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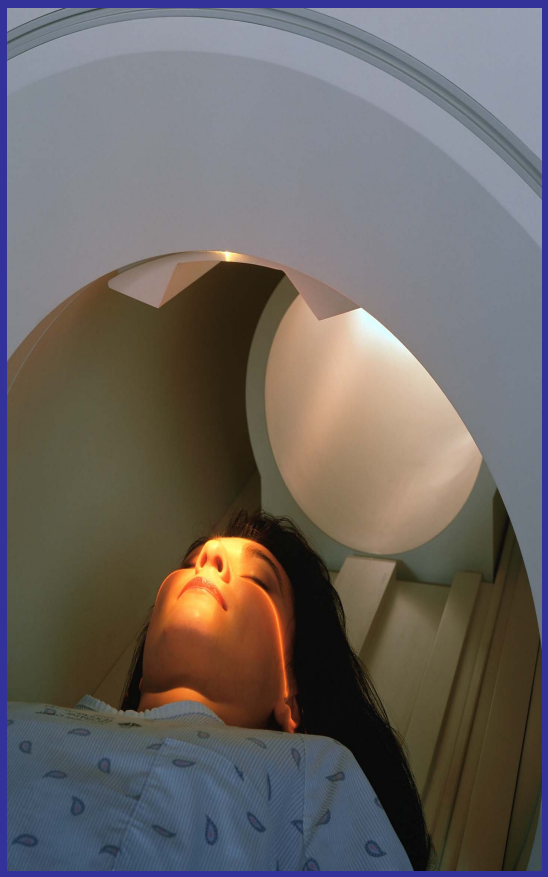
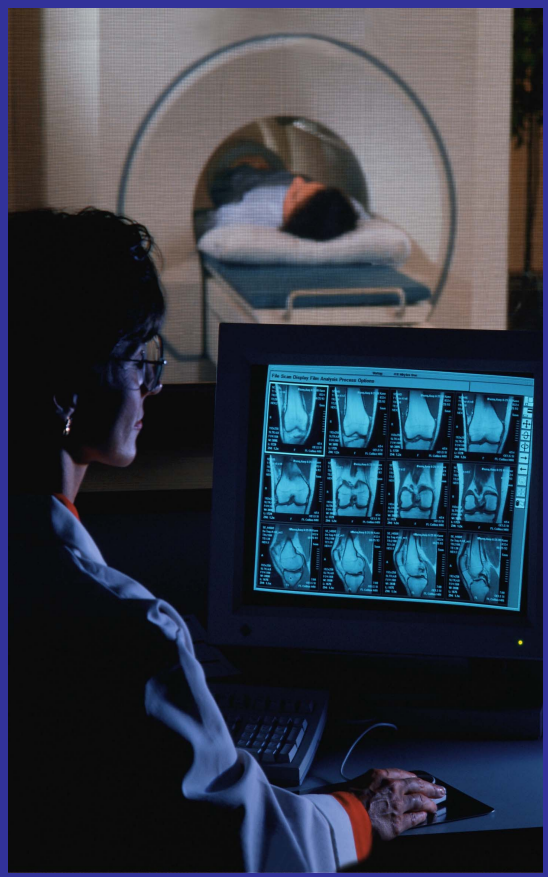
Access to MRI in Ontario: Addressing the Information Gap





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EXECUTIVE SUMMARY

Summary of Literature Review

1) Ontario, and Canada as a whole, have low rates of magnetic resonance imaging (MRI) scanners per population compared to other countries in the developed world;
2) MRI technology is evolving, and the potential indications for MRI are increasing;
3) The length and management of waiting times for MRI are perceived to be problematic by many different groups;
4) Increasing MRI capacity (number of scanners, operating hours and staff) is likely to improve access and wait times in the very short term. However, experience in other jurisdictions suggest that simply increasing capacity is not likely to alleviate waiting lists over time. The reasons for this include: expanding indications for MRI, changing referral patterns caused by increased availability, and others;
5) Developing a scale that will allow accurate and reliable assessment of a patient's need for an MRI scan is difficult. The wide variety of legitimate indications for MRI scanning makes it unlikely that a general scale applicable to all patients will be feasible. Some scales specific to particular indications have been developed, but their validation is not known;
6) Jurisdictions that use administrative databases to monitor waiting lists for MRI are not known;
7) The Winnipeg Regional Health Authority collects "primary data" on a monthly basis; these data are used to monitor MRI waiting lists and for planning purposes.

Key Findings

The preliminary analysis of MRI scans in Ontario using administrative data suggests that these data can be used to provide the following information for **outpatient scans** only (with a time lag of approximately one year):

1) *Temporal trends in MRI utilization in Ontario by body part* (the frequency of MRI scans has increased more than 5-fold in the last decade and by more than 50% from 1999 to 2001);
2) *Age- and gender-adjusted regional variations in MRI rates across the province* (there is considerable variation in access, with individuals in northern Ontario generally having a higher rate of MRI scans per population than those in southern Ontario);
3) *The frequency of repeat MRI scans* (about 15% of patients have a repeat MRI scan within 2 years);
4) *The specialty of the physician ordering an MRI* (neurologists order 24% of all MRI scans, family physicians 20%, orthopedic surgeons 17%, neurosurgeons 8%).

Further Uses of Administrative Data

It is possible that administrative databases can be used to evaluate the relative importance of patient (e.g. age, gender, socioeconomic status), physician (e.g. type of practice, year of graduation) and system (e.g. region, location of MRI scanner) factors upon the likelihood that a patient will receive an MRI (on an outpatient basis). As well, for some very specific conditions, it might be possible to estimate the proportion of MRI scans that lead to a subsequent diagnosis (e.g. the proportion of MRI scans of the brain that lead to a diagnosis of multiple sclerosis). In some groups of patients with a particular disease (e.g. brain tumour) it may be possible to determine the frequency of repeat MRIs. Finally, administrative databases can be used to determine the frequency of patients who receive other tests, such as ultrasonography or CT scans, prior to and after the MRI.

Qualitative Survey of MRI Centres

Data gleaned from an ICES qualitative survey of MRI centres in Ontario suggest that the centres routinely collect patient medical information, including indication for MRI, other co morbidities and often results from prior tests before an MRI is scheduled. Although most of this information is kept in hard copy, it may be feasible through chart review, to gather some of the missing pieces mentioned below.

Future Steps/Limitations

This analysis has demonstrated that administrative data can provide helpful information about utilization of MRI in Ontario. Many important pieces of information are missing, however, including:

1. Accurate inpatient diagnostic testing data;
2. Patients' presenting symptoms and the reason(s) for ordering the MRI;
3. An accurate assessment of waiting time;
4. The results of the MRI, and its impact upon patient management and outcome;
5. The relative impact of the MRI results compared with the results of other less expensive tests.

Data that are specifically collected to address the above issues will be required so that more informed decisions can be made about the provision of MRI in Ontario. ***Policy options/Recommendations*** arising from this report are found on page 13.

PREFACE

In June 2002, the Ontario Ministry of Health and Long-term Care (MoHLTC) asked the Institute for Clinical Evaluative Sciences (ICES) to evaluate whether it is possible to use administrative data to monitor the appropriateness of, and waiting times for, magnetic resonance imaging (MRI). This request came in a climate of intense political, medical and public debate about the sustainability of the Canadian health care system and the Ontario government's plan to introduce new MRIs into independent health facilities. At the same time, it was recognized that Canada as a whole and Ontario, have considerably fewer MRI units per population than most OECD countries [1-4]. The decision to increase MRI capacity should depend on evidence-based targets that ensure that patients who would definitely benefit from an MRI are receiving a scan in a timely fashion.

This report examines:

1. Why examination of waiting times for MRI is important in 2002;
2. The challenges of assessing wait times for MRI;
3. Local, national and international studies of MRI wait times;
4. The utilization and cost of MRI in Ontario over the past 10 years using administrative data, and provides a discussion of the opportunities and limitations of using these data for examining MRI wait times;
5. The results of an ICES qualitative survey of Ontario MRI centres to determine how waiting lists are currently managed, what information about waiting times is collected by MRI centres, and the centres' self-reported waiting times;
6. Options for how Ontario could more accurately monitor the appropriateness of MRI utilization, and the management of waiting lists for MRI.

INTRODUCTION

'Waiting lists' are currently viewed as a proxy of access to medical care, and since access to medical care in a timely fashion is one of the prime tenets of the Canada Health Act (1982), the issue of 'waiting lists' is socially and politically charged. The reasons for this are many. Waiting unusually long periods for medically necessary treatments may cause patients physical and psychological pain, loss of economic productivity, decreased quality of life, and in some instances even death[5;6]. There have been various proposals to reduce waiting times for medical services, most recently by the two reviews of Canada's health care system led by The Honourable Michael Kirby[7] and Commissioner Roy Romanow[4].

Kirby called for the development of a "health care guarantee" whereby patients would receive timely care based on clinical, evidence-based waiting time criteria that would be applied nationally[7]. Romanow announced a "Diagnostic Services Fund" that would improve access to medically necessary diagnostic tests, such as MRI and CT and called for the provinces to work toward a more managed waiting list system[4]. Others have proposed to alleviate the discordance between supply and demand by increasing the number of actual available services, increasing staffing and funding[8], better management[5;9], and accepting out-of-pocket payments by patients.

Some have pointed out that simply increasing capacity (in this case providing more MRI scanners) will not decrease waiting lists in the long term, because the indications for referral change as capacity increases [5;9;10].

Numerous reports[8;9], the ICES interview with MRI center managers described later in this report and media coverage suggest that waiting lists for MRI are long and growing. The suggested reasons for this are many, including: shortage of equipment, MRI-trained radiology technologists and radiologists; old and inefficient equipment is still being used[8]; increased patient care needs due to the aging population[3]; expanding indications for MRI[2;11]; patient and physician enthusiasm for new technologies that is sometimes greater than the evidence would support[10;11]; and, overworked physicians who find it quicker to order an MRI than to take the time to carefully examine and counsel patients[10]. Further, some suggest that waiting lists may be inflated by 30%-60% due to patient over-counting, including double bookings and cancellations[10].

CHALLENGES OF ASSESSING WAITING TIMES FOR MRI

The challenges of assessing waiting times for MRI include:

1. Standardization of wait times definition and measurement;
2. Determining the appropriateness of an MRI in relation to waiting times;
3. Deciding what a reasonable waiting time is;
4. Defining wait times using administrative data.

These points will be considered in turn.

The following steps must occur in order for a patient to receive a diagnostic test such as an MRI. The patient develops symptoms suggestive of a disorder, recognizes them as being worthy of investigation, and goes to a physician who decides that the patient should have a test. The test is ordered, the order is received and processed by the laboratory, and the patient's test is scheduled for a certain date. The patient then has the test, the results are interpreted by a radiologist, and are sent to and received by the ordering physician. The time between when the physician orders the test and when the test is performed may be a reasonable definition of the waiting time for a diagnostic test. However, defining wait times for diagnostic tests such as MRI is further complicated because a patient may experience considerable delay in accessing a physician who is able order the test. This is particularly a problem in MRI centres where a specialist is required to order the test. Further, when access to a test such as an MRI is severely limited, physicians may not order that test at all, but instead, may order an inferior test that is more readily available. As with other health services research information, it is important to remember that waiting lists only evaluate those patients for whom a test has been ordered – no information is available about patients who may need the test, but for whatever reason, are unable to obtain it.

Further obstacles are evident in defining the notion of 'acceptable' wait times for MRI. In general, it is more difficult to determine the need for a diagnostic test than the need for a therapy. The goal of therapies is to improve symptoms or delay the progression of disease, and it is relatively straightforward to determine whether the patient has a disorder that would benefit from the therapy (e.g. symptomatic triple vessel disease for coronary artery bypass surgery, or AIDS

for antiretroviral therapy). On the other hand, diagnostic tests are not only used to make a diagnosis, but also to assess prognosis, determine the response to therapy and provide reassurance to patients and physicians. Diagnostic tests, such as MRI, are used for a multitude of often non-specific symptoms that could potentially suggest disease (e.g. diagnosing multiple sclerosis, assessing the cruciate ligaments of the knee, diagnosing spinal stenosis). These numerous presenting complaints and their non-specificity make it very difficult for physicians to determine the appropriateness of a test.

Defining an appropriate waiting time for a scan is therefore inextricably linked to the appropriateness of ordering an MRI. Few would argue that excessive delay to receive a diagnosis or to determine treatment effectiveness is psychologically and physically harmful. The definition of "excessive" waiting time varies according to perspective (patient, physician, payer) and jurisdiction (an informal discussion among radiologists in England determined that an average 13 week waiting time is considered reasonable[12]; this wait time would be considered excessive in many parts of the United States). As well, there is considerable variability in the urgency of MRI, depending upon the presenting complaints. New onset of back pain with incontinence suggests a spinal cord compression that requires an immediate MRI, while chronic back pain with mild sciatica does not. Thus, "average" waiting times calculated by aggregating reasons for MRI can be misleading and difficult to interpret.

