Ten years of temporal artery biopsies in Ontario, Canada: a population-based study on practice patterns and the incidence of giant cell arteritis

Jonathan A. Micieli[1] MD, CM, Robert Micieli[2], Edward Margolin[1] MD

[1]Department of Ophthalmology and Vision Science, University of Toronto, Toronto, Ontario, Canada
[2]Faculty of Science, York University, Toronto, Ontario, Canada

Address correspondence to:

Jonathan A. Micieli, MD, CM
340 College Street, Suite 400
Toronto, Ontario
M5T 3A9
Toronto ON M5T 2S8

Phone: (416) 978-6294
Fax: (905) 303-4700

Email: jonathan.micieli@utoronto.ca

Keywords giant cell arteritis; temporal artery biopsy; epidemiology; residency training

Word Count 2,472

Abstract

Background: The incidence of giant cell arteritis (GCA) and which surgical specialists perform temporal artery biopsies (TABs) remains unknown in Canada. If there is significant geographic variation in the specialists that perform TABs it may stimulate strategies to ensure residents in the responsible specialties are competent in this procedure regardless of training location.

Methods: This was a population-based study including all physicians in Ontario from 2002 to 2013. Using comprehensive physician services data from the Intellihealth Medical Services database, physicians performing TABs were categorized by specialty and geographic Local Health Integration Unit. The rate of positive TABs was retrieved from the literature from an Ontario sample during the study period.

Results: The number of TABs was declining over the 10-year study period and the incidence of GCA was determined to be 3.0 per 100,000 people over 50. Of the 9,958 TABs performed over 10 years, most were performed by general surgeons (38%) followed by ophthalmologists (31%) and plastic surgeons (23%). Ophthalmologists performed significantly more TABs per person compared to general surgeons but significantly more general surgeons performed at least one biopsy. There was significant variation based on geographic location with plastic surgeons performing the most biopsies in regions with more than 1 million people and general surgeons performing most biopsies in rural areas.

Interpretation Geographic location determines which specialty is most likely to perform TABs. Consequently, residents in general surgery, ophthalmology and plastic surgery have variable exposure to TABs and may be unprepared to serve their future practice population.

Introduction

Giant cell arteritis (GCA) is an inflammatory vasculopathy involving large and medium-sized arteries that occurs in people over 50 years of age. The epidemiology of GCA has been studied in several areas in the world and shows a predilection for females and those of Scandinavian descent.[1] In Scandinavia, the incidence of GCA ranges from 7.2 per 100,000 people over 50 years of age in Finland[2] to 29.1 per 100,000 people over 50 years of age in Norway.[1] There have been few studies assessing the incidence of GCA in North American populations. These studies include one from Tennessee[3] that reported an overall incidence of 1.58 per 100,000 people over 50 years of age and studies from Olmsted county, Minnesota, which found a higher incidence of 16.4 per 100,000 people over 50 years of age.[4]

The incidence of GCA in Canada remains unknown. A previous study from Saskatchewan estimated the incidence for the Saskatoon area to be 9.4 per 100,000 people over 50 years of age by estimating the population served by a neuro-ophthalmology clinic and reviewing the positive temporal artery biopsies (TABs) performed from 1998 to 2003[5]. However, this study was limited in that only biopsies performed at one hospital were accounted for and did not take into account other specialists that may have performed TABs and diagnoses made outside of the studied clinic.

The gold standard for the diagnosis for GCA is a TAB.[6] Biopsy confirmation provides clinicians with the rationale to use high-dose corticosteroids for prolonged

periods of time and avoids unnecessary treatment in patients who do not actually have the disease. The frequency that different specialists perform TABs has not been previously studied. It is unknown whether the role of different specialists such as ophthalmologists and general surgeons varies by geographic location and population. If such variation exists it would have implications for residency training in that some graduates may not have performed enough biopsies to feel comfortable for practice because of the referral patterns in the area of their residency training program. Residents training in certain regions may not be able to serve the population they practice in the future if they do not have experience performing TABs.

The goal of the current study was to determine which surgical specialists perform TABs and how this has evolved over the past decade. In addition, the incidence of GCA in Ontario, Canada was determined based on the number of TABs performed over the past decade. To our knowledge, this is the first study to quantify the output of TABs based on medical specialty and assess the incidence of GCA in Ontario.

Methods

Ontario is Canada's most populous province with a population that ranged from 7.2 to 9.4 million people over 50 years of age during the study period. Ontario provides universal government-funded healthcare to all of its citizens through the Ontario Health Insurance Plan (OHIP). Ontario licensed physicians receive fee-for-service payment by submitting specific billing codes; they cannot bill patients directly for services covered by OHIP. This allows the Ontario population to serve as an ideal population to study procedure output. The OHIP billing database has been used in previous population-based studies and has been validated.[7-9] IRB/Ethics approval was not required for this study.

