A CROSS-SECTIONAL ANALYSIS OF LUMBAR SPINE CT REFERRAL RATES BY FAMILY PHYSICIANS USING ROUTINELY COLLECTED DATA IN ONE HEALTH REGION IN NEWFOUNDLAND AND LABRADOR, CANADA: A BRIEF REPORT

Authors: Gabrielle S Logan MSc*[1], Bethan Copsey PhD(c)[2], Holly Etchegary PhD[1], Patrick Parfrey MD[1], Krista Mahoney PhD[1], Amanda Hall PhD[1,3]

Affiliations: (1) Faculty of Medicine, Memorial University of Newfoundland, St. John's, NL, Canada; (2) Centre for Statistics in Medicine, Nuffield Department of Orthopaedics, Rheumatology and Musculoskeletal Sciences, University of Oxford, Oxford, UK (3) Primary Health Research Unit, Memorial University of Newfoundland, St. John's, NL, Canada.

*Corresponding author: Gabrielle S Logan; Address: 300 Prince Philip Dr, St. John's, Newfoundland and Labrador, Canada, A1B 3V6; email: glogan@mun.ca (Orcid ID: https://orcid.org/0000-0001-7007-9373)

INTRODUCTION

Choosing Wisely recommends reducing unnecessary lumbar spine imaging for low back pain, primarily to improve patient safety by avoiding unnecessary exposure to carcinogenic ionising radiation and secondarily to reduce healthcare spending associated with over testing (1,2). However, only a handful of studies have examined population based utilisation of lumbar spine computed tomography (CT) examinations, with most studies reporting the proportion of patients with low back pain who receive CT imaging compared to those who do not (3,4). Australia and the US provide population level data on lumbar spine CT utilisation for their countries, which is helpful for comparisons of usage internationally (5,6). These estimates range from 209 CTs /100,000 to 2,464/100,000 individuals (5,6). In Canada, this type of data is challenging to find. The only data available were provided in a government commissioned report on appropriate imaging and it focused on the lumbar spine CT rates in just two Canadian provinces, Manitoba and Ontario, and found different estimates in both provinces (7).

The objective of this study is to determine the yearly age-sex standardised rates of lumbar spine CT imaging for adults (≥20 years old) by family physicians in the Eastern Health Region of Newfoundland and Labrador (NL), Canada. This study focused on CT imaging largely in response to a report by the Canadian institute for Health information (CIHI) which reported Newfoundland and Labrador's all type CT imaging rate to be to twice as high as the national average and the second highest rate of all the provinces (8). This study adds to the body of work in this area by presenting lumbar spine CT rates from a 3rd province in Canada. It has been estimated that NL has higher use of CTs (any-type) than any other Canadian province (8). While we could hypothesize that the rate of lumbar spine CTs may also be higher in NL than other provinces, comparisons between provinces are beyond the scope of this study due to lack of data access required for this analysis.

METHODS

Setting and Study Period. This study was conducted in the Eastern Health Region of Newfoundland and Labrador. It is the largest health region in the province, providing health care to approximately 300,000 people, or 60% of the province population. The years of this study (2013-2016) period were chosen, because they were years with data that were fully available, considered reliable, and were recent. Older data was unreliable due to a change in a data management system. No policy changes or educational campaigns to reduce imaging had occurred.

Data Source. The third-party data custodian, the Newfoundland and Labrador Centre for Health Information (NLCHI), identified the dataset from the administrative codes for lumbar spine CTs with and without contrast from Meditech, an electronic medical records database in the Eastern Health Region of NL. Records from 2013 to 2016 were accessed and the following variables were collected: number of lumbar spine CTs with or without contrast, age, sex, ordering physician specialty, and imaging service date. Only select hospitals perform CT examinations, therefore we believe that this dataset is comprehensive and accurate, encompassing all CT examinations that were performed with or without contrast in Eastern Health. While it is possible there may be some overlap with the thoracic spine, it is unlikely due to the different codes that are used for such examinations. Repeated, cancelled, and missed CT examinations may have occurred in the dataset, which are not possible to distinguish from a completed exam and may overestimate the CT rates.

