










# Healthcare Utilization and Costs for Musculoskeletal Disorders in Ontario, Canada

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**ABSTRACT. Objective.** To examine the magnitude and costs of ambulatory primary care, specialist physician care, and hospital service use for musculoskeletal disorders (MSDs) in Canada's largest province, Ontario.

**Methods.** Administrative health databases were analyzed for fiscal year 2013–2014 for adults aged  $\geq 18$  years, including data on physician services, emergency department (ED) visits, and hospitalizations. International Classification of Diseases diagnostic codes were used to identify MSD services. A validated algorithm was used to estimate direct medical costs. Person-visit rates and numbers of persons and visits were tabulated by care setting, age, sex, and physician specialty. Data were examined for all MSDs combined, as well as for specific diagnostic groupings.

**Results.** Overall, 3.1 million adult Ontarians (28.5%) made over 8 million outpatient physician visits associated with MSDs. These included 5.6 million primary care visits. MSDs accounted for 560,000 (12.3%) of all adult ED visits. Total costs for MSD-related care were \$1.6 billion, with 12.6% of costs attributed to primary care, 9.2% to specialist care, 8.6% to ED care, 8.5% to day surgery, and 61.2% associated with inpatient hospitalizations. Costs due to arthritis accounted for 40% of total MSD care costs (\$639 million). MSD-related imaging costs were \$169 million, yielding a total cost estimate of \$1.8 billion for MSDs overall.

**Conclusion.** MSDs place a significant and costly burden on the healthcare system. Health system planning needs to consider the large and escalating demand for care to reduce both the individual and population burden.

*Key Indexing Terms:* arthritis, health services, healthcare costs, musculoskeletal diseases

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Musculoskeletal disorders (MSDs) are highly prevalent and include a range of conditions such as osteoarthritis (OA), rheumatoid arthritis (RA), and spinal disorders.<sup>1,2,3,4</sup> In Canada, the estimated prevalence of MSDs increased from approximately 23% in 1990 to 27.8% in 2017.<sup>5</sup> MSDs are a leading cause of pain and disability, ranking first among conditions in global years lived with disability.<sup>1,4</sup> The economic burden of MSDs is substantial and includes both indirect costs due to lost work productivity and direct medical costs associated with the use of healthcare services. The most recent Economic Burden of Illness in Canada study reported total costs for MSDs, excluding injury, of \$8.7 billion, with \$6.7 billion attributed to direct costs such as medications, hospital care, and physician care.<sup>6</sup> Annual US costs for treatment and lost wages due to MSDs were estimated to be \$980 billion in 2014 or 5.76% of the gross domestic product.<sup>2</sup>

The need for effective and cost-effective care for MSDs is amplified by the aging of the population, which is expected to be accompanied by an increase in the prevalence of these conditions.<sup>7,8,9</sup> Improving care for MSDs in part depends on planning for increased demand, which necessitates clarity on how healthcare resources are used and how costs are distributed across

these resources. Such findings are important for understanding the changing burden on the healthcare system, as well as for informing the development of models of care that maximize healthcare value for dollars spent. Currently, available data on healthcare utilization (HCU) for MSDs are limited in scope, in terms of both comprehensiveness of services or diagnoses considered and the lack of inclusion of detailed data on associated costs.

Therefore, the purpose of this paper was to assess both the use and cost of healthcare services for MSDs in a large and well-defined population with universal healthcare coverage—Canada's most populous province, Ontario. We examined ambulatory primary and specialist physician care and hospital service use, considering different physician types and hospital settings, as well as the use of MSD-related imaging. Findings are presented for all MSDs combined and by specific MSD diagnosis, including both trauma- and nontrauma-related conditions.