Given the above caveats, measurement of waiting times for diagnostic tests using administrative data has not frequently been reported in the literature. Administrative databases are much better at identifying therapies (e.g. surgery, prescription of a drug) than they are at recording patient symptoms, when a test was ordered or a diagnosis. Further, the administrative databases available in Ontario do not include any information about test results. Thus, it is not possible to determine what proportion of tests is normal (one might consider an excessive proportion of normal tests as suggesting that a test is being ordered too frequently). Finally, Ontario administrative data do not provide information about inpatient use of diagnostic tests. For the above reasons, administrative data have not been used frequently to assess wait times or the appropriateness of ordering diagnostic tests. However, as illustrated later in this report, administrative data can provide some useful information relatively easily.

STUDIES OF MRI WAIT TIMES

This review is not intended to summarize the full wait time literature. Rather, the important studies that focus on MRI wait times in particular are described. Please refer to McDonald et al [9] for an exhaustive literature review on wait times.

Canada:

The most comprehensive review of waiting times in Canada was published by ***Health Canada*** in 1998 [9]. It consisted of an extensive literature review of waiting lists and wait times, interviews with key Ministry informants, and surveys of all large Canadian hospitals, consumer and non-governmental groups between November 1997 and June 1998. Although the report mostly focused on therapies, wait times for MRI was consistently identified as being problematic by most groups surveyed. For example, 50 percent of hospitals cited MRI wait lists as usually or

always a problem. However, the most striking finding of the report was the almost complete lack of reliable and timely Canadian information about waiting lists in general, making evidence-based policy making virtually impossible. This is certainly true for MRI, and it is unlikely that the situation has improved considerably since then.

In an effort to respond to some of the issues raised by the Health Canada report, the ***Western Canada Waiting List (WCWL) project*** [6;13-15], a partnership of 19 health, medical and research organizations was launched in November 1999 to develop a standardized method of prioritizing patients in five clinical areas: MRI, hip and knee replacement, cataract surgery, general surgery and children's mental health. Priorities for an MRI scan were based on criteria set by clinicians. A score that would assess the urgency, need and priority of individual patients for an MRI scan was developed, consisting of 5 items (the amount of pain and/or suffering, severity of illness/ impairment, probable time course of clinical deterioration, probability of MRI providing clinically significant diagnostic information, probability of successful treatment based upon the diagnostic information). Note that this score was intended to be applicable to all indications for an MRI. Unfortunately, the reliability of the scale between patients was poor and it was not clear whether this approach would yield a useful standardized tool for assessing the indications for MRI or other diagnostic tests [6].

The Ontario response to the Health Canada wait times report was the ***Ontario Waiting List project (OWL)***, commissioned to the Joint Policy and Planning Committee by the Ontario MoHLTC[16]. The aims of the project were to evaluate practical tools for organizing and managing waiting lists using the application of clinical evidence and evaluation, and to provide recommendations on waiting list strategies in Ontario[17]. The release of this report is pending.

Since 1998, the ***Winnipeg Health Authority*** has been monitoring MRI utilization and waiting times on a monthly basis, in cooperation with the nine area hospitals[18;19]. Each hospital charge technologist completes a monthly data collection form outlining the number of exams and the wait times. On the final business day of each month, each hospital counts the number of patients waiting for diagnostic tests and measures the length of time from when a requisition was received to the time of the next available appointment. The length of wait for each procedure sub-group, such as MR brain, MR abdomen, MR spine is calculated and then a weighted average to is taken to calculate the average wait for that procedure at that site. The information is collated by the Regional Health Authority and disseminated to hospital administrators, health planners, the Manitoba Ministry of Health and others, who use this information for monitoring and planning. Information about other diagnostic tests such as CT scanning, ultrasound and bone mineral density is collected at the same time. Despite the fact that the collected wait times are crude estimates, health planners and policy-makers in the Winnipeg area use the information to manage utilization and wait times in the area.

In 2002, the ***Fraser Institute's*** extensive report on hospital wait times included diagnostic tests, such as CT, MRI and ultrasound for the first time[1]. Their data were based on a self-report survey of physicians across the country. With a 30% response rate, the accuracy of their information about waits for diagnostic tests must be viewed with caution. They found that wait times for MRI in Canada had remained stable from 1999 to 2001/02 at around 12 weeks and that Ontario's median wait times averaged 11 weeks in 2001.

The ***Ontario Association of Radiologists (OAR)*** recently released a report outlining their recommendations for MRI services in Ontario[20]. They recommended that 51 new scanners be installed in Ontario hospitals with increased funding of 75 million dollars annually, based on a fact-finding survey of the MRI centres in Ontario. This infusion of equipment and funding would, according to the OAR, alleviate the wait times experienced by Ontario patients. Nine specific recommendations outlined the process for the expansion of MRI scanners in Ontario. These included:

a) Increase the number of scanners from 44 to 95 to make sure the population in each county has adequate access;
b) MRI and CT scanning should be complementary – additional MRI scanners should be added to hospitals where CT scanning is already available;
c) Establish patient workload requirements and number of hours of operation for each scanner to alleviate waiting lists;
d) Require political discussion about access to diagnostic testing annually;
e) Ensure that hospital policies are in place so that all OHIP-insured patients receive equal access to testing regardless of referral source; and
f) Utilization and wait time data be submitted on a regular basis (although it was not outlined who would receive these data or in what format).

Their report was extremely detailed, with recommendations for the number of scanners required in each county. Future health services research-type reports are pending from the OAR to further their analysis of MRI utilization in Ontario.

Bell et al[21] surveyed 48 US and 18 Canadian acute care hospitals (2 hospitals from every city with a population over 500,000) about the waiting time for 7 elective services available in most hospitals, including MRI of the head without gadolinium, from May 1996 to April 1997. The median American wait time for MRI of head was 3 days compared with 150 days in Canada.

In a study from more than a decade ago, Mustard et al[22] found that MRI scans performed for residents of Manitoba (for whom requests had to meet specific referral protocols) were less likely to be "inappropriate" than scans performed on patients from adjacent provinces (who did not need to meet the protocols). This suggested that referral protocols might increase the appropriateness of referral. Of course, it is not possible to determine how many patients who might have benefited from a scan did not receive one.

Statistics Canada administered ***The Health Services Access Survey***[23] in November and December 2001 to a sub-sample of the Canadian Communities Health Survey (CCHS). The topics in the survey included self-reported waiting times for specialists, non-emergency surgery (cardiac, joint etc) and diagnostic testing (MRI, CT scans and angioplasty). Aggregated data at the national level are currently available.

United States:

There are few American studies that focus on wait times for MRI per se. Most studies deal with the utilization, uptake and management of MRI, and the clinical effectiveness and cost of mobile MRI units. Complete MRI utilization data is difficult to obtain and analyze in the US because

delivery is scattered throughout various providers, from hospital to private clinics to mobile scanners[24]. This review will only discuss the articles that dealt most closely with wait times or utilization of MRI. Mitchell et al (2002)[25] used administrative data from a northeastern US state (Medicare and a state fee-for-service provider database) to examine the utilization of body (pelvic, abdominal and chest) MRI relative to other body parts from 1998/99. Overall, MRI volume increased 21% from 1993 to 1996 and 35% from 1996 to 1999. Pelvic and neurologic MRIs increased 29%, chest/breast 10%, extremities 64%, and abdominal 101%, from 1996 to 1999. This being said, the majority of MRIs were for brain/spine (around 80%) and extremities (16%) in 1999.

Baker and Wheeler[24] found that high health maintenance organization (HMO) market-share was associated with lower levels of availability and use of MRI. They concluded that managed care may reduce costs for MRI, but were unable to comment upon the appropriateness of use in HMO and non-HMO markets.

According to a report in 1997, MRI utilization in the US is increasing up to 17% per year, with increases for vascular use leading the way[11]. Promises of using MRI for new indications, such as definitive diagnosis of stroke may drive utilization even higher.

Outside North America:

Some studies from the UK and continental Europe deal with wait times and appropriateness of use of MRI. Robling et al[26] used a critical incident technique to evaluate MRI use by general practitioners (GPs) in the UK who had direct access to MRI. Twenty-five GPs in Kent and Canterbury were interviewed retrospectively about patients who received MRI scans for knee and lumber spine complaints, to determine the reasons for referral and impact on management. Most patients were referred to specialists after they had their MRI (63%). MRI was perceived to be helpful in determining the appropriate specialist to refer to (e.g. pain clinic versus orthopedic surgeon) and in expediting referral when indicated. Direct access to MRI helped the primary care physician to manage the patient by him/herself, but it was imperative that GPs were aware of when to refer and how to best manage patients after MRI.

Of note, within the same paper, Robling et al reported upon a panel that was convened to develop criteria for assessing the appropriateness of requests for MRI. Separate criteria were developed for knee and lumbar spine. Both non-medical and biomedical criteria were identified as being important for the appropriateness of referral. It is noteworthy that separate criteria for knee and lumbar spine MRIs were developed, and that the criteria were quite specific. This is in marked contrast to the approach taken by the Western Canada Waiting List (WCWL) project, which attempted to develop one non-specific instrument for all MRI indications. Unfortunately, Robling et al did not report the frequency with which GP referral was appropriate, according to their criteria.

Szczepura and Clark (2000)[12] were commissioned by the National Health Service (NHS) in the United Kingdom (UK) to formulate a strategic plan for the management of local area MRI. From surveying the NHS regional trusts, they found that there was considerable under-provision with a lower than national number of scanners per million population. Most scanners in the area were heavily used with some waiting times exceeding a year, which was longer than the 13

weeks wait that was felt appropriate for a non-urgent scan (based on informal discussions with UK specialists). The strategic planning group outlined three main recommendations to the NHS trust Executive: an additional 8 to 14 new scanners were needed; extending working hours throughout weekends and evenings may help to reduce wait lists to 13 weeks; a minimum data set was required to validate and revise projections and to identify further areas of need.

A 1992 study in Oxford, UK[27] examined the levels of MRI patient throughput in an effort to alleviate wait times. Patients (N=173) were selected if they had clear-cut indications for MRI. Patients with brain, knee and lumber spine indications were allotted 20 minutes for MRI examination; cervical spine and lumber spine were allotted 30 minutes. Eighty-six percent (86%) were examined within the target times. The number of sequences performed was the most predictive factor affecting overall throughput. For this study, only the prescribed views were performed. In real clinical situations, subsequent views are often ordered for adequate diagnosis while the patient is already set up for an MRI. However only 12 of 173 patients had to be recalled for subsequent views. This study shows that quick patient throughput is possible by carefully selecting patients for this process. The upfront time required to triage patients into an expedited-type MRI track could increase efficiency to alleviate wait times substantially.

In a very recent study, Jones et al[28] examined delays in the diagnosis and treatment of 75 patients with head and neck cancer using the Liverpool Head and Neck database. Time intervals from general practitioner (GP) ear, nose and throat (ENT) specialty services, ENT to biopsy, ENT to CT and MRI scans, ENT to radiotherapy and ENT to surgery were collected. Thirty-six of 75 patients had an MRI, and waited a mean of 4.1 weeks (2 to 14 week range). Although the wait for primary radiotherapy (10.3 weeks) was deemed to be of the greatest concern, the compounded delay in each step of the management process, including obtaining a diagnosis, was deemed to be unacceptable.

The Royal College of Radiologists in the UK have developed guidelines for use of radiology as part of the European medical exposure directive[29]. According to the guidelines, MRI was deemed preferable over CT when both would provide the same information because MRI does not use ionizing radiation. However, they concede that MRI is subject to inappropriate uses. Detailed guidelines for radiology for various indications (head, musculoskeletal, breast, pediatrics) were developed.

Oakeshott et al conducted a randomized control trial to evaluate general practitioners' response to the introduction of The Royal College of Radiology guidelines for appropriate radiology use in the UK[30]. Sixty-two practices with 170 general practitioners were randomized into 2 groups. The intervention group (30 practices) received the guidelines by mail while the other group did not. Practices that received the guidelines referred patients less often for spinal radiologic examinations and made more referrals that conformed to the guidelines than the non-intervention group in the short term. The proportion of relevant positive findings from the radiology exams were not different in the groups. Long-term adherence to these guidelines was not assessed.

In Sweden[3], all hospitals and clinics were surveyed regarding the utilization and management of MRIs. Approximately 57 MRI scanners were available for clinical use, translating into about 7 scanners per million population. Wait times generally ranged from four days for inpatients, to between 30 and 40 days for outpatients; private scanners had 11-day average waits. In their

survey of countries, Japan and the US had the highest number of scanners per million population (31 and 24, respectively) while Mexico, Poland, Lithuania, Latvia, Ireland, Hong Kong, the Czech Republic, China and Canada had fewer than 2 scanners per million population between 1997 and 2000.

MRI UTILIZATION TRENDS AND WAITING TIMES IN ONTARIO

How the Analysis was Done

OHIP data available to ICES were used to describe trends in MRI utilization for outpatients in Ontario*. The professional component of all OHIP claims for MRI from January 1, 1992 to December 31, 2001 was identified. Claims that were not reimbursed by OHIP were excluded (1.05%).