Data Cleaning. The dataset contained all lumbar spine CT examinations conducted between January 1st, 2013 and December 31st, 2016. The inclusion criteria were adults (≥20 years old) who received a CT scan, and referrals that were ordered from a family physician (FP; any specialty other than family medicine or general practitioner was excluded). Data that did not fit the inclusion criteria were removed. The paediatric population (<18) was removed because different diagnostic imaging guidelines apply to children. The 18- and 19-year olds were considered to be part of the paediatric group (group range was 15 to 19) and would thus not appear in our dataset. Therefore, we excluded the small number of patients (n=98) aged 18- and 19- years old in our adult dataset since including them would underestimate the number of images occurring in this age group, inaccurately influencing our rate estimation. Only family physicians were included because in our local context the first point of contact for a patient with low back pain (LBP) typically is the patient's FP. As such, we focused only on this group of providers and this decision was made *a priori*. Finally, yearly totals of lumbar spine CT imaging were obtained.

Data Analysis. Crude rates of lumbar spine CT referrals were calculated by dividing the total number of CTs performed in Eastern Health Region in each year of interest (numerator) by the total population of Eastern Health Region in that same year of interest (denominator) and multiplying that proportion by 100,000 people. Population estimates were provided by NLCHI. The rate from 2016 used 2015 Eastern Health Region population estimates, as the population estimates for 2016 were not available.

Age-sex standardised rates of lumbar spine CTs were calculated by categorising all records of CT referrals into appropriate age groups and sex of the patient for each year of interest. Each age group contained 5 different ages (e.g., 20 to 24). Each year of interest's CT rate for the applicable age-sex categories was determined by dividing CT count for age-sex category by the population estimate for that same age-sex category and multiplying the proportion by 100,000.

CT counts for 2014, 2015, and 2016 were estimated using 2013 population age-sex estimates. For example, this was calculated for 2014 by taking the 2014 rate for each age-sex category and dividing it by 100,000 to get the proportion, and multiplying the proportion by the 2013 population estimate. Then we summed the estimated CT counts for each year of interest. The total estimate of CT counts for each year was used to calculate the age-sex adjusted rate by taking the CT count estimate for each year of interest, dividing it by the 2013 population estimate and multiplying it by 100,000.

To compare whether or not rates of CT referrals per 100,000 people in a 1-year period were increasing over time, rate ratios and 95% confidence intervals were calculated. Each year's age-sex standardised lumbar spine CT rate was compared to the previous year's rate to see if there was a statistically significant change. Confidence intervals (CI) were calculated, and if either the upper or lower CI crossed one, this indicated that the rates were not significantly different.

This study was exempt from ethical approval from the local Health Research Ethics Boards as it is a secondary analysis of anonymised data and is a part of a provincial quality improvement strategy (9).

RESULTS

There was a total of 18,358 lumbar spine CTs performed in the Eastern Health Region between 2013 and 2016. 3,987 records were excluded due to non-FP healthcare provider (n=

2,831; specialists e.g., neurologists, orthopaedic surgeons), patient age (n=98), or insufficient information (n=1,058) resulting in 14,371 included records. 54.2% of the included CT examination referrals were for females, with the average age being 54.1 years old (standard deviation 14 years). Table 1 presents the numbers of included records stratified by age and sex in the age categories determined by NLCHI. The raw numbers of lumbar spine CTs performed in the Eastern Health Region are as follows: 3,118 in 2013, 3,581 in 2014, 4,042 in 2015, and 3,629 in 2016.

The age-sex standardised rates were similar to the crude rate and are as follows: 1,225/100,000 in 2013, 1,393/100,000 in 2014, 1,556/100,000 in 2015, and 1,395/100,000 in 2016. Crude rates of CT referrals per 100,000 were as follows: 1,225/100,000 in 2013, 1,399/100,000 in 2014, 1,568/100,000 in 2015, and 1,408/100,000 in 2016. The rate ratios comparing a year to an adjacent year are presented in Table 2. The greatest increase in rates was between 2014 and 2013, and there was a decrease in rates between 2016 and 2015.

DISCUSSION

The age-sex standardised lumbar spine CT rate ranged from 1,253 to 1,556/100,000 individuals over four years. While our rate ratio analysis identified that the observed differences in rates were statistically different, the magnitude of these differences were so small they are likely clinically irrelevant, meaning that the differences in lumbar spine CT numbers for each year is most likely due to the large sample size and not representative of actual changes in CT ordering rates from FPs. Thus, the lumbar spine CT rate in NL has remained steady from 2013-2016. Diagnostic imaging data from a larger timeframe would allow for an accurate trend analysis.