## METHODS

In Canada, provincial and territorial health insurance plans provide publicly funded, universal coverage for medically necessary hospital and physician services with no copayments. There is no parallel private insurance system. The province of Ontario accounts for almost 40% of Canada's total population. This study examined administrative health data for the 2013 fiscal year (April 1, 2013, to March 31, 2014) for the Ontario population aged  $\geq 18$  years as of April 1, 2013 ( $N = 10,841,302$ ). Over 90% of Ontario physicians are paid on a fee-for-service (FFS) basis, or they submit shadow bills for each patient encounter.<sup>10,11</sup> Access to specialists requires a referral from another physician, typically a primary care physician (PCP).

**Data sources.** Data sources for this study included the Ontario Health Insurance Plan (OHIP) Claims History Database, which captures diagnoses and service fee codes for in- and outpatient physician services. The OHIP database was linked to Ontario's Registered Persons Database to identify patient age and sex, and the ICES (formerly Institute for Clinical Evaluative Sciences, [www.ices.on.ca](http://www.ices.on.ca)) Physician Database to identify physician specialty. Data on diagnoses and procedures for inpatient hospitalizations were obtained from the Canadian Institute for Health Information (CIHI) Discharge Abstract Database (DAD), which records diagnoses and procedure codes associated with all inpatient hospitalizations, and the CIHI National Ambulatory Care Reporting System (NACRS), which captures diagnoses and procedure codes for all emergency department (ED) and day surgery encounters in Canada.

Ambulatory physician visits were identified in the OHIP database by the fee code provided on the physician claim. Physician claims to OHIP require a single diagnosis code reflecting the main reason for the physician consultation. An ambulatory visit was defined as 1 claim per patient per diagnosis per service date. The classification scheme used in the OHIP database is based on a subset of 3-digit codes adapted from the International Classification of Diseases, 9th revision (ICD-9). Hospital-based care for MSDs was identified as the most responsible diagnosis in the DAD or NACRS databases. The "most responsible diagnosis" is defined as the diagnosis most responsible for the patient's hospital stay or visit. If there is more than 1 such condition, the selected condition is the one held most responsible for the greatest portion of the length of stay or greatest use of resources. The DAD and NACRS databases use the full range of diagnosis codes from the ICD-10. MSD diagnosis codes were selected and grouped (Supplementary Table 1, available with the online version of this article) for analyses based on clinical and research expertise, as well as previous research.<sup>12,13</sup> While data specific to spinal conditions were the focus of a separate, more detailed publication,<sup>14</sup> they are included here to ensure that the burden of MSDs is fully characterized.

**HCU.** Person-visit rates were defined as the number of persons with  $\geq 1$  visit coded for the MSD condition grouping of interest. These rates were calculated per 1000 population for ambulatory care and per 100,000 population for hospital care. We computed total, age-specific, and sex-specific ambulatory care visit rates, as well as total number of visits and persons receiving care for each MSD condition category. For each group, we computed the percentage of individuals with  $\geq 1$  ambulatory visit according to physician specialty. For hospital care, total number of ED visits and person-visit rates stratified by hospital setting were determined. We computed the percentage of all physician visits for any reason that were attributed to MSDs and to each condition grouping, stratified by care setting (ambulatory care, ED, hospital inpatient, day surgery).

MSD imaging claims were identified using specific fee codes for radiograph, computed tomography (CT), and magnetic resonance imaging (MRI) scans for individuals who had an MSD-related ambulatory care visit in 2013/14. The number and percentage of patients who had  $\geq 1$  MSD imaging exam were computed, as was the total number of exams.

**Healthcare costs.** Total direct costs were computed for each MSD condition grouping and the percentage distribution of costs by care setting was calculated. Costs were estimated using the methods described by Wodchis et al.<sup>15</sup> Briefly, fees for services rendered by physicians paid on an FFS basis were as recorded in the OHIP Claims History Database. Services rendered by physicians who were paid via capitation or other blended methods but who shadow bill were assigned the mean fee paid to FFS physicians for the same service. Payments to salaried physicians and those under alternative payment plans that do not shadow bill vary widely in number according to specialty but represent roughly 5–10% of physicians overall<sup>11</sup>; these were not included.