MRI OHIP fee codes are available for head, neck, thorax, abdomen, pelvis, extremities and spine. For each of the above body parts, a base code for a multi-slice sequence is available as well as an additional code for repeat sequences (another plane or different pulse sequences – Appendix 1). A prescribed maximum number of repeat codes is allowed and the amount differs by body part (e.g. 2 repeats are allowed for head MRI, but 3 are allowed for neck, thorax). The repeat sequence codes, as well as those for additional MRI-related procedures such as cardiac gating, gadolinium and 3-dimensional imaging, should be submitted only when accompanied by a base multi-slice sequence code. Ninety-five percent (95%) of MRI scans were accompanied by repeat codes. MRI utilization was defined by counting the base multi-sequence codes, with or without repeats. Appendix 2 specifies the inclusion/exclusion criteria.

Temporal utilization trends of MRI by body type from 1992 to 2001 were derived. MRI physician-related costs and the yearly percent change in costs were estimated. The estimates included all claims reimbursed by OHIP, including fees for base multi-sequence codes, repeat codes, and additional related procedures.

Age- and sex-specific MRI utilization rates were derived. Patients' age, gender and the first 3 digits of the postal code (forward sortation area or FSA) from the Registered Persons Data Base (RPDB) were obtained. Age was calculated from the 1st of July of the year of patient birth to the date of MRI scan. The county where each patient resided was derived by converting the FSA to county, using Statistics Canada conversion files. Age was aggregated into 10-year age groups.

* Only outpatient records were analyzed for this report, since the professional and technical components for inpatient MRI scans are absorbed by hospital global budgets and are therefore not submitted to OHIP. Hospital discharge abstract data (DAD), from the Canadian Institute for Health Information (CIHI) were used to investigate whether accurate information about inpatient MRI utilization could be obtained. The submission of MRI and other diagnostic tests to the DAD is no longer mandatory and therefore, the inpatient estimate that was obtained (approximately 7,600 scans in 2001) was considered to be an underestimate of the true number of inpatient scans. Further, coding in the DAD for MRI does not distinguish MRIs for different body regions. Management information system (MIS) data was also consulted to determine if accurate inpatient MRI information could be obtained to describe utilization, however, these data do not provide information on the number scans performed.

Age- and sex-specific rates of MRI utilization were calculated for 2000 and 2001 using inter-censal estimates based on the 1996 Census population data as the rate denominator.

In order to estimate the number of repeat scans for patients in a two-year period, patients were selected patients who had an MRI scan for any body region in 1999. To identify patients with a first scan, patients who had an MRI scan for the same body region in 1997 and 1998 were excluded. The percentage of patients with a scan in 1999, and repeats scan for the same body region in the next two years were identified for the remaining patients (73% of MRI scans in 1999).

In order to examine referral patterns for MRI, referring physician specialty was obtained from the validated Ontario Physician Human Resources Data Centre (OPHRDC) files from 1992-1999. For the years 2000 and 2001, referring physician specialty was obtained using the 1999 files (the most current data available at ICES). More than 96% of referring physicians to their specialty were linked. The percent of referring physician specialty by MRI body type was derived.

Utilization of MRI scans in 2001 by region was derived using small area rate variation (SARV) methods. The age- and sex-adjusted rate per 100,000 population in each of the 49 counties in Ontario was calculated for MRI of the extremities, head and spine. The 2001 Ontario population was used as the standard in the adjusted rate calculation. SARV summary statistics were derived [extremal quotient (EQ); coefficient of variation (CV); systematic component of variation (SCV); adjust chi-square likelihood ratio] to determine the extent of variation across the province.

The number of scanners currently running in Ontario was tallied by health planning region, based on a listing from the MoHLTC. The number of scanners per million population by health planning region was calculated.

Finally, in an attempt to examine MRI wait times, a cohort of patients was created who had their first MRI in 2001 and a valid referring physician number for that scan and a referring physician visit within the year prior to the MRI scan. In order to examine wait times for persons receiving their first MRI for a particular condition (i.e., not follow-up scans), excluded were all patients who had the same type of MRI scan in the 3 years prior to their initial scan in 2001, based on Ontario Health Insurance Plan (OHIP) billings and linked Canadian Institute for Health Information (CIHI) hospital discharge abstract data. Since there was no information about the date of MRI scan referral, patients who had more than one visit to the referring physician during the year prior to the MRI were excluded. Finally, only the first MRI scan in 2001 was considered for patients with multiple MRIs in 2001 and the same referring physician. In the remainder (13% of all scans in 2001), the wait time from the visit to the referring physician to the first body-specific MRI scan in 2001 was calculated.

Findings and Discussion

Please note that all findings discussed below are based on ***outpatient data only***, since inpatient data are not currently available.

Exhibit 1 shows the number of outpatient MRIs and cost trends from 1992 to 2001 in Ontario. In 1992, 25,406 MRIs were performed. This increased by 474%‡ to 145,810 in 2001. The overall amount that OHIP paid for MRI scans increased from $2,828,243 in 1992 to $23,636,480 in 2001 (736%‡). Between 1999 and 2001, the total number of MRI scans in Ontario increased by 53%. Exhibits 2 and 3 show that all types of MRI scans have increased during the last decade, with MRIs of the head, spine and extremities being the most frequent (39%, 30% and 21% of all scans respectively, in 2001). Although MRI scans of the abdomen have had the greatest proportional increase during the last decade (1,133%‡ from 1992 to 2001), they still accounted for a small proportion of all MRI scans (3%) in 2001.

Exhibit 4 illustrates the age-specific rate of outpatient MRI visits per 100,000 males and females in the years 2000 and 2001. MRI utilization was highest for women ages 40 to 69 years, peaking at age group 50-59 and dropping after the age of 70. For men, the utilization steadily climbed to age 60 to 69. Women compared with men had higher MRI utilization across all age groups less than 70 years of age. Exhibit 5 illustrates the age- and sex-specific MRI rates per 100,000 population by MRI body region for the year 2001. Overall, women had higher rates of utilization for all body types except for extremities and neck. Men ages 20 to 49 had higher utilization of MRI of the extremities than women.

Outpatient MRI scans were mainly ordered by neurologists (24%), family physicians (20%), orthopedic surgeons (17%) and neurosurgeons (8%) (Exhibit 6). These four physician types ordered almost 69% of all MRI scans in 2001. The most frequent referring specialty varied considerably, depending upon the body region of the MRI scan. In northern Ontario, 42% of referrals for MRI were by family physicians, compared with 17% in the southern part of the province.

Fifteen percent (15%) of patients who had an outpatient MRI had repeat scans of the same type between 1999 and 2001 (Exhibit 7). This varied relatively little by body region, and was greatest for MRI scans of the thorax and spine (17%) and lowest for MRI scans of the extremities (10%).

Exhibits 8, 9 and 10 depict the regional variation of outpatient MRI utilization per 100,000 population across Ontario counties for MRI of the extremities, head and spine, respectively. There is considerable variability in the MRI utilization rates across counties and across MRI body regions. Counties in the central west region of the province (Waterloo, Kent, Oxford) have consistently lower utilization rates than the provincial rate while counties in the northern part of the province (Cochrane, Thunder Bay Algoma, Sudbury) have higher rates of utilization across the MRI body regions examined.

Exhibit 11 depicts the number of MRI scanners per million population across Ontario by health planning region. The regions with among the highest number of scanners per capita were among the counties with the highest utilization, as depicted in Exhibits 8-10 (the northern areas of Ontario), while areas with the lowest number of scanners per million population were among the counties with the lowest utilization (Central west).

‡ Numerical figures are correct, however in the March 2003 report there was an error in the translation of these numbers into percentages. Revised percentages are incorporated in the above. These revisions do no change the overall trends or recommendations in this report. Revision date: July, 2003.

Exhibit 12 illustrates a preliminary estimation of waiting times for an outpatient MRI scan in 2001 - a median wait time of about 7 weeks, and a mean wait time of 12 weeks. Two caveats must be considered when interpreting these data. First, only 13% of patients were included in

the wait time analysis, because individuals who had an MRI scan prior to 2001 and/or had more than one visit to the referring physician during the preceding year were excluded (it was impossible to know on which visit the MRI was ordered). A large proportion of referrals from GPs are therefore excluded, because many patients see their GP more than once per year. Since 20% of referrals for MRI come from GPs, the calculated wait times in this analysis may not be generalizable to the entire population. Second, the available administrative data suggest that 13% of patients in this cohort had an MRI on the same day as the referral. This finding is surprising since only outpatient data was evaluated and further work is needed to assess the validity of these data regarding the referring physician. ***Therefore, because of gaps in the available data, wait time cannot be ascertained with certainty using administrative data.***

Interpretive Cautions

These analyses of administrative data have many limitations including:

a) No information about symptoms;
b) Inability to reliably determine when a test was ordered, therefore making it difficult to calculate wait times;
c) No information about the test results and their impact upon patient management;
d) No information about inpatient MRIs or patients who had their MRIs paid for by the Workplace Safety and Insurance Board of Ontario (WSIB),
e) Inability to identify groups of patients who would have benefited from MRI, but who did not receive a scan.

Interviews with Managers of Ontario MRI Centres

Background

A qualitative telephone interview with the managers at the MRI centres in Ontario was conducted in late 2002 to get a sense of MRI wait times in Ontario and to gain an understanding of the type and breadth of patient clinical information that the centres collect on an ongoing basis.

Data Source

The location of the MRI centres in Ontario was obtained from the Independent Health Facilities Branch at the MoHLTC (Appendices 4 and 5). The managers of the MRI centres in 38 Ontario hospitals were identified and an introductory letter that explained the intent of our survey was sent. A week later, a copy of the survey was sent to the managers so that they could obtain information prior to the interview. A week after that, each manager was telephoned to discuss the survey questions.

The interview questions were developed by the ICES Diagnostic Testing Working Group. This group consists of researchers with various clinical and methodological backgrounds. The

interview was administered and analyzed qualitatively, and consisted of basic operational questions about the MRI centre (the number of years in operation; referrals; triage information; crude wait time information; staffing). Managers were also asked to fax copies of their referral forms and requisition sheets to gain an understanding of the information that they collect on patients.

Findings and Discussion

Exhibit 13 illustrates the qualitative results of our interview. All 38 MRI centres were telephoned. Data from 25 centres were obtained (66%). Of these, 4 centres did not fax back their requisition forms. One centre of the 38 contacted refused the interview and managers from 12 centres were not available after repeated attempts.

Operational Issues:

- The 25 centres that responded hold 75% of Ontario's scanners (33 scanners in total). Seven centres who answered the survey have more than one scanner;
- Two centres are open 24 hours a day, 7 days a week. Two are operational less than 12 hours per day. Seven centres are not open on weekends;
- Twelve centres reserve a portion of their scanning time for third party payers, however most are done during 'off-hours'; one centre has a privately-run scanner that is only used for 3rd party payers (legal or insurance);
- The number of inpatient MRI scans performed per day ranges from 1 to 5; these either have designated time slots or are just added into the schedule ad hoc;
- A median of 20 outpatients per day are performed with a range of 15 to 27;
- Nine centres have set times for different MRI types, based on the availability of radiologists and the time taken to perform the scans; neurological and musculoskeletal scans are often performed in the evenings;
- Five hospitals require referrals from specialists only; 3 teaching hospitals allow affiliated GPs to refer; all others allow both GPs and specialists to refer.

MRI centres in Ontario have been in operation for a median of 4 years. Five have been in operation for less than two years, while three have been in operation for more than 10 years. All centres require a completed requisition and/or patient information forms from referring physicians and patients before an appointment is made. Twenty-one, or 84 percent, of centres that responded faxed their blank requisition forms to us. Although the forms were laid out differently across hospitals, the content was similar (patient current clinical state and medical history). Eleven hospitals store their patient information electronically. Most hospitals have kept, or will keep the stored information for five years.

Triage:

- Three hospitals have written triage policies, however, each hospital has some form of patient prioritization according to clinical indication for MRI or by referring physician;
- Two hospitals indicated that patients of referring GPs waited longer, regardless of indication;

- Triage is handled in all cases by the radiologist; 2 hospitals also involve technologists in this process;
- Most hospitals have ongoing lists of patients who are available at short notice to fill cancelled MRI appointments; inpatients often fill cancellations.

Wait times:

MRI wait times were reported by the technologist/managers, based on the next available date for future bookings. Below are the findings:

- An MRI for urgent indications, such as cord compression or trauma is available within 24 hours in all centres;
- MRIs for tumours or other urgent indications range from 48 hours to 2 weeks.
- Wait times vary for non-urgent indications, such as chronic pain and general neurological indications;
- The median MRI wait time is about 4 months (range 2 weeks to 18 months);
- The two most recently opened MRI centres report average wait times of one month, while the more established MRI centres report wait times from 5 months to over a year;
- The monitoring of wait times varies from weekly formal evaluations to no evaluation at all.

Interpretive Cautions:

The results described above were based on qualitative interviews with MRI center managers. **The wait time data were based on approximations reported by the managers.** ***Booking records were not accessed to calculate quantitative estimations of wait time.***

POLICY OPTIONS/RECOMMENDATIONS

While administrative data can be used to monitor access to and utilization of MRI, the limitations of these data do not allow for some key policy-relevant questions to be addressed.

With the existing gaps in data, the following ***cannot*** be analyzed:

1) Inpatient data;
2) Appropriateness of use (i.e. the patient's symptoms and the reason for ordering the MRI);
3) Waiting time;
4) Impact of MRI use on patient outcome;
5) Impact of the use of MRI, relative to the use of other less expensive tests, on patient outcome.