The OHIP billing codes were accessed via the Medical Services database in the Intellihealth Ontario system, which contains detailed information on physician billing, procedures, and hospital information in the province. The Ontario Schedule of Benefits published each year from the Ministry of Health and Long Term Care contains the specific billing codes that physicians must use for each procedure and the financial remuneration for each service. All physicians performing temporal artery biopsies must submit the specific code Z815A to receive remuneration for their work. The Medical Services database classifies each physician by their subspecialty based on the specialty that they billed the most during a fiscal year. Each specialist or general physician who submitted the Z815A code from the 2003 to 2012 fiscal years (April 1, 2003 to March 31, 2013) was retrieved and studied. Bilateral biopsies were not

considered in the study since the number of patients undergoing TAB was used as the output filter.

Because only the total number of TABs and not the number of positive TABs were available from Intellihealth system, the incidence of GCA was determined by using a published positive-biopsy rate from Ottawa, Ontario from 2007 to 2010 and multiplying this rate by the total number of biopsies performed per year.[10] In this study, a biopsy length of 2cm was used as the desired standard and all specimens were reviewed with an experienced pathologist. To estimate the upper and lower limits of the positive-TAB rate, a systematic review of the literature using the keywords "temporal artery biopsy" in the MEDLINE database (1996 to September Week 3 2013) was performed to retrieve studies reviewing the rate of positive TABs. Only countries from North American and Europe were included in the review to more accurately reflect the demographics and practice patterns in the Ontario population.

To determine the variation of TABs by region, the procedure output per Local Health Integration Units (LHINs) was determined. The province of Ontario is divided into fourteen different LHINs based on geography and each LHIN plans, integrates and funds local health care. There are five different LHINs that include ophthalmology residency programs: Toronto Central (University of Toronto), Hamilton Niagara Haldimand Brant (McMaster University), Champlain (University of Ottawa), South East (Queen's University) and South West (Western University). To determine if the specialists performing TABs varied based on the population size, LHINs were divided into those with less than 600,000 people, those with 600,0000 to 1 million people, and

those with more than 1 million people. Those with less than 600,000 people included North West, North Simcoe Muskoka, South East and North East. Those with 600,000 to 1 million people were Erie St. Clair, Waterloo Wellington, Central West, and South West. Those with more than 1 million people were Toronto Central, Mississauga Halton, Camplain, Hamilton, Central East and Central.

The Intellihealth data was exported to SAS version 9.4 and analyzed statistically. A line of best fit for the number of TABs per year was constructed and a t-test of the regression slope was used to determine if there was a significant trend. Non-parametric Tukey-Kramer test was used when the assumption of homogeneity of variances was violated. The Levene's test for homogeneity of variances was used to determine this. The Dwass-Steel-Chritchlow-Fligner a posteriori test was used to determine which means differed from each other. If the assumption of homogeneity of variances was not violated an Analysis of Variance (ANOVA) was used with the Tukey-Kramer post-hoc test. A statistically significant results was considered when $p < 0.05$.

Results

The number of TABs performed per year in Ontario was declining over the 10-year study period (R^2=0.6751; p<0.05, **Figure 1**). The reported positive TAB rate in the Ontario population during the study period (24.8%)[10] was used to estimate the number of GCA cases per year with the upper (39.9%)[11] and lower limits (15.9%)[12] retrieved from the literature and is displayed in **Figure 1.** The overall incidence of GCA was determined to be 3.0 per 100,000 people over 50 years of age in Ontario. Using the highest and lowest positive-TA biopsy rates in the literature, the overall incidence was between 1.9 and 4.9 cases per 100,000 over 50.

Eleven different subspecialists performed at least one biopsy during the study period and included ophthalmology, plastic surgery, otolaryngology, general surgery, vascular surgery, thoracic surgery, neurosurgery, urology, family medicine, emergency medicine and cardiac surgery. Over the 10 year period, general surgeons as a group performed the most TABs, followed by ophthalmologists and plastic surgeons **(Figure 2)**. However, of the physicians that performed TABs, ophthalmologists performed significantly more per person each year compared to general surgeons, neurosurgeons and family physicians (p<0.001). Significantly more general surgeons performed at least one TAB compared to ophthalmologists, plastic surgeons and otolaryngologists (p<0.05**; Figure 3).** .