Nonphysician ED costs were estimated by assigning patients to Comprehensive Ambulatory Classification System (CACCS) groups. Each of these groups was assigned an individual resource intensity weight reflecting the average resource utilization for each CACCS group relative to the average patient. A similar approach was used for both same-day surgery and acute inpatient care; however, in the latter case patients were assigned to specific case mix groups based upon the patient's age, major diagnoses (comorbidities), procedures, and interventions. Costs for hospital stays that began before or extended beyond the study period were prorated according to the portion of the hospital stay within the study period. As with emergency service costs, costs related to surgeon services rendered during same-day surgery or hospital-based physician services are not included in the estimated costs per weighted case, as these are paid directly to physicians and surgeons through OHIP claims, as described above.

Costs for imaging include both technical and professional (physician) fees in outpatient clinic settings. Costs associated with imaging done in hospital do not include technical costs, as these are included in hospital global budgets that are not billed to OHIP. Costs associated with MSD imaging were calculated overall and by type of scan (radiograph, CT, MRI). All costs are presented in 2013–2014 Canadian dollars, where \$1 CAD was equivalent to approximately US \$0.9088 in 2013–2014, on average.<sup>16</sup>

All datasets were linked using unique encoded identifiers and analyzed at ICES. Use of the data for this project was authorized under section 45 of Ontario's Personal Health Information Protection Act and does not require review by a research ethics board.

## RESULTS

During the study year, 3.1 million adult Ontarians, or approximately 28.5% of the population, made  $\geq 1$  ambulatory visit to a physician for MSDs for a total of just over 8 million visits (Table 1). Person-visit rates for all MSDs increased with age, peaking at 38% for the population aged  $\geq 65$  years. Rates were higher for women than men for all MSDs, as well as for each of the major condition groupings.

Table 1. Ambulatory care utilization for MSDs overall, by age group, and by sex in Ontario, Canada, 2013–2014.

Condition Group	Persons, n <sup>a</sup>	Visits, n <sup>a</sup>	Person-visit Rate per 1000 Population <sup>b</sup>					
			All	18–44 yrs	45–64 yrs	≥ 65 yrs	Women	Men
Trauma and related conditions, excluding spine	1023	1953	94.4	77.8	108.8	107.6	97.7	90.9
Fracture/dislocation	201	432	18.5	14.2	18.8	28.4	19.9	17.0
Strains/sprains	791	1292	73.0	62.7	85.3	75.0	75.2	70.6
Joint derangement	126	229	11.7	7.8	15.3	14.1	11.3	12.0
All spinal conditions <sup>14</sup>	822	1557	75.8	60.2	90.3	86.6	80.7	70.7
Nontrauma spine	572	1073	52.8	38.6	64.4	65.3	55.2	50.2
Strains/sprains	308	471	28.4	26.0	32.8	25.8	31.0	25.5
Fracture/dislocation	7	14	0.7	0.3	0.6	1.7	0.7	0.7
Arthritis and related conditions	1285	2654	118.5	58.6	150.0	204.3	134.1	101.9
Rheumatoid arthritis	90	230	8.3	2.9	10.6	17.0	11.4	5.0
Ankylosing spondylitis	13	24	1.2	1.0	1.6	1.1	1.1	1.4
Connective tissue disease	26	59	2.4	1.5	3.2	3.2	4.0	0.8
Osteoarthritis	552	1066	51.0	10.2	62.7	127.4	60.4	40.9
Synovitis	377	549	34.8	23.5	46.3	40.5	38.2	31.1
Traumatic arthritis	15	23	1.4	0.8	1.8	2.1	1.4	1.3
Gout	67	102	6.1	2.6	7.7	11.9	2.6	9.9
Soft tissue disorders	126	217	11.6	7.9	15.7	13.1	14.3	8.8
Other arthritis	230	384	21.2	14.5	27.3	26.1	24.5	17.7
Bone conditions	178	250	16.5	3.6	18.5	43.5	25.8	6.6
Unspecified MSD	928	1593	85.6	65.4	102.1	103.4	95.1	75.5
All MSDs	3085	8008	284.6	207.4	333.5	379.8	310.6	257.0

<sup>a</sup> Values are n × 1000. <sup>b</sup> Person-visit rate is defined as the no. of persons with ≥ 1 visit coded for the condition grouping of interest per 1000 population. MSD: musculoskeletal disorder.