The inability to assess the above noted items represents a significant gap in the evidence required to support decision-making and policy development. Addressing the existing gaps in data is a prerequisite to being able to effectively manage waiting lists and resources and to optimize outcomes.

Following is a series of policy options/recommendations for addressing the current information gap to support evidence-based decision-making relating to MRI in Ontario.

Establish a committee or group with the responsibility for reporting on quality issues regarding MRI. Responsibilities would include identifying appropriate indications for MRI, monitoring MRI utilization and waiting times, and overseeing the management of waiting lists. The overarching function of this group would be to identify the data needed to examine these gaps, to determine how to obtain these data, and to use these data to regularly report on MRI use in Ontario.

Pros: Such a group will increase the likelihood that decisions about MRI provision will be based on evidence. This group could also be given responsibility for other diagnostic tests.
Cons: Balancing the potentially conflicting interests of the numerous stakeholders interested in MRI and other diagnostic tests might be difficult.

The following sub-options flow from above:

a) **Annually monitor MRI utilization, including regional variation, with administrative data. All MRI scans, whether publicly or privately funded should be monitored.**

   Pros: Will provide policy-makers, clinicians and the public with information about the frequency of MRI use on a regular basis. Providing this information is relatively inexpensive.
   Cons: Information about utilization does not provide information about access, appropriateness of use, or impact on patient outcome.

b) **Establish a brief, standard form across the province for recording the indication for MRI and the length of waiting times. This should be collected electronically in a format that would allow linkage to administrative data. This should apply to inpatient and outpatient MRIs, public and private providers.**

   Pros: Would provide useful information about the indications for MRI and waiting times that is currently not available, but that could be used to monitor MRI use.
   Cons: Initial costs of establishing this system could be substantial. In the absence of established criteria for determining the indications for MRI, providing this information may not improve the management of MRI demand.

c) **Further the development and implementation of clear criteria for the indications for MRI and for most of the common conditions/symptom complexes for which MRI is ordered. Include a version for the public.**

   Pros: Could be built on work that has already been done (e.g., the Royal College of Radiologists[29] in the UK and the Canadian Association of Radiologists[31]) and would provide referring physicians and patients with information about the indications for MRI. Could be used to help manage waiting lists for MRI.
   Cons: Experience to date suggests that developing clear indications for MRI is difficult. Initial development of these indications will likely be costly and time consuming. Indications must be reviewed regularly.

d) Collect information on the results of MRI scans that could be linked with administrative data.

Pros: This information could be used to monitor the referral patterns for MRI, appropriateness of use, and to begin examining impact on patient outcome (e.g., comparing the rate of normal MRI scans among regions and over time). Could be done relatively easily as most radiology departments store results electronically.
Cons: In some circumstances it will still be difficult to determine the 'appropriateness' of MRI use.

Based on the evidence gained from the collection of the above data, and recommendations put forth by the established committee, the evidence would be available to make decisions regarding MRI provision in Ontario.

Pros: Changes in the system will be based on the best available evidence.
Cons: This process will be time consuming and data collection may be costly.

Exhibit 1: The number and cost of outpatient MRI visits by scan type in Ontario, OHIP 1992–2001

	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001
Abdomen	394	526	549	577	849	1119	1725	2087	3185	4858
Extremities/multiple	3543	4385	5009	5994	7729	10171	14905	18472	23895	30790
Head	13304	15526	16730	18270	22511	26989	34362	41544	47871	57106
Neck	354	363	467	509	707	851	1102	1803	2420	2876
Pelvis	550	770	767	836	1032	1277	1645	1980	2775	3853
Spine	6799	8638	10039	11061	13618	16578	22673	27509	34746	43582
Thorax	462	504	594	608	727	857	1108	1662	1921	2745
ALL	**25406**	**30712**	**34155**	**37855**	**47173**	**57842**	**77520**	**95057**	**116813**	**145810**
Fees paid by OHIP ($ CAN)	2,828,243	3,529,887	3,945,058	4,461,902	5,643,689	6,836,056	10,242,838	13,954,168	18,089,703	23,636,480

Exhibit 2: Number of outpatient MRIs by body type and year in Ontario, OHIP 1992–2001

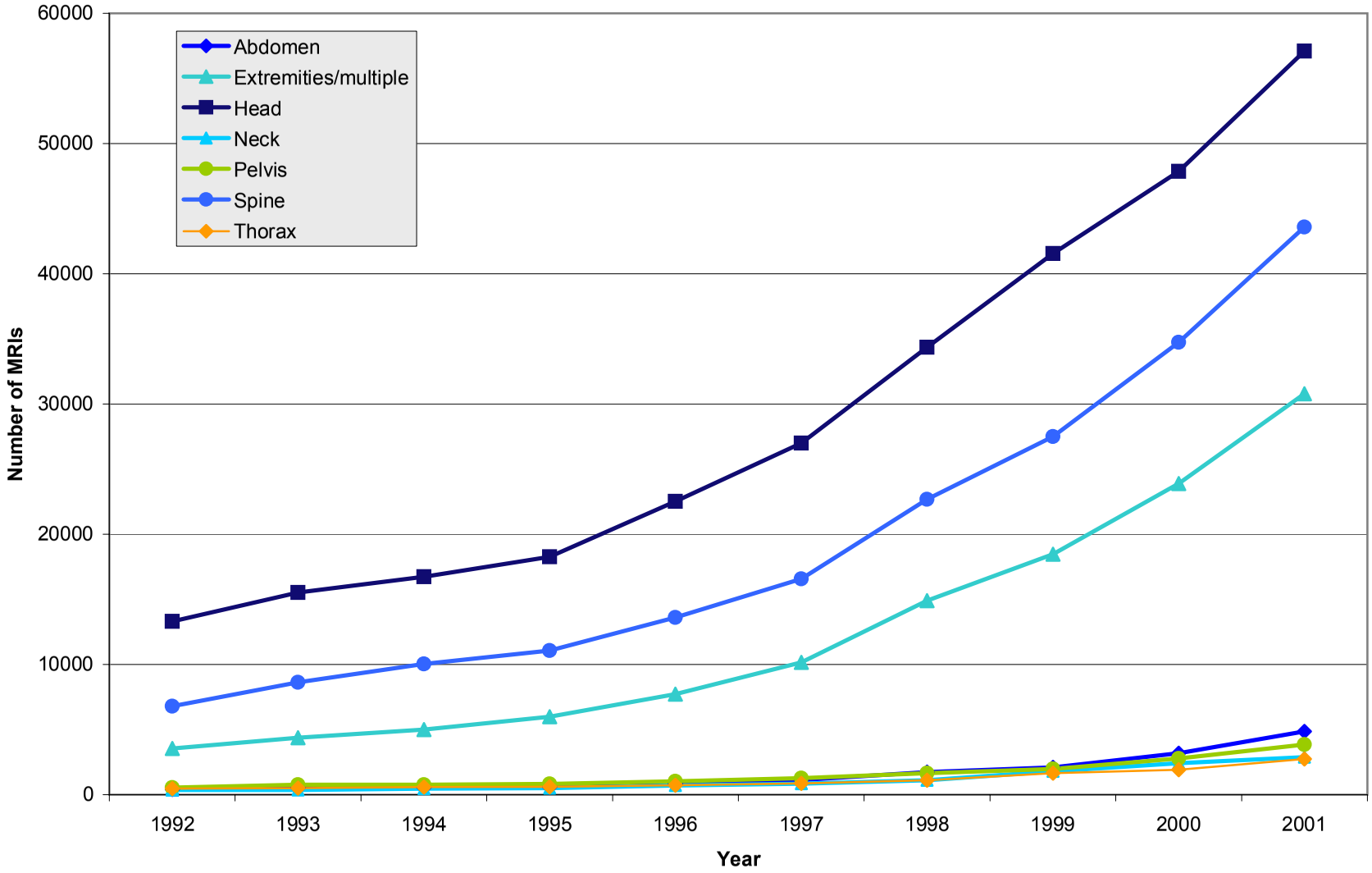

Exhibit 3: Cumulative percent change in outpatient MRI utilization in Ontario, OHIP 1992–2001

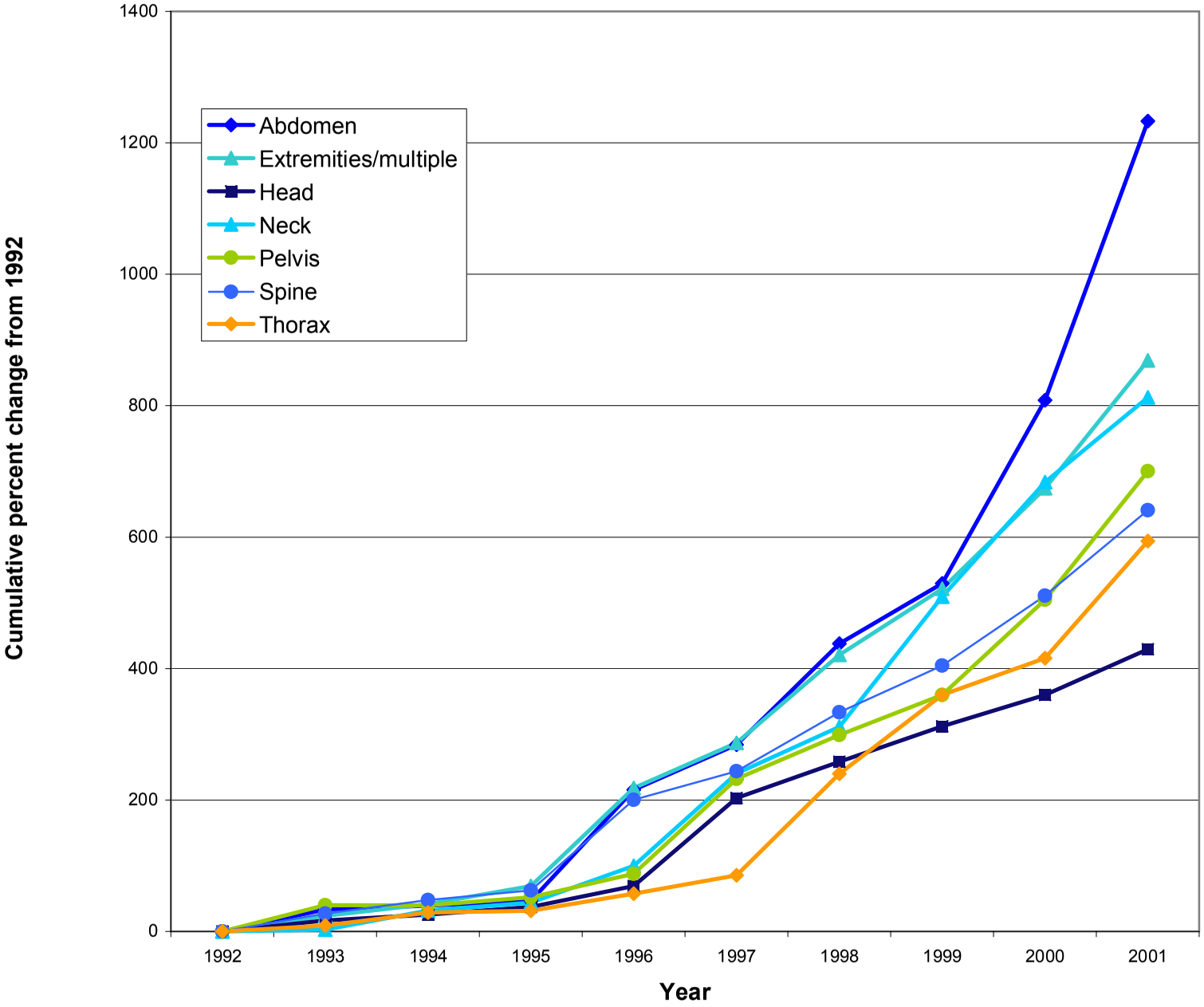

Exhibit 4: Age- and sex-specific outpatient MRI rate per 100,000 in Ontario by year, OHIP 2000 and 2001

