers of patients, especially with some case definitions. Not surprisingly, patients identified through a hospital admission associated with RA (case definition #5) had a high admission rate over time and the data point for the admission rate at the first encounter was so high (8.17) that it negated the ability to discriminate other hospitalization curves and was not included in the graph.

Comparison of use rates between RA cases and controls. In view of the similarity in patterns of use, regardless of the case definition, differences in use between RA cases and controls were derived for a representative case definition, namely #7 (Combination). Estimates of use by RA cases compared to controls are summarized in Table 2.

Comorbidities. The proportions of patients with RA and matched controls with selected comorbidities over the period of study are summarized in Table 1. Regardless of which RA case definition was used, all of the comorbidities were more frequent in RA cases compared to their matched controls ($p < 0.0001$), with the exceptions of CHD ($p = 0.346$) and renal impairment ($p = 0.295$) in RA case definition #3 (MacLean-like algorithm with Lacaille variation). For the same case definition, the higher frequency of diabetes ($p = 0.004$) and lymphoma ($p = 0.020$) in RA compared to controls reached a lower level of statistical significance. A higher proportion of patients with comorbidities was found among RA cases identified through a hospital admission associated with RA (case definition #5).

Multivariate analysis indicated that higher physician use was associated with female sex, older age, urban dwelling, and all of the comorbidities identified ($p < 0.0001$). There were similar associations for ER visits ($p < 0.0001$), with the exception that these were more likely to occur for men. Hospitalization was associated with male sex, older age, urban dwelling, and all of the comorbidities identified ($p < 0.005$) with the exception of CVD, diabetes, and mental health.

DISCUSSION

Healthcare use and associated costs have been studied in RA and other chronic rheumatic diseases using different research methodologies. Most studies have involved secondary use of health administrative data on prevalent cohorts followed over short time frames¹³. In our study, we wished to examine the change in healthcare use in the total population of patients with RA in our geographic area at the time of diagnosis and over the ensuing years, and to compare it to that seen in population controls. To this end, we studied an incident cohort of patients with RA followed for up to 13 years using health administrative data, which was previously validated against a clinical dataset.

Studies of healthcare use have consistently found that it is higher in patients with RA than in comparator groups of patients^{3,14}. Use may be influenced by a variety of factors, including medication costs, higher comorbidities leading to increased hospitalization⁷, and the type of healthcare delivery system. Previous studies have been cross-sectional, retrospective, and longitudinal in design, using prevalent rather than incident RA cases. In our current study, use was assessed in the first year that the incident case occurred in the dataset, which was taken as the year of diagnosis of RA. Subsequent use was tracked for up to 13 years. Seven case definitions for RA with a range of sensitivities and specificities were used to identify the full spectrum of RA. The accuracy of these definitions and the identification of incident and prevalent cases of RA have been published in detail elsewhere¹⁰. Their use in this and future studies allows a form of sensitivity analysis for use and costs. The cases identified by each definition were matched by age and sex to 4 controls. The trends in healthcare use were remarkably consistent across case definitions. Regardless of the RA case definition, physician encounters were highest in number in the year of diagnosis, trended lower in subsequent years, but always remained above that in matched controls. Although not proven, it seems reasonable to assume that the gradual increase in use in the controls over time was most likely because of the change in healthcare needs with increasing age.

It is to be expected that multiple physician groups will be involved in the care of patients with RA given the systemic characteristics of the illness and the higher frequency of comorbidities. Indeed, we recently reported a very similar pattern of healthcare use in patients with SLE¹⁵. In our current study, physician encounters were categorized into

Table 2. Estimates of healthcare use in incident RA cases compared to controls over the study.

Values	All Physicians ¹	Family Doctors ¹	Rheumatologist ²	General Internist ¹	Other Physicians ¹	ER Visits ²	Hospitalization ¹
Estimate	1.75	1.63	0.46	1.81	1.83	0.10	1.55
95% CI	1.69–1.81	1.58–1.68	0.33–0.60	1.76–1.86	1.75–1.91	0.09–0.12	1.48–1.62

¹ OR estimate, negative binomial model. ² Least square adjusted mean difference. RA: rheumatoid arthritis; ER: emergency room.

those with family physicians, general internists, rheumatologists, and others. Use of all 4 physician groups was substantially higher in RA cases compared to controls over the entire study. Encounters with family physicians, who are responsible for delivering primary care in the Canadian healthcare system, were the most frequent. Subspecialty care was used most frequently early in the disease course, falling substantially over the next 3 years. In contrast, the frequency of encounters with family physicians changed relatively little over time. The interpretation and implications of these observations are 2-fold. First, access to subspecialty care is most frequent and thus most critical around the time of diagnosis of RA and in the first few years of followup when the disease is being stabilized. Second, the use of family physicians remains high, but relatively constant over the course of the illness, which underlines the important role that family physicians play in the longterm management of patients with RA. Given the need to prevent and treat comorbidities, which were more frequent in patients with RA compared to matched controls in our study, the strategic delivery of effective care will require ongoing coordination by rheumatologists and primary care physicians.

The frequency of admissions to hospital is an indicator of the clinical effect of a medical illness and has previously been demonstrated to be higher in patients with RA compared to controls¹. Our current study confirms this observation, as well as demonstrating a higher frequency of hospital ER visits, which is likely linked to hospital admission rates. Further, there was a consistent change in the pattern of use over the 13 years of observation. Both services were accessed most frequently in the first year following the diagnosis of RA (index yr), and declined thereafter to eventually reach the same frequency as in controls by the end of the study. Although this could reflect a survivor effect because of excess mortality in RA cases early in the disease course, a more likely explanation is that following the diagnosis of RA, appropriate treatment is initiated, leading to improved disease control and reduced need to visit the ER or require admission to hospital.

There are a number of strengths to our current study. First, because of the Canada Health Act, all patients accessed healthcare through a single provider, ensuring comprehensive data identification for all physician encounters, ER visits, and hospitalizations. Second, the Nova Scotia population is stable, with a mix of urban and rural communities and a range of socioeconomic groups; it thus represents many of the features of a general Canadian population, albeit without a diversified racial/ethnic mix. Third, the use of 7 validated case definitions reduces the risk of bias that could arise from using a more limited strategy for identifying cases and controls.

There are also some limitations to our study. First, because of the homogeneous characteristic of the Nova Scotia population, it was not possible to examine the effect of

race/ethnicity on healthcare use. Second, although the definition of incident cases was in agreement with traditional methodology in population health studies⁵, it would not have excluded patients with RA with longstanding disease who relocated to Nova Scotia during the period of study. Third, the cases were not stratified for disease activity or severity, in which use patterns may have been different. Fourth, although the presence and effect of several predefined comorbidities were examined, there are other potentially important comorbidities (e.g., smoking) that were not available for inclusion in the analysis. Finally, comparative data on patients with other chronic disease in a population of similar age and sex were not available. Future studies will address these deficiencies and determine the economic costs of healthcare use in this cohort of patients with RA.

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