The majority of MSD visits were coded for arthritis and related conditions (2.6 million visits), most commonly OA (Table 1). Approximately 550,000 Ontarians, 5.1% of the population, made approximately 1 million physician visits that were coded specifically for OA.

Overall, 87.0% of people who visited any type of physician for an MSD saw a PCP at least once (Table 2). The majority of ambulatory visits for each of the major condition groups occurred in primary care, so that overall, approximately 70% of MSD visits were in primary care, totaling 5.6 million visits.

The proportion of Ontarians with visits for arthritis and related conditions who consulted a medical or surgical specialist at least once was approximately 20% for each of these specialist groups, although the types of specialists varied by type of arthritis (Table 2). For people who made ambulatory visits for RA, ankylosing spondylitis (AS), and connective tissue disorders, high proportions saw a rheumatologist at least once (57.8%, 73.9%, and 76.1%, respectively). For individuals who made visits for OA, 26.3% consulted an orthopedic surgeon at least once.

Person-visit rates for hospital care for each of the MSD conditions were highest for the ED (Table 3), with the exceptions of joint derangement and bone conditions, for which day surgery rates were highest, and OA, for which inpatient hospitalization rates were highest. In total, there were 560,000 ED visits for MSDs, with 244,600 (43.7%) related to trauma. Nontrauma spinal conditions<sup>14</sup> and arthritis and related conditions were responsible for 130,000 and 142,000 ED visits, respectively. ED person-visit rates for these 2 condition groups were similar at approximately 1% of adults.

Total direct costs for all MSDs in 2013–2014 were \$1.6 billion (Table 4). The proportion of costs by care setting was highest for inpatient hospitalizations (61% or \$975 million) and similar across specialist care, ED care, and day surgery at approximately 9% or \$143 million for each setting. Primary care costs were \$200 million. Costs associated with ED visits for some nontrauma conditions were notable, including gout and nontrauma spinal conditions.<sup>14</sup> Costs due to arthritis accounted for 40% of total MSD costs (\$639 million). Most arthritis costs were attributed to OA (\$400 million), for which costs were largely due to inpatient hospitalizations (86%).

Among the 3.1 million Ontarians who made an ambulatory visit to a physician for an MSD during the study year, just over half had ≥ 1 MSD imaging exam, with a total of 3.2 million imaging exams. Costs for imaging for those who made an ambulatory MSD visit during the study year were \$169.3 million (radiograph = \$96.2 million; CT = \$9.2 million; MRI = \$64.0 million; data not shown). Adding imaging costs to the direct costs yields an overall cost of \$1.8 billion.

Ambulatory and hospital care for MSDs accounted for notable proportions of the care delivered in these settings for any reason (Figure 1). In ambulatory care settings, visits for MSDs were responsible for 13.4% of all visits for any reason, with arthritis and related conditions responsible for 4.4%. In the ED, MSDs were responsible for 12.3% of all visits, with 4.8% due to trauma. Nontrauma spinal conditions<sup>14</sup> and arthritis and related conditions were each responsible for about 3% of visits to the ED. MSDs were responsible for 10.8% of inpatient hospital care and 6.2% of day surgery.

Table 2. Primary and specialist care utilization for MSDs, Ontario, Canada, 2013–2014.