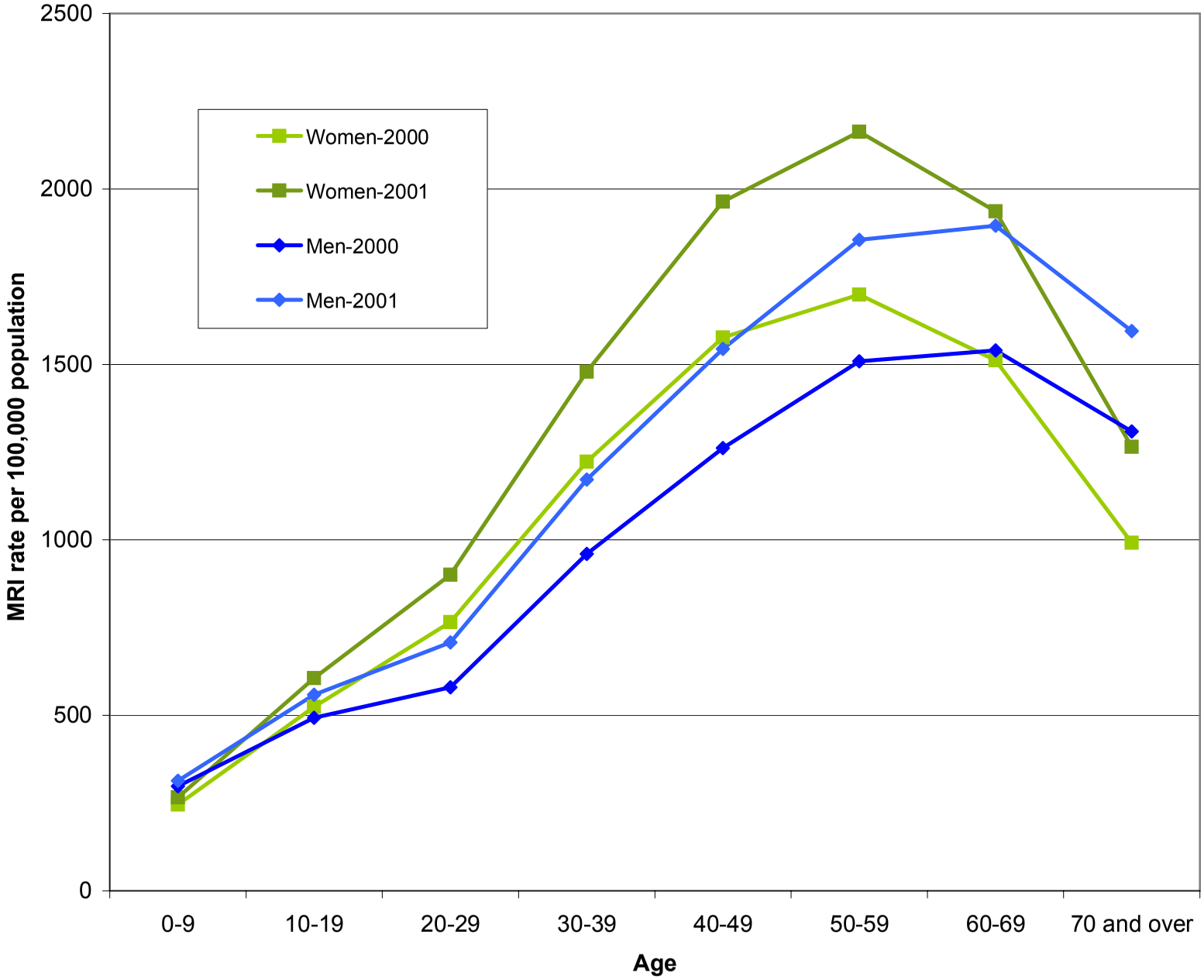

Exhibit 5: Age- and sex-specific outpatient MRI rates per 100,000 population in Ontario, OHIP 2001

Age group	0-9 years	10-19 years	20-29 years	30-39 years	40-49 years	50-59 years	60-69 years	70+ years	ALL
				FEMALES					
Abdomen	7	10	19	37	53	80	98	84	**45**
Extremities	23	214	215	252	339	396	294	140	**237**
Head	167	252	436	671	800	824	768	531	**557**
Neck	2	11	11	18	28	39	47	39	**23**
Pelvis	4	14	26	53	70	71	62	46	**43**
Spine	56	94	177	419	633	701	619	399	**382**
Thorax	8	12	17	29	41	52	49	26	**28**
All	**266**	**606**	**901**	**1479**	**1964**	**2163**	**1936**	**1265**	**1316**
				MALES					
Abdomen	7	9	7	18	35	71	107	117	**37**
Extremities	22	218	297	382	404	397	298	145	**282**
Head	210	224	221	350	482	643	713	660	**402**
Neck	2	8	10	17	28	52	63	67	**26**
Pelvis	7	10	12	14	18	34	60	48	**21**
Spine	54	76	144	378	561	633	624	535	**351**
Thorax	11	14	18	14	17	24	30	22	**18**
All	**314**	**559**	**708**	**1172**	**1544**	**1855**	**1895**	**1595**	**1137**

Exhibit 6: Percent of referring physician specialty for outpatients by MRI type, OHIP 2001

MRI frequency	Abdomen	Extremities	Head	Neck	Pelvis	Spine	Thorax	% of total MRIs
NEUROLOGY	0.3	0.6	**41.5**	**16.2**	2.2	**22.2**	2.9	**23.6**
GP/FP	**13.9**	**24.3**	**14.8**	**15.6**	**13.9**	**24.2**	**12.2**	**19.5**
ORTHOPEDIC SURGERY	0.5	**54.2**	0.3	**13.3**	9.2	**15.2**	3.0	**16.5**
NEUROSURGERY	0.2	0.2	9.0	5.7	0.3	**13.5**	1.2	7.8
OTOLARYNGOLOGY	0.1	0.1	**10.5**	**15.5**	0.1	0.2	0.5	4.6
OTHER	3.5	2.9	4.5	2.8	2.9	3.2	5.8	3.8
RADIOLOGY & NUCLEUR MED	4.0	3.7	2.3	1.6	3.3	2.9	1.4	2.9
PHYSICAL MEDICINE AND REHAB.	0.0	3.0	0.6	0.6	1.5	6.1	1.6	2.8
RADIATION ONCOLOGY	1.5	0.4	3.8	**11.7**	**11.6**	1.4	5.1	2.7
RHEUMATOLOGY	0.9	4.5	0.4	1.2	3.1	3.3	1.9	2.2
PEDIATRICS	2.4	1.0	3.6	0.7	2.4	1.1	5.9	2.2
MEDICAL ONCOLOGY	5.8	0.5	1.3	2.7	7.7	2.2	9.3	1.9
INTERNAL MEDICINE	6.8	1.1	2.0	1.5	1.1	1.3	2.7	1.7
GENERAL SURGERY	**13.4**	1.4	0.2	2.7	7.4	0.4	8.8	1.4
ENDOCRINOLOGY	1.1	0.1	3.1	0.8	0.2	0.1	0.1	1.3
OBSTETRICS AND GYNECOLOGY	3.1	0.1	0.5	0.0	**22.8**	0.1	1.0	1.0
GASTROENTEROLOGY	**21.7**	0.3	0.1	0.0	1.9	0.1	0.7	0.9
EMERGENCY MEDICINE	0.4	0.7	0.7	0.9	0.8	1.3	0.6	0.9
CARDIOLOGY	1.1	0.0	0.1	1.9	0.2	0.1	**27.8**	0.7
UROLOGY	8.6	0.1	0.1	0.0	4.3	0.4	0.2	0.6
NEPHROLOGY	7.4	0.1	0.3	0.2	0.4	0.1	1.3	0.5
CARDIOLOGY/THORACIC SURGERY	1.6	0.0	0.2	0.4	1.7	0.2	4.0	0.3
VASCULAR SURGERY	1.4	0.4	0.1	3.6	0.8	0.1	1.8	0.3
PEDIATRIC SURGERY	0.3	0.0	0.0	0.1	0.3	0.0	0.2	0.1
TOTAL NUMBER	4649.0	27487.0	54511.0	2691.0	3686.0	41065.0	2584.0	137710.0

Note: Rates in bold signify specialties with over 10% referral

Exhibit 7: Percent of outpatients who had an MRI in 1999 and a repeat scan in 2000 or 2001, OHIP 1997–2001

	Percent of MRI outpatients in 1999						
	1 visit only	1 repeat	2 repeats	3 repeats	4 or more repeats	Total % repeats	Total patients
Abdomen	88.82	7.87	2.22	0.7	0.38	11.17	1843
Extremities	89.69	8.78	1.11	0.31	0.1	10.3	16885
Head	84.02	10.82	2.8	1.05	1.31	15.98	32099
Neck	86.56	10.03	1.99	1.22	0.19	13.43	1555
Pelvis	85.56	9.53	2.31	1.58	1.03	14.45	1648
Spine	82.83	13.13	2.78	0.79	0.48	17.18	22917
Thorax	82.78	11.41	3.3	1.22	1.29	17.22	1394
Total patients	**66,642**	**8,580**	**1,880**	**647**	**592**	**11,699**	**78,341**

Note: Excludes patients who had an MRI 1997 or 1998

Exhibit 8: Age- and sex-adjusted MRI of the extremities outpatient rates per 100,000 population by county in Ontario, OHIP 2001

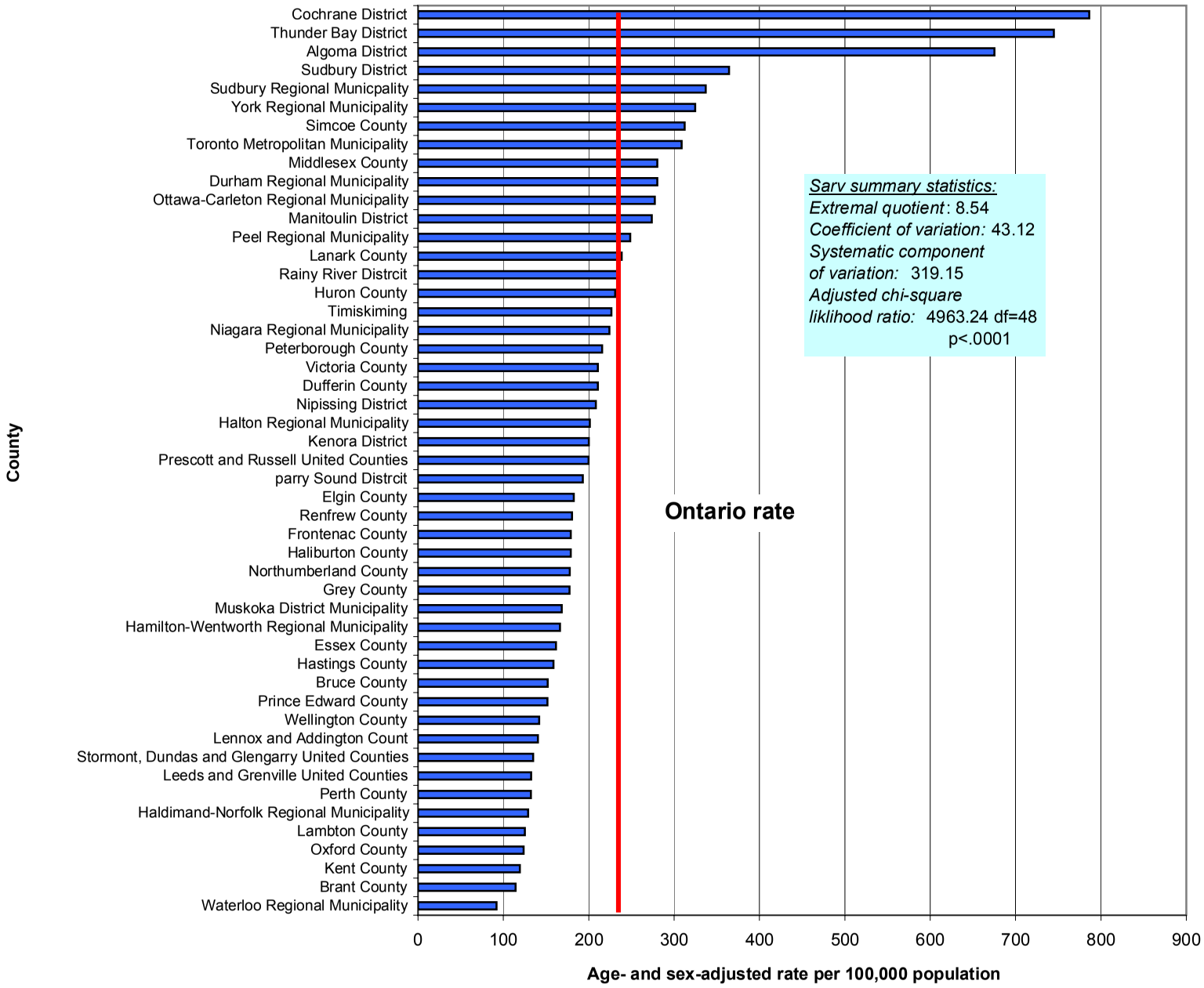

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Exhibit 9: Age- and sex-adjusted MRI of the head outpatient rates per 100,000 population by county in Ontario, OHIP 2001