To put our findings in context with the other populations, we found data from Canada, Australia, and USA (5-7). Busse et al. published grey-literature rates and found that in Manitoba, Canada, in 2010/11, the age-sex standardised rate of lumbar spine CTs ordered was 967 all axial CTs per 100,000 individuals (all physician included), and in Ontario, Canada, the age-sex standardised rate was approximately 600 all axial CTs per 100,000 persons (all physicians included) (7). However, direct comparisons are difficult, as the reference population in our NL context used NL specific age-sex standardised population estimates in the analysis techniques and Busse et al. did not use the same reference populations. It is also noteworthy that family physicians were the target provider for the NL age-sex standardised rates, thus all other providers were excluded; This was not the case for Busse et al. Busse et al. also collected data from a years much more historic than ours, thus there may be changes that have occurred that make comparison challenging.

In Australia, we found age-standardised rates only, which varied from 209/100,000 to 2,464/100,000 individuals (6). In the USA, there were also different rates of spinal imaging (MRI and CT) from different hospital referral regions, which ranged from 320/100,000 to 2,370/100,000 individuals (age, sex, and race standardised) (5). Caution needs to be taken when comparing NL CT utilisation rates to other countries. While numerically our rates are within the range of these other countries, differing population estimates for the reference populations and inclusion of MRI in the USA rates limits direct comparison.

It is important to note the limitations in our dataset. First, the age-sex standardised rate for 2016 was based on population estimates from 2015. Given that the number of people in the Eastern Health Region may have changed from 2015 to 2016, the accuracy of the 2016 estimate may not be as robust compared to estimates with accurate data. Second, the data used for analysis was routinely collected health data not collected with research purposes in mind. We cannot know if there was misclassified or missing data, if the quality and accuracy of the data was considered, or if there were other unforeseen confounders (e.g., seasonal effects, local hospital policy change, rural patients travelling to Eastern Health for care) (10). There was no known policy change in the included years, however, there may have been local changes that decreased the number of imaging in 2016. Third, repeat imaging examinations of the same individual may have occurred in any of the included years, which may have an impact on the imaging rate. Records that were missing patient age and specialist information were also excluded, which may result in an underestimation of the true rate of CT imaging. Finally, specialist physicians were excluded from this analysis; the inclusion of these physician specialties would only increase the age-sex standardised rates of lumbar spine CTs. Finally, there was missing data that was excluded from analysis, which has the possibility of underestimating the true lumbar spine CT rates.

In conclusion, there appears to be a high rate of lumbar spine CTs ordered in the Eastern Health Region of NL and this seems similar or possibly even higher than other larger Canadian provinces. While direct or indirect comparisons were beyond the scope of this paper, future research could look more closely at comparisons of lumbar spine CT utilization rates amongst provinces, especially given the high prevalence of LBP, the potential harm to a patient from radiation, and the questionable clinical utility for patients with uncomplicated LBP who require only conservative care. Similarly, further research is needed to better understand how many CTs were necessary for the management of a patient's condition. It is important to focus research on health system targeted interventions to improve the appropriateness of CT referrals, which would ensure patient safety is prioritized and healthcare funding is spent appropriately.

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Table 1. Included patient demographics stratified by age category and sex

Age Groups	Number of Records
Female	**7795**
Age 20 to 24	132
Age 25 to 29	249
Age 30 to 34	356
Age 35 to 39	497
Age 40 to 44	718
Age 45 to 49	863
Age 50 to 54	1051
Age 55 to 59	1020
Age 60 to 64	966
Age 65 to 69	850
Age 70 to 74	525
Age 75 to 79	314
Age 80 to 84	168
Age 85 plus	86
Male	**6575**
Age 20 to 24	119
Age 25 to 29	209
Age 30 to 34	338
Age 35 to 39	414
Age 40 to 44	577
Age 45 to 49	742
Age 50 to 54	869
Age 55 to 59	918
Age 60 to 64	880
Age 65 to 69	636
Age 70 to 74	457
Age 75 to 79	237
Age 80 to 84	128
Age 85 plus	51
Grand Total	**14370**

Table 2. Rate ratios comparing age-sex standardised rate estimates in adjacent years

Year comparison	Rate Ratio* (95% confidence interval)
2014 to 2013	1.137 (95% CI 1.084, 1.194)
2015 to 2014	1.117 (95% CI 1.067, 1.169)
2016 to 2015	0.896 (95% CI 0.857, 0.938)
*Calculated by dividing the more recent year by the year previous.	