Condition Group	Primary Care Visits, n <sup>a</sup>	Visits in Primary Care, %	Primary Care	Percentage of People With ≥ 1 Visit to a Physician of Indicated Specialty <sup>b</sup>					
				Medical Specialists			Surgical Specialists		
				All	Rheum	Gen Int	All	Ortho	Neuro
Trauma and related conditions, excluding spine	1119	57.3	72.5	4.1	0.3	0.5	34.5	31.3	0.3
Fracture/dislocation	110	25.4	41.2	2.9	0.1	0.8	66.8	58.2	0.0
Strains/sprains	970	75.1	82.9	4.1	0.2	0.5	18.4	16.7	0.0
Joint derangement	39	16.9	22.3	3.0	0.7	0.2	78.0	75.0	2.5
All spinal conditions <sup>14</sup>	1333	85.6	91.2	10.0	2.7	0.8	5.6	3.1	2.4
Nontrauma	890	83.0	88.3	11.9	3.7	0.8	6.3	3.5	2.7
Strains/sprains	437	92.7	94.0	5.0	0.1	0.6	2.5	1.3	1.1
Fracture/dislocation	6	42.6	48.4	12.3	0.3	1.8	45.5	28.5	17.1
Arthritis and related conditions	1650	62.2	76.1	20.2	11.6	2.1	20.1	15.9	0.1
Rheumatoid arthritis	80	34.8	49.0	65.1	57.8	5.5	5.3	3.7	0.0
Ankylosing spondylitis	3	13.6	17.8	79.9	73.9	4.6	7.6	5.2	2.0
Connective tissue disease	6	10.7	14.1	91.0	76.1	5.5	1.5	0.1	0.0
Osteoarthritis	670	62.8	74.6	12.8	7.0	1.5	27.0	26.3	0.1
Synovitis	410	74.7	80.5	8.2	4.4	1.4	15.3	9.2	0.0
Traumatic arthritis	10	41.4	42.8	6.6	2.0	2.2	50.8	49.0	0.0
Gout	88	85.8	91.1	12.1	8.8	2.1	0.6	0.3	0.0
Soft tissue disorders	166	76.6	79.1	14.2	6.0	1.8	9.0	3.1	0.0
Other arthritis	217	56.4	62.9	26.2	4.3	1.8	18.1	7.8	0.2
Bone conditions	167	66.7	74.1	22.3	7.5	2.8	8.7	7.7	0.0
Unspecified MSD	1363	85.5	89.3	9.8	2.7	1.1	4.6	3.7	0.3
All MSDs	5631	70.3	87.0	14.8	6.4	1.6	20.9	17.4	0.9

<sup>a</sup> Values are n × 1000. <sup>b</sup> The sum of percentages for a given condition is > 100% as an individual can consult > 1 type of physician during the study year. Gen Int: general internist; MSD: musculoskeletal disorder; Neuro: neurosurgeon; Ortho: orthopedic surgeon; Rheum: rheumatologist.

## DISCUSSION

Our findings demonstrate the major burden attributable to MSDs on Ontario's healthcare system, accounting for just over 8 million ambulatory physician visits, or 13.4% of all visits made for any reason, and resulting in estimated direct costs of CAD \$1.8 billion (US \$1.6 billion) for hospital and physician services, including imaging. PCPs play a substantial role in the care of many MSDs; however, a notable number of visits to the ED are also attributable to these conditions. To the best of our knowledge, our findings represent the most up-to-date and comprehensive assessment of MSD-related HCU conducted in Canada, and the first to examine the associated costs at this level of detail.

Our overall MSD ambulatory person-visit rate for adults aged ≥ 18 years of 284.6 per 1000 population is somewhat higher than that reported for Ontario in 2006 (251.0 per 1000 population for those aged ≥ 15 yrs).<sup>13</sup> There were also age-specific visit rate increases in the younger and middle-aged groups over this period, while rates for those aged ≥ 65 years were fairly stable. Our overall MSD person-visit rate is also consistent with the 2017 Global Burden of Disease Study prevalence estimate for MSDs in Canada of 27.8% (26.3–29.3%).<sup>5</sup>