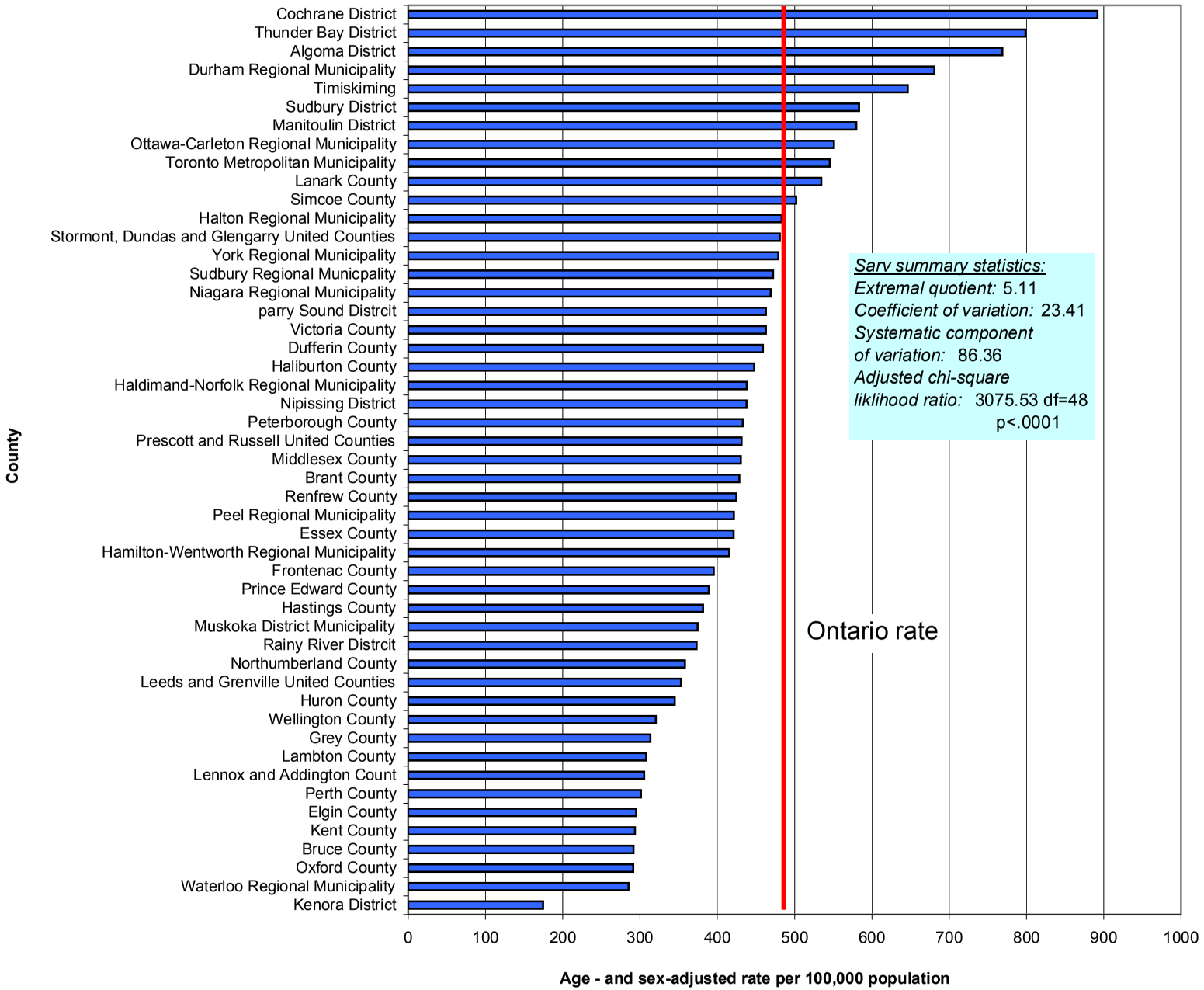

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Exhibit 10: Age- and sex-adjusted MRI of the spine outpatient rates per 100,000 population by county in Ontario, OHIP 2001

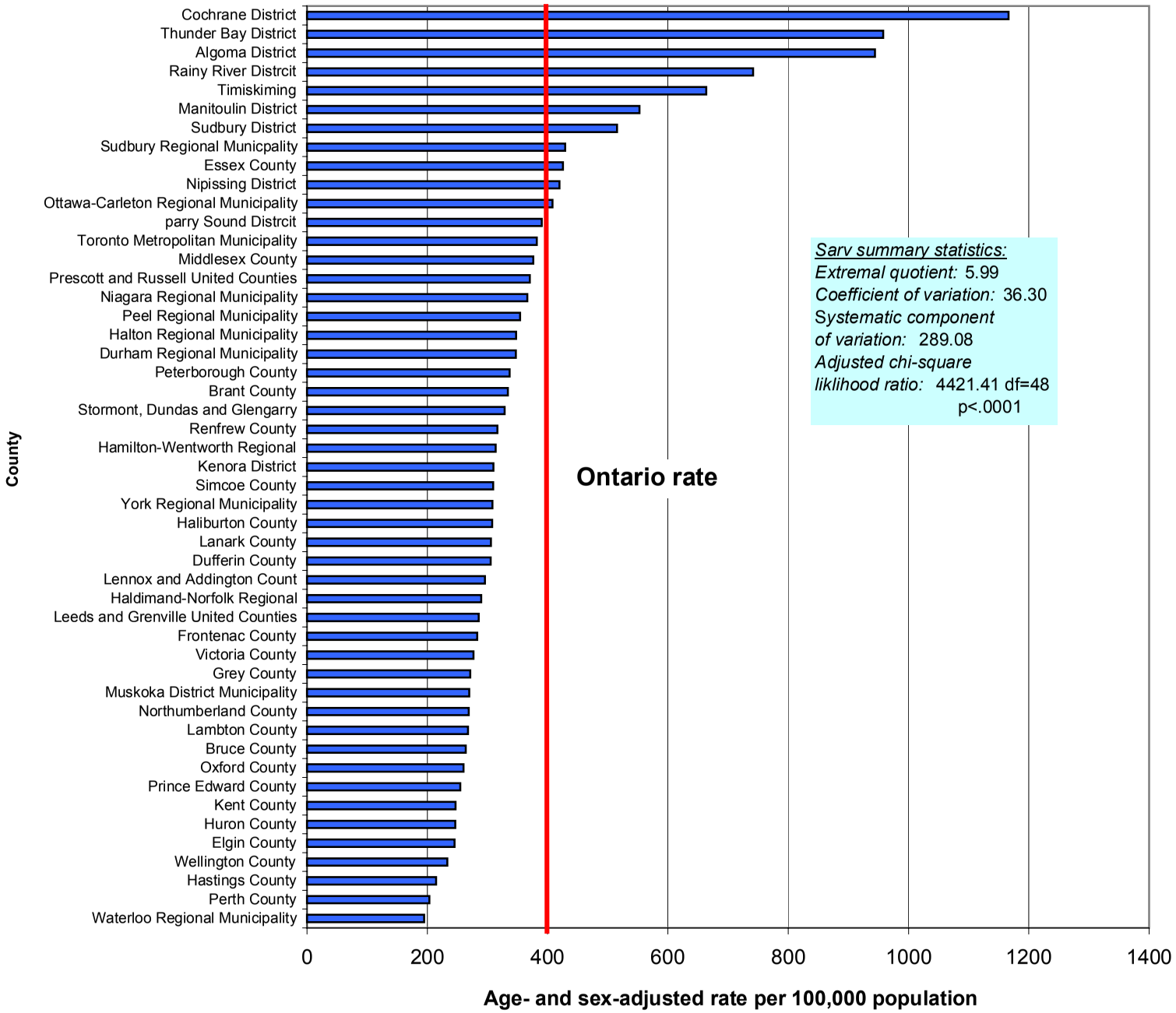

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Exhibit 11: Number of MRI scanners per million population by health planning region in Ontario, Ontario Ministry of Health and Long-Term Care (MOHLTC), 2002

Ministry of Health Planning Regions	District Health Councils
1 Toronto	Toronto
2 Central East	Durham, Haliburton, Kawartha and Pine Ridge Simcoe-York
3 Central West	Waterloo Region–Wellington–Dufferin Halton–Peel
4 Central South	Grand River Hamilton–Wentworth Niagara Region
5 Eastern	Champlain Quinte, Kingston, Rideau Valley
6 North	Algoma, Cochrane, Manitoulin and Sudbury Muskoka, Nipissing, Parry Sound and Timiskaming Northwestern Ontario
7 South West	Grey, Bruce, Huron, Perth Thames Valley Essex, Kent and Lambton

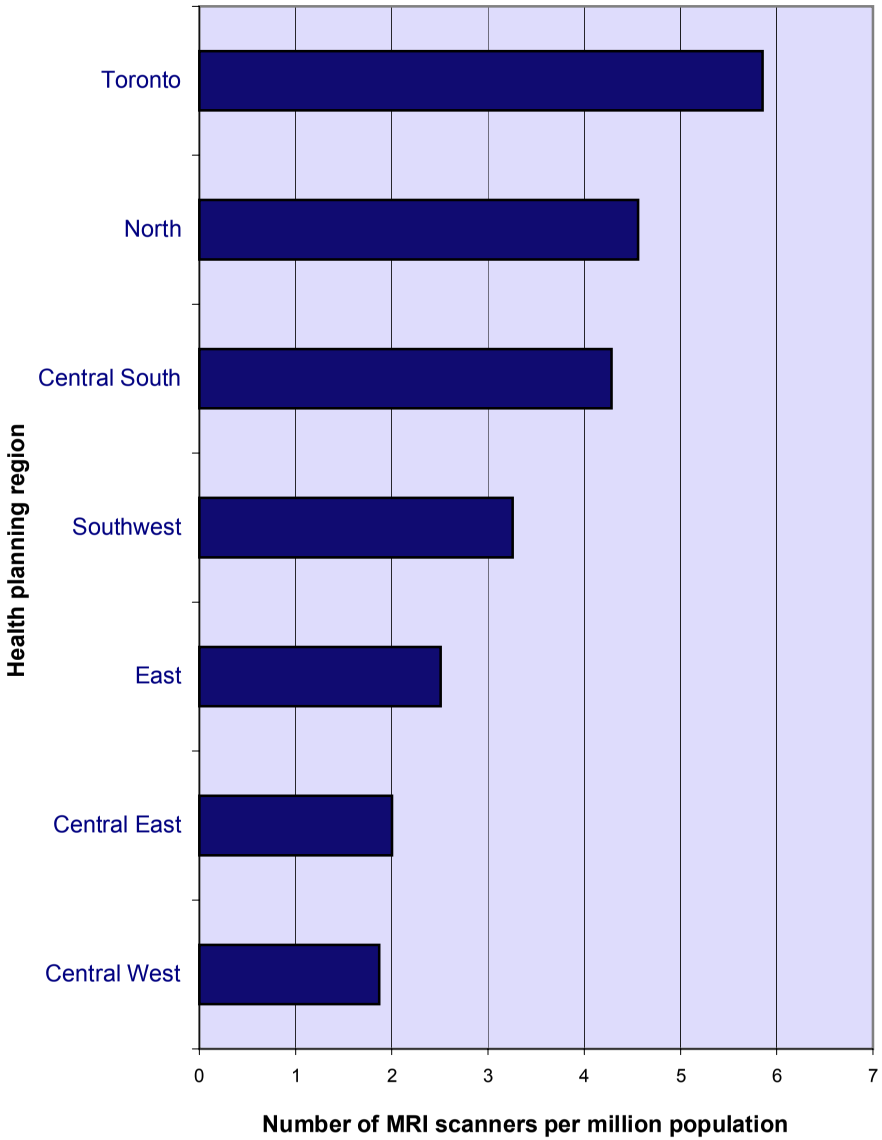


Exhibit 12: Cumulative percent of outpatients who received an MRI within the time from referral to billing claim for MRI by body region, OHIP 2001

(Note: The data used for this analysis are not representative due to exclusion criteria - Appendix 3)

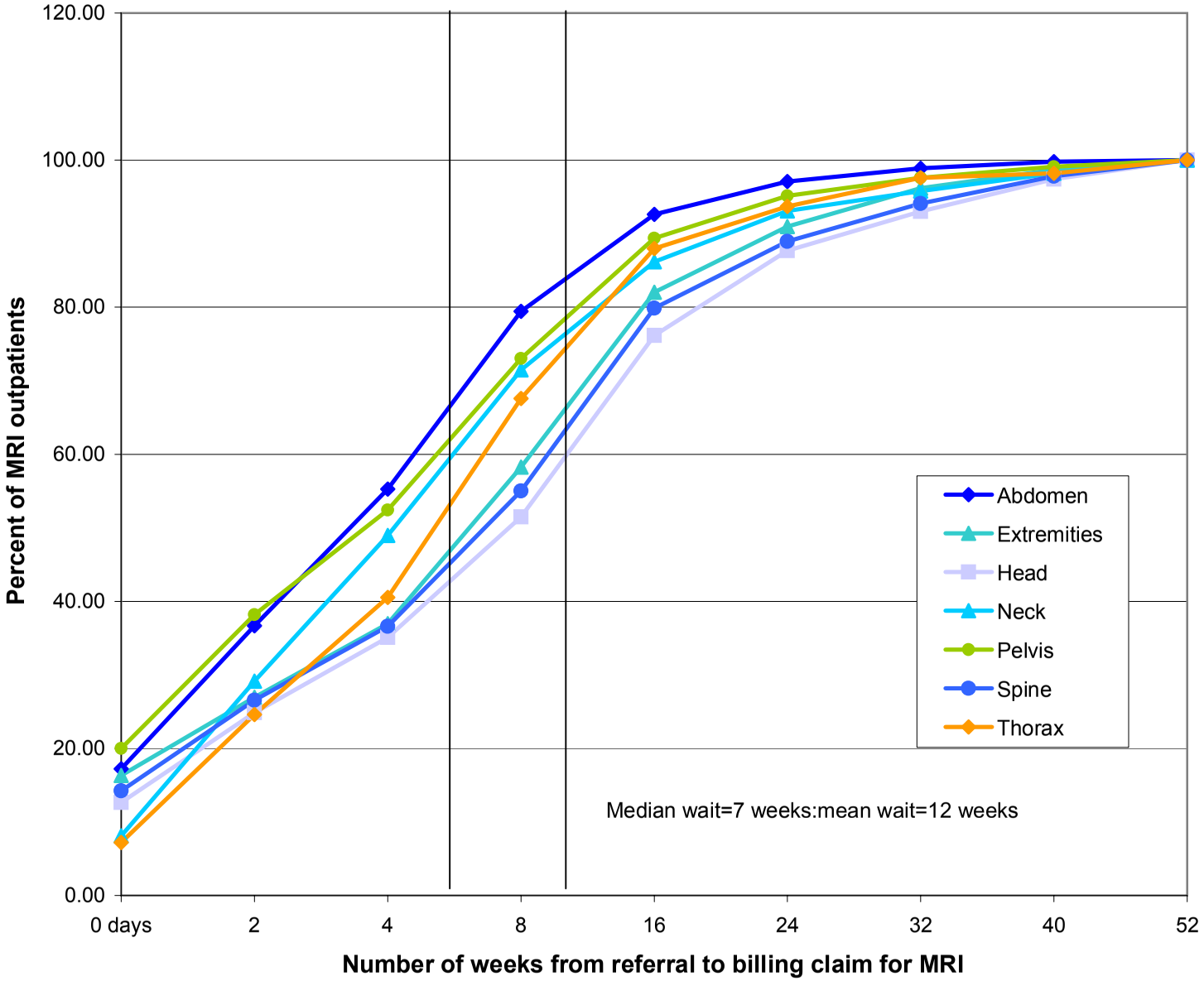


Exhibit 13: Results from the ICES survey of MRI Centre Managers in Ontario, November 2002