The medical specialty performing most TABs varied based on geographic location. General surgeons performed significantly more TABs per person in regions

where the population was smaller (less than 600,000 people) compared to regions with a larger population **(**p<0.01**; Figure 4).** Ophthalmologists in regions with a population between 600,000 and 1 million people performed significantly more biopsies per person than ophthalmologists in regions with less than 600,000 and more than 1 million people. Plastic surgeons in areas with more than 1 million people performed significantly more biopsies per person than plastic surgeons in regions with less than 600,000 people. As shown in **Figure 4** general surgeons were the leaders in performing TABs in smaller populated regions, ophthalmologists and general surgeons performed the most in regions with 600,000 to 1 million people, and plastic surgeons performed most biopsies per person in regions with more than 1 million people.

The medical specialists performing TABs also varied significantly in the regions with residency training programs. Ophthalmologists in the Champlain (University of Ottawa) and South West (Western University) LHINs performed the most biopsies in their respective regions over the entire 10-year study period (p<0.05). Contrarily, ophthalmologists in Toronto and Hamilton made only small contributions to the TABs in their areas. General surgeons were the leaders in the South East LHIN (Queen's University) and played an important role in the South West and Hamilton LHINs, but made a very small contribution in Toronto and Champlain. Residents in these geographic areas would not be able to achieve enough TAB experience based on the small number of biopsies performed per year. Toronto was the only LHIN in which plastic surgeons were the leading specialty and plastic surgeons in the other areas with

residency training programs made only small contributions to the TABs in their area.

These results are displayed graphically in **Figure 5.**

Interpretation

The incidence of GCA in Ontario, Canada has not been previously reported and has been estimated in one previous Canadian paper from Saskatchewan. We determined the overall incidence of GCA in Ontario to be 3.0 cases per 100,000 people over 50 years of age. This is greater than the incidence reported in Tennessee[3] and very similar to that reported in South Australia[14] and Northern Italy.[3] It is less than the incidence previously reported from Scotland[15], Finland[2], Spain[16], Saskatchewan[5], Jerusalem[17], Olmsted County[4], Sweden[18], Denmark[19], Iceland[20] and Norway.[1] These differences can be accounted for by different ethnic background in the Ontario population. More than a quarter of Ontario's population is comprised of visible minorities including South Asian, Chinese, Black and those from Latin American.[21] The incidence of GCA is uncommon in those of Asian, Hispanic, Middle Eastern and African origin.[22,23]

A challenge in determining the epidemiology of GCA is that various diagnostic criteria may be used. The American College of Rheumatology criteria for the classification of GCA does not require a TAB, although this criteria has been shown to be insufficient in making a diagnosis of GCA.[24] In the present study, we used a unique methodology to determine the incidence of GCA in Ontario. This method has the advantage of only considering cases that underwent a biopsy and included every healthcare facility that performed a TAB in Canada's most populous province. However, it is limited in that the exact number of positive biopsies was inferred from a smaller

sample. The literature-reported positive biopsy rates were used to get a more confident range of the GCA incidence.

The number of TABs per person over 50 years of age was declining over the study period and may be accounted for by several factors. There may be a change in demographic patterns in the elderly population over time with people at lower risk of GCA (Asians, Hispanics, Blacks) accounting for a greater proportion of the population. Moreover, there may be a trend towards physicians opting-out of performing TABs but continuing to treat patients as if they had the disease. A study by Drehmer *et al*.[25] found that 15 to 35 percent of physicians involved in the diagnosis and treatment of GCA do not recommend TAB for the diagnosis of GCA. Whether this trend is increasing or decreasing remains unknown. Finally, the number of true cases of GCA may be stable but physicians may be more selective about which patients should have a TAB. This would be reflected in a greater rate of positive TABs over time.

The regional variation of specialists performing TABs has implications for residency training. Exposure to the TAB procedure varied significantly based on geographic location and ophthalmology residency program. Graduates of certain residency programs may be inadequately trained to serve the community in which they practice in the future. It is important that residents be familiar with this geographic variation when referring suspected cases for TAB during their training. Residents may want to seek out a staff comfortable with the procedure in their own specialty for a TAB when a suspected case presents to the clinic or emergency room rather than referring it

to another department. Moreover, in regions where few biopsies are done by a particular specialty, increasing exposure to the specialty that performs most TABs in the region during off-service resident rotations (in the internship year) may help improve the skills of graduating residents.