The 2016 National Ambulatory Medical Survey indicated that in the US, nontrauma MSDs accounted for 8.3% of all visits to physician offices,<sup>17</sup> a similar proportion as we found in the current Ontario-based study. PCPs play a significant role in the management of most MSDs. We report that 70% of all physician

visits for MSDs occurred in primary care and that 87% of people who visited any type of physician for an MSD saw a PCP at least once. Globally, back pain and arthritis have been identified as among the 10 most common reasons for visits to PCPs.<sup>18</sup> It is likely appropriate that most MSDs are managed largely in a primary care setting. However, studies have highlighted concerns with the quality of primary care for MSDs<sup>19,20,21,22,23</sup> and a need for greater MSD education in medical school, as well as continuing education, has been identified as important in addressing these issues.<sup>23–29</sup>

Our findings as they relate to types of physicians consulted for OA are supported by similar US estimates. A nationally representative US study of HCU reported that 80% of patients with OA saw a PCP during a 1-year period, 6% saw a rheumatologist, and 25% saw an orthopedist.<sup>30</sup> We similarly found that 75% of patients with OA ambulatory visits in Ontario saw a PCP at least once during the study year, 7% saw a rheumatologist, and 26% saw an orthopedic surgeon. In 2006, these proportions were similar for patients with OA seeing PCPs and rheumatologists (79% and 7%, respectively) and somewhat lower for orthopedic surgeons at 20%.<sup>13</sup> We found that OA had the highest rate of all MSDs for inpatient hospitalizations, which was the main driver of direct costs for OA care. The demand and cost for surgical care for OA are expected to continue increasing with the aging of the population. A Canadian simulation study examining data from 2003 to 2010 estimated that the average cost of OA increased by 40% over



Table 3. Hospital care for MSDs, Ontario, Canada, 2013–2014.

Condition Group <sup>a</sup>	ED Visits, n <sup>b</sup>	Person-visit rate per 100,000 population <sup>c</sup>		
		ED	Hospital Inpatient	Day Surgery
Trauma and related conditions, excluding spine	219	1865.3	240.6	332.8
Fracture/dislocation	138	1183.7	230.6	77.4
Strains/sprains	76	676.8	3.1	22.6
Dislocations/sprains/strains	1	11.1	0.0	0.0
Joint derangement	3	23.9	7.2	233.5
All spinal conditions <sup>14</sup>	156	1237.8	121.0	26.6
Nontrauma	130	1031.6	80.4	26.5
Strains/sprains	17	151.0	0.5	0.0
Fracture/dislocation	8	71.0	40.5	0.0
Dislocations/sprains/strains	0.6	5.8	0.0	0.0
Arthritis and related conditions	142	1173.3	409.8	193.8
Rheumatoid arthritis	1	8.1	5.1	2.6
Ankylosing spondylitis	0.9	7.7	3.1	0.4
Connective tissue disease	1	9.0	6.5	1.7
Osteoarthritis	12	106.3	339.5	37.3
Synovitis	18	154.4	4.3	47.3
Traumatic arthritis	0.8	7.1	6.0	1.0
Gout	10	81.0	6.3	1.4
Soft tissue disorders	92	786.9	28.8	94.8
Other arthritis	6	55.2	12.7	8.3
Bone conditions	7	65.6	32.8	69.6
Unspecified MSD	39	342.6	11.2	23.1
All MSDs	560	4396.4	803.2	638.6

<sup>a</sup>The “most responsible diagnosis” code was used to classify patients into the condition groups of interest. <sup>b</sup> Values are n × 1000. <sup>c</sup> Person-visit rate is defined as the no. of persons with ≥ 1 visit coded for the condition grouping of interest per 100,000 population. ED: emergency department; MSD: musculoskeletal disorder.

Table 4. Direct cost for care of MSDs, Ontario, Canada, 2013–2014.