Operations:	Number of Centres	% of Centres
> 1 scanner	7	28
Centre open 24 hours; 7 days	2	8
Centre open <12 hours/day	2	8
Centre not open on weekend	7	28
3rd party patients	12	48
Accepts specialist referrals only	5	20
Accepts only hospital affiliated GPs	3	12
Accepts specialist and GP referrals	17	68
Triage		
Radiologist only	23	96
Radiologist and technician	2	8
Keeps list for cancellations	25	100

Patient throughput:	Number of scans/day
Number of inpatient scans/day	1-5
Number of outpatient scans/day	median=20; range 15 to 27

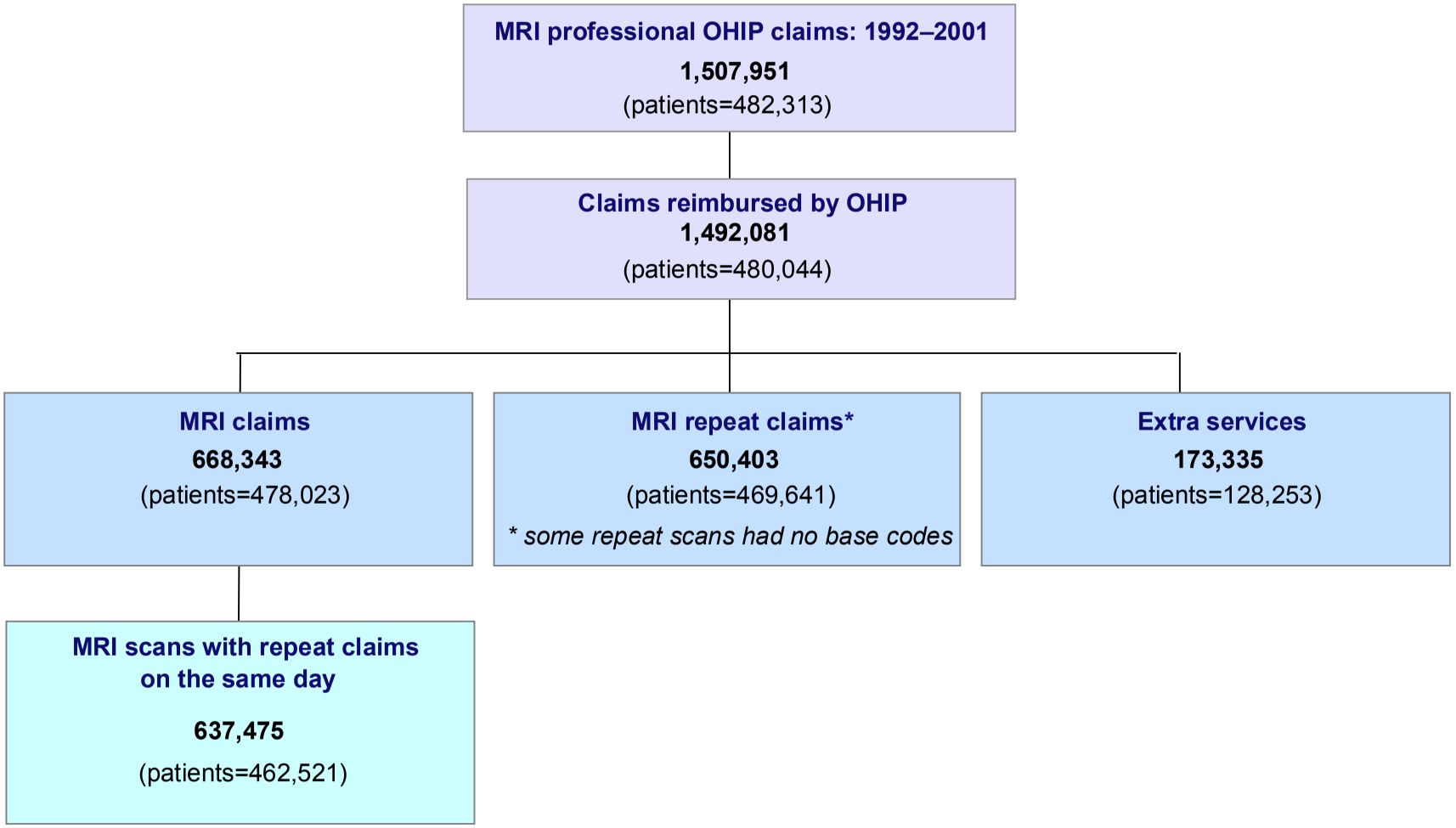
*Wait times:	Number of weeks:
Urgent cases (e.g. cord compression)	24 hours
Semi-urgent (e.g. tumour)	24 hours to 2 weeks
Non-urgent (chronic head or back pain)	median=4 months; range 2 weeks to 18 months

* ***Note:*** *These wait times data are based on MRI centre manager self-report - booking schedules were not used to estimate wait times.*

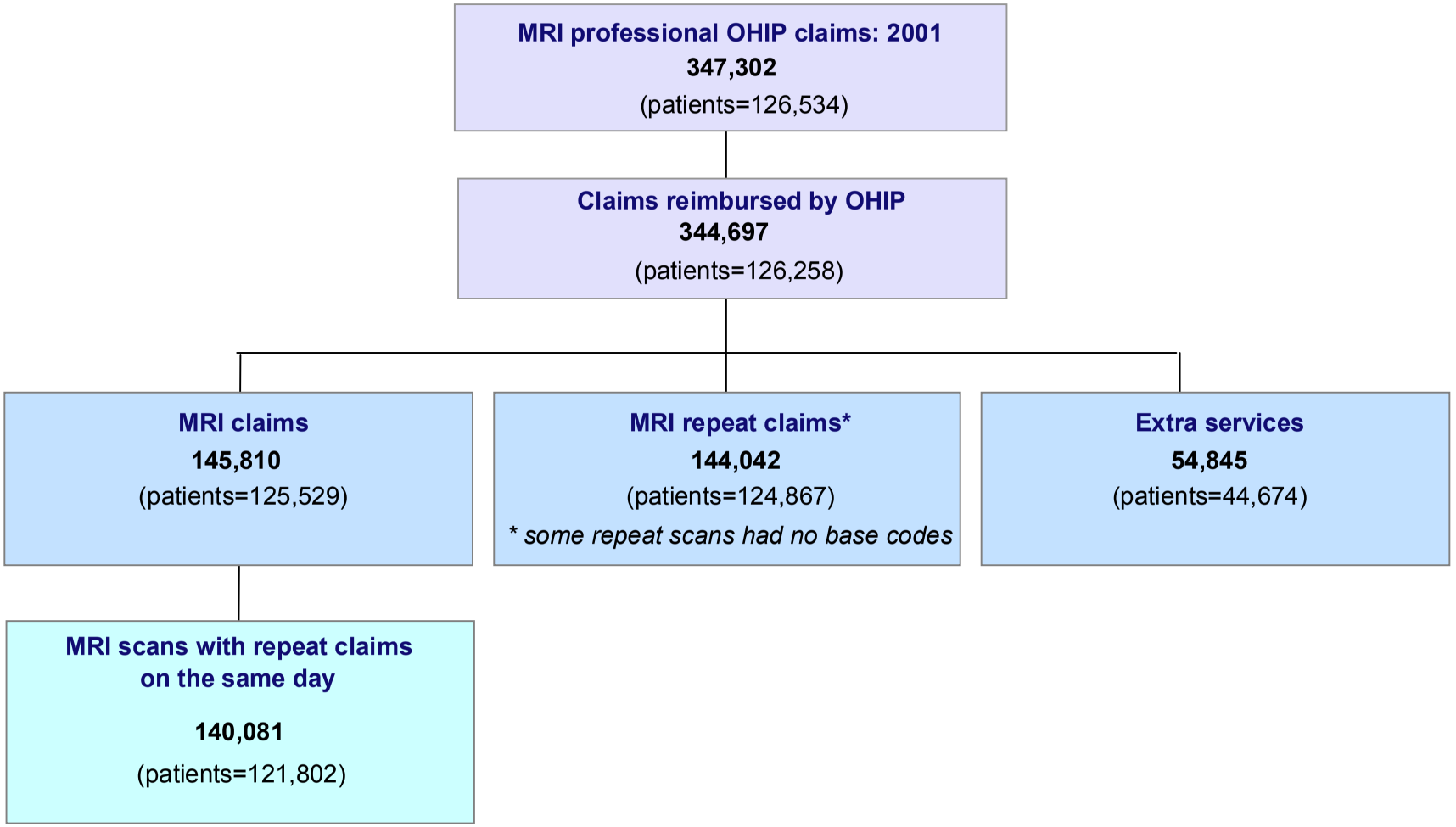
Appendix 1: Codes used to extract MRI data from OHIP, Schedule of Benefits 2000

OHIP code	Definition
X421	Head - multislice sequence
X425	- repeat (another plane, different pulse sequence; maximum 2 repeats)
X431	Neck - multislice sequence
X435	- repeat (another plane, different pulse sequence; maximum 3 repeats)
X441	Thorax - multislice sequence
X445	- repeat (another plane, different pulse sequence; maximum 3 repeats)
X451	Abdomen - multislice sequence
X455	- repeat (another plane, different pulse sequence; maximum 3 repeats)
X461	Pelvis - multislice sequence
X465	- repeat (another plane, different pulse sequence; maximum 3 repeats)
X471	Extremities - multislice sequence
X475	- repeat (another plane, different pulse sequence; maximum 3 repeats)
X488	Multiple extremities - multislice sequence
X489	- repeat (another plane, different pulse sequence; maximum 3 repeats)
X490	Limited spine - multislice sequence
X492	- repeat (another plane, different pulse sequence; maximum 3 repeats)
X493	Intermediate - multislice sequence
X495	- repeat (another plane, different pulse sequence; maximum 3 repeats)
X496	Complex - multislice sequence
X498	- repeat (another plane, different pulse sequence; maximum 3 repeats)
X486	When cardiac gating is performed
X487	When gadolinium
X499	Three-dimentions MRI acquisition sequence, including post-processing

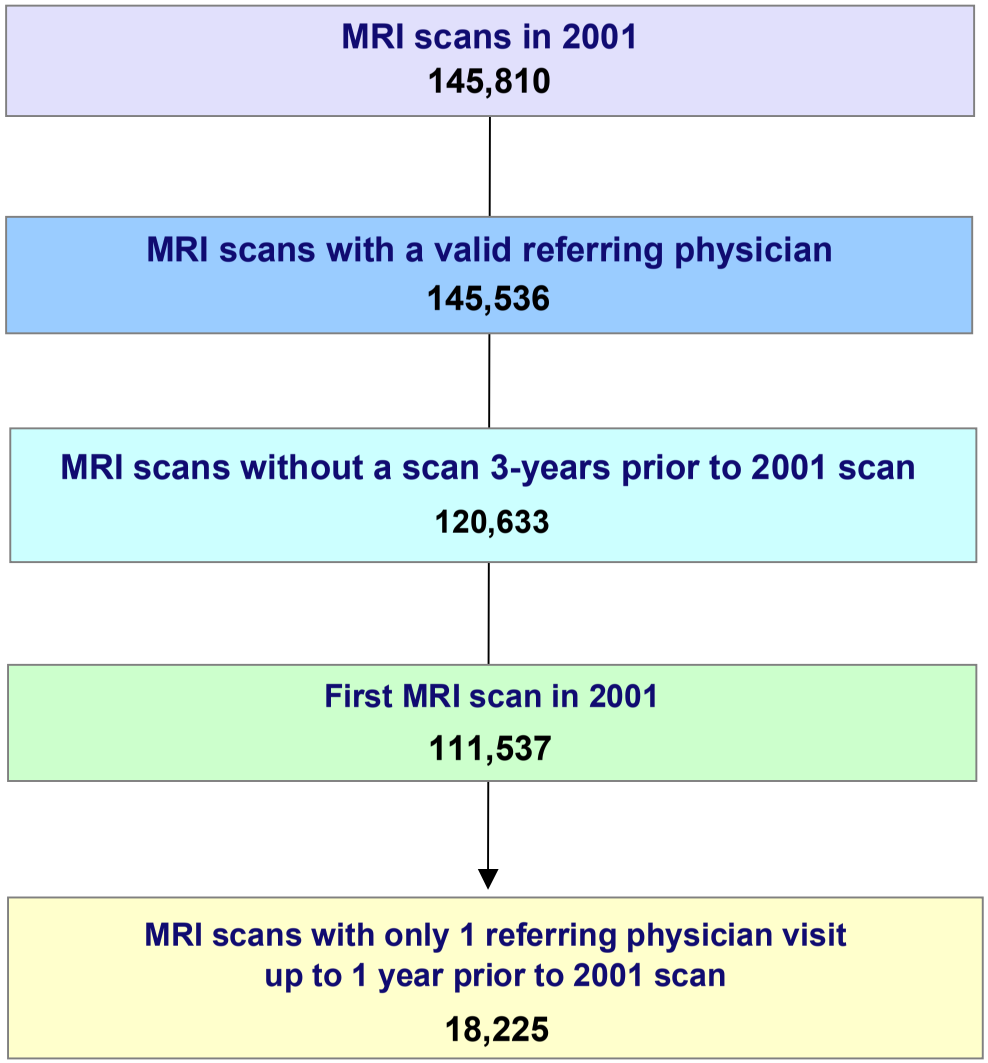
Appendix 2: Inclusion/exclusion criteria, 1992–2001



Appendix 2 (continued): Incusion/exclusion criteria for 2001



Appendix 3: Exclusion criteria for wait time analysis, OHIP 2001

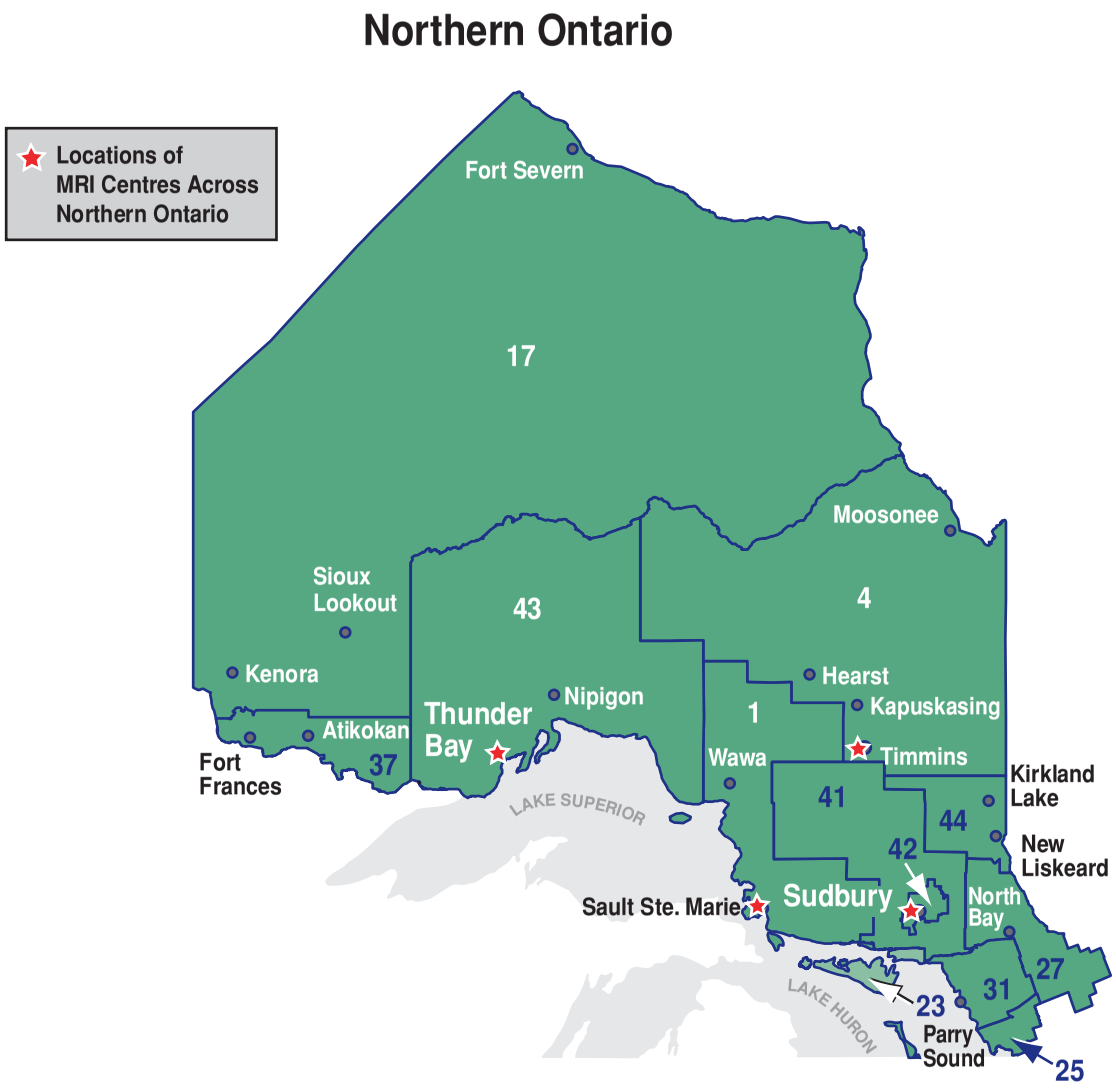


Appendix 4: MRI Sites Across Ontario *(As of November 18, 2002)*

Region/Hospital	Site	Start Date
North		
Sault Area Hospitals	Sault Ste. Marie General	May/98
Sudbury Regional Hospital	Laurentian	Oct/97
Thunder Bay Regional Hospital	Port Arthur	Feb/99
Timmins and District Hospital	-	Apr/97
East		
Kingston General Hospital	-	Apr/94
The Ottawa Hospital Corporation	General Hospital	Jul/87
	Civic Hospital	Nov/97
Children's Hospital of Eastern Ontario	-	Nov/97
Central East		
Peterborough Regional Health Centre	Hospital Drive	'Jun/01
Royal Victoria Hospital of Barrie	-	Sept/97
Southlake Regional Health Centre	-	Jul/97
Lakeridge Health Corporation	Oshawa	May/97
Toronto		
Hospital for Sick Children	Unit #1	Mar/89
	Unit #2	Nov/99
St. Michael's Hospital	Bond St. #1	Jun/90
	Bond St. #2 (fmr. Wellesley)	Feb/95
St. Joseph's Health Centre	-	Jul/99
North York General Hospital	General Division	Aug/00
Humber River Regional Hospital	Finch Ave.	Mar/00
Scarborough General Hospital	General Division	Feb/00
Sunnybrook & Women's College Health Sciences Centre	Sunnybrook #1	Dec/90
	Sunnybrook #2	Jan/02
University Health Network	Toronto General	Apr/94
	Western Division	Mar/90
	Princess Margaret Hospital	Mar/93
Rouge Valley Health System	Centenary	Jan/02
Mount Sinai Hospital	-	Dec/01
Central South		
Hamilton Health Sciences Corporation	McMaster	Mar/91
	Henderson	Oct/02
	General	Feb/01
St. Joseph's Hospital	-	Sept/01
Niagara Health System	-	Jul/99
Central West		
William Osler Health Centre	Brampton	Nov/98
Trillium Health Centre	Mississauga	Mar/97
Joseph Brant Memorial Hospital Corporation	-	Sept/97
Credit Valley Hospital	-	Nov/01
South West		
London Health Sciences Centre	University Campus	Sept/86
	Victoria Campus	Oct/01
St. Joseph's Health Services Association	St. Joseph's Health Centre	Dec/89
Sarnia General Hospital	-	Jan/02
Windsor Hotel Dieu-Grace Hospital	Hotel Dieu of St. Joseph's	Dec/97

Source: MoHLTC, November 2002

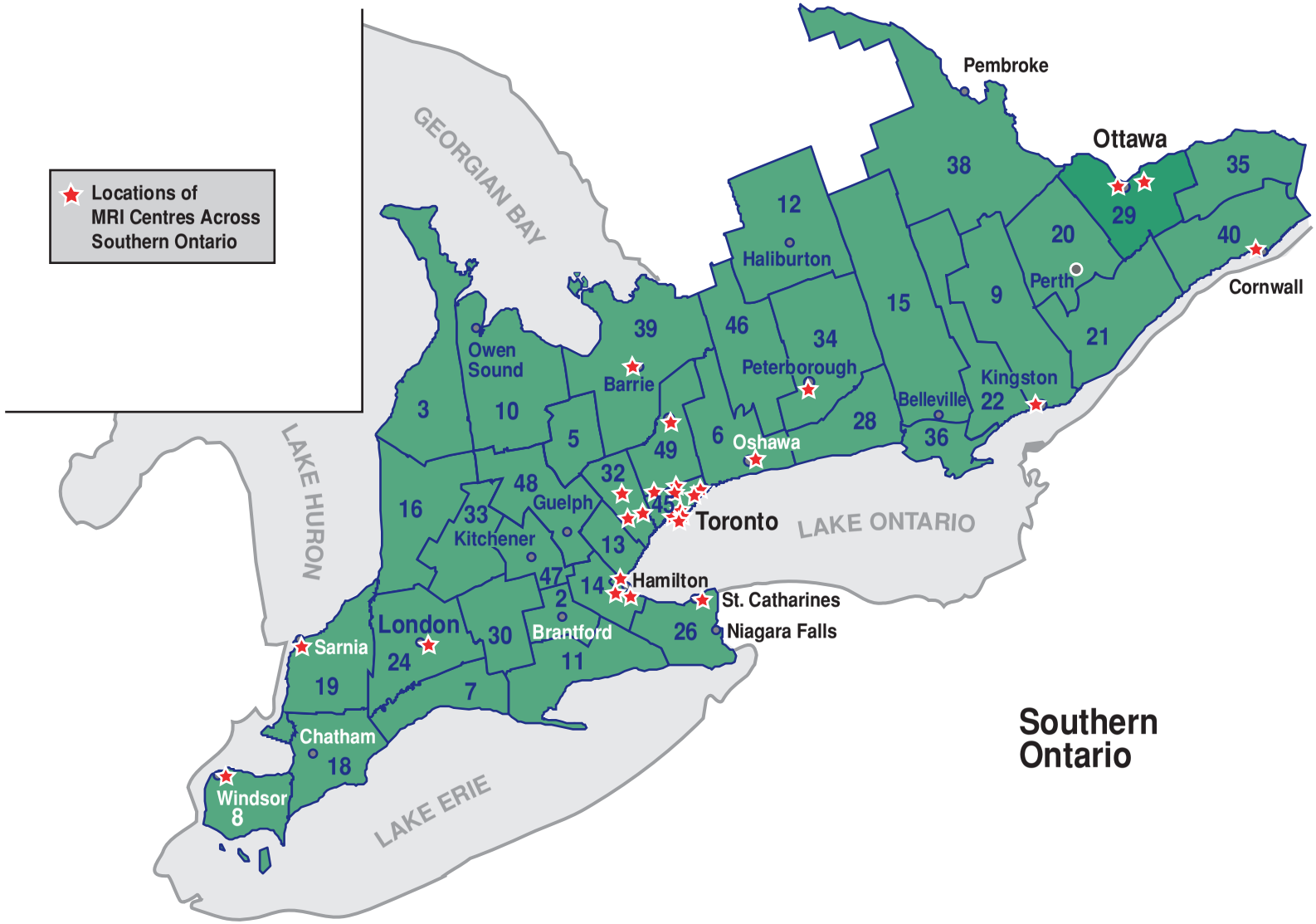
Appendix 5: MRI Centres in Northern Ontario



Ontario Counties

1 Algoma District
2 Brant County
3 Bruce County
4 Cochrane District
5 Dufferin County
6 Durham Regional Municipality
7 Elgin County
8 Essex County
9 Frontenac County
10 Grey County
11 Haldimand-Norfolk Regional Municipality
12 Haliburton County
13 Halton Regional Municipality
14 Hamilton-Wentworth Regional Municipality
15 Hastings County
16 Huron County
17 Kenora District
18 Kent County
19 Lambton County
20 Lanark County
21 Leeds and Grenville United Counties
22 Lennox and Addington County
23 Manitoulin District
24 Middlesex County
25 Muskoka District
26 Niagara Regional Municipality
27 Nipissing District
28 Northumberland County
29 Ottawa-Carleton Regional Municipality
30 Oxford County
31 Parry Sound District
32 Peel Regional Municipality
33 Perth County
34 Peterborough County
35 Prescott and Russell United Counties
36 Prince Edward County
37 Rainy River District
38 Renfrew County
39 Simcoe County
40 Stormont, Dundas and Glengarry United Counties
41 Sudbury District
42 Sudbury Regional Municipality
43 Thunder Bay District
44 Timiskaming District
45 Toronto Metropolitan Municipality
46 Victoria County
47 Waterloo Regional Municipality
48 Wellington County
49 York Regional Municipality

Appendix 5: MRI Centres in Southern Ontario



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