Condition Group	Direct Costs, CAD\$ <sup>a</sup>	Percentage of Direct Costs by Care Setting				
		Primary Care	Specialist Care	ED	Hospital Inpatient	Day Surgery
Trauma and related conditions, excluding spine	532	7.4	7.8	11.4	60.7	12.7
Spinal conditions <sup>14</sup>						
Nontrauma	168	18.8	8.2	16.7	52.9	3.4
Trauma	96	16.3	3.5	9.3	70.9	< 0.1
Arthritis and related conditions	639	9.3	10.3	4.4	69.3	6.6
Rheumatoid arthritis	19	15.4	55.1	1.1	25.4	2.9
Ankylosing spondylitis	11	1.1	14.5	2.2	82.0	0.2
Connective tissue disease	17	1.5	23.5	1.9	72.1	1.0
Osteoarthritis	400	6.1	5.7	0.7	85.7	1.9
Synovitis	37	38.8	25.2	9.1	9.4	17.6
Traumatic arthritis	12	2.9	5.6	2.8	87.1	1.6
Gout	11	27.0	10.4	15.7	44.8	2.1
Soft tissue disorders	90	7.6	4.0	20.2	40.1	28.1
Other arthritis	42	18.4	30.2	3.4	43.4	4.7
Bone conditions	75	8.8	8.2	2.6	60.7	19.8
Unspecified MSD	85	56.7	19.2	9.7	8.7	5.7
All MSDs	1594	12.6	9.2	8.6	61.2	8.5

<sup>a</sup> Values are n × 1,000,000. ED: emergency department; MSD: musculoskeletal disorder.

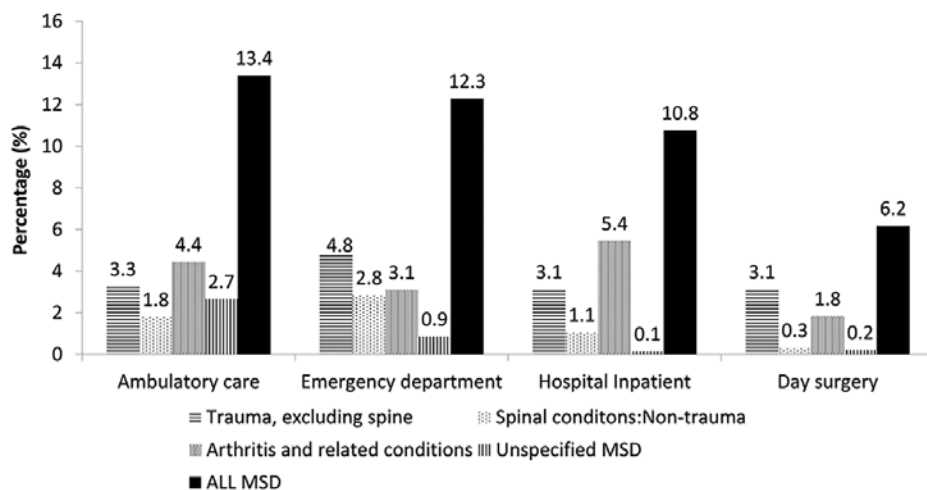


Figure 1. Visits for specified diagnosis as a percentage of all visits in Ontario for any reason<sup>a</sup>, by care setting, Ontario, Canada, 2013–2014. <sup>a</sup> Data not shown for the following as all percentages were < 1%: (1) spinal conditions: trauma; and (2) bone conditions. MSD: musculoskeletal disorders.

this time frame, driven primarily by total joint replacement surgeries.<sup>31</sup>

Rheumatologists were the most frequently consulted specialists for inflammatory forms of arthritis such as RA, AS, and connective tissue disorders. For these conditions, 58%, 74%, and 76% of patients, respectively, saw a rheumatologist at least once during the study year. These proportions represent increases relative to fiscal year 2006, for which analogous estimates were 47%, 63%, and 71%, respectively.<sup>13</sup> However, our observed proportion for patients with RA was still relatively low and may reflect some shared care with PCPs or internists, as well as barriers to rheumatology access. Research from Ontario has found that rheumatology wait times exceed established benchmarks<sup>32</sup> and that there is significant geographical variation in access across the province,<sup>32,33</sup> with a provincial deficit of 200 rheumatologists estimated in 2015.<sup>34</sup> Timely access to rheumatological care is an important issue that warrants continued study, as early referral has been associated with treatment regimens that significantly slow disease progression.<sup>35,36,37,38</sup>

MSDs as a group were responsible for 12.3% of all ED visits in Ontario during the study year, with each of the arthritis and nontrauma spinal conditions<sup>14</sup> being responsible for approximately 3% of all ED visits for any reason. This is comparable to past ED-related findings for arthritis in Ontario,<sup>13</sup> as well as findings from other jurisdictions. A 2017 metaanalysis reported a global pooled prevalence of low back pain in emergency settings of 3.4% (3.1–3.8%).<sup>39</sup> In the US, arthritis and related conditions have been reported to account for approximately 5% of ED visits.<sup>40,41</sup> ED use for arthritis and spinal conditions may represent a barrier to accessing appropriate ambulatory care and is associated with substantially greater cost per patient encounter relative to primary care.<sup>14</sup>

Strengths of our study include its population-based design and broad, inclusive characterization of services for MSD. This included trauma, as well as a number of nonspecific MSD diagnosis codes that are relatively commonly used, particularly

in ambulatory care settings. We also included a broad range of physician specialities, both ambulatory and hospital care, as well as data on MSD-related imaging. However, the study also has important limitations. Administrative data diagnosis codes may not accurately reflect clinical diagnoses. Our estimates for MSD care are likely to underrepresent all care for MSDs. For example, for hospital-based care, we considered only diagnoses coded as most responsible for the hospital/ED encounter. In office settings, only 1 diagnosis code — the primary reason for the visit — can be entered on an OHIP physician claim, although patients often present with multiple issues, particularly in primary care. Consequently, the MSD-related aspect of a physician visit in individuals with multiple diagnoses may not be captured. Care delivered by salaried physicians and those working under other alternative payment plans was excluded, and is estimated to represent 5–10% of Ontario's physician workforce.<sup>11</sup> Nonhospital, nonphysician care for MSDs, such as physiotherapy, is also not captured in Ontario health administrative data. Outpatient medications are also not included and represent an important contributor to overall MSD costs. In the US, the share of MSD healthcare costs due to prescription medications was 23% of total healthcare costs in 2011.<sup>2</sup> Medications for inflammatory forms of arthritis are particularly costly, and the average annual cost of a biologic disease-modifying antirheumatic drug prescription in Canada was approximately CAD \$18,000 during our study year.<sup>42</sup> We could include only the direct costs of hospital and ambulatory care for MSDs, from the public payer perspective, excluding capital and administrative costs associated with operating the healthcare system.<sup>15</sup> Costs associated with MSD imaging did not include technical fees when provided in hospitals. Additionally, because imaging orders do not include diagnosis codes in Ontario, we estimated imaging utilization for MSDs by examining data on image orders for people who had an MSD-related ambulatory visit during the study year. It is possible that we included some image orders for non-MSD diagnoses. Our estimated costs for hospital stays

that began before or extended beyond the study period were prorated according to the portion of the hospital stay within the study period. As the actual costs are typically greater during the beginning of a hospital stay, if the complexity of these visits was relatively similar at both ends of the study period, it is possible we may have underestimated actual costs if the end of the study period included fewer incomplete hospital stays than the beginning of the study period. We cannot comment on the substantial direct and indirect costs of MSDs to patients, informal caregivers, employers, and other stakeholders. Finally, while Ontario is Canada's most populous province, HCU estimates based on administrative data may vary among provinces<sup>12</sup> and countries, influenced, at least in part, by variations in insurance coverage and coding practice. While the generalizability of our findings to jurisdictions with different health insurance systems and models of healthcare delivery is unknown, our findings are generally in line with those observed elsewhere. Data analogous to ours for more recent, as well as future, years should be examined to monitor the evolving effect of MSDs on the healthcare system and to assess the effect of the introduction of new interventions and models of care.

Our findings show that MSDs continue to place a significant and costly burden on the healthcare system. Health system planning, therefore, needs to consider the large and escalating demand for MSD care, in terms of human resources planning and the implementation of more clinically and cost-effective models of care, to reduce both the individual and population burden.

## ONLINE SUPPLEMENT

Supplementary material accompanies the online version of this article.

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