Much of the regional variation in the specialties performing TABs may be accounted for by the availability of comfortable surgeons. In rural areas general surgeons performed the bulk of TABs, but performed few per year. This may also be due to the paucity of plastic surgeons, ophthalmologists, or otolaryngologists in the area. Other factors that may contribute to the variation are the availability of support staff such as nurses and administration and available space and equipment. In addition, financial remuneration may influence the procedures specialists decide to perform at high volumes especially if the additional costs of equipment and support staff must be incurred by the physician.

Overall, the estimated incidence of GCA in Ontario, Canada was determined to be 3.0 cases per 100,000 people over 50 years of age. The number of TABs performed over the study period has been decreasing over time and may represent shifts in the demographics of the population. Significant regional variability exists in terms of which specialists perform TABs. In rural populations, most biopsies are performed by general surgeons, whereas plastic surgeons performed more biopsies on average in higher populated areas. Overall, ophthalmologists performed the highest number of biopsies per person. Competency in performing TABs should be required for graduates of

general surgery, plastic surgery and ophthalmology to ensure that graduates will be able to meet the needs of the communities they practice . Awareness of this variability can help trainees take steps to help improve their exposure to this procedure.

Acknowledgements

a) Funding Support: none

b) Financial Disclosures: none

c) Contributions of authors: Design and conduct of study (JAM, RM, EM), collection and data management (JAM, RM), analysis and preparation of data (JAM, RM, EM), preparation, review and approval of manuscript (JAM, RM, EM).

d) Other acknowledgements or conflicts of interest: none

References

1. Haugeberg G, Paulsen PQ, Bie RB. Temporal arteritis in Vest Agder County in southern Norway: incidence and clinical findings. *J Rheumatol.* 2000;27:2624–7.
2. Franzen P, Sutinen S, von Knorring J. Giant cell arteritis and polymyalgia rheumatica in a region of Finland: an epidemiologic, clinical and pathologic study, 1984–1988*. J Rheumatol.* 1992;19:273–6.
3. Smith CA, Fidler WJ, Pinals RS. The epidemiology of giant cell arteritis. Report of a ten-year study in Shelby County, Tennessee. *Arthritis Rheum* 1983;26:1214–9.4
4. Salvarani C, Crowson CS, O'Fallon WM, Hunder GG, Gabriel SE. Reappraisal of the epidemiology of giant cell arteritis in Olmsted County, Minnesota, over a fifty-year period. *Arthritis Rheum*. 2004;51:264–8.
5. Ramstead C, Patel, AD. Giant cell arteritis in a neuro-ophthalmology clinic in Saskatoon, 1998–2003. *Can J Ophthalmol*. 2007;42:295–8.
6. Danesh-Meyer, HV. Temporal Artery Biopsy: Skip It at Your Patient's Peril. *Am J Ophthalmol.* 2012;154:617-619.
7. Williams JI, Young W. A summary of studies on the quality of health care administrative databases in Canada. In: Goel V, Williams JI, Anderson GM, et al, eds. Patterns of Health Care in Ontario: the ICES Practice Atlas. 2nd ed. Ottawa: Canadian Medical Association; 996:339–45.
8. Campbell RJ, Bell CM, Gill SS, et al. Subspecialization in glaucoma surgery. *Ophthalmology.* 2012;119:2270–73.
9. Micieli JA, Micieli A, Schlenker MB, Kertes PJ. Growth of medical and surgical vitreoretinal subspecialization in Ontario over 12 years. *Can J Ophthalmol.* 2014;49:312-9.
10. Durling B, Toren A, Patel V, Gilberg S, Weis E, Jordan D. Incidence of discordant temporal artery biopsy in the diagnosis of giant cell arteritis. *Can J Ophthalmol*. 2014;49:157-161.
11. Cavazza A, Muratore F, Boiardi L, et al. Inflamed temporal artery: histologic findings in 354 biopsies, with clinical correlations. *Am J Surg Pathol*. 2014;38:1360-70.
12. Lenton J, Donnelly R, Nash JR. Does temporal artery biopsy influence the management of temporal arteritis? *QJM* 2006;99:33-6.
13. Salvarani C, Macchioni P, Zizzi F, et al. Epidemiologic and immunogenetic aspects of polymyalgia rheumatica and giant cell arteritis in northern Italy. *Arthritis Rheum* 1991;34:351–6.
14. Dunstan E, Lester SL, Rischmueller M, et al. Epidemiology of biopsy-proven giant cell arteritis in South Australia. *Intern Med J*. 2014;44:32-9.
15. Jonasson F, Cullen JF, Elton RA. Temporal arteritis. A 14-year epidemiological, clinical and prognostic study. *Scot Med J* 1979;24:111–7.
16. Gonzalez-Gay MA, Alonso MD, Aguero JJ, Bal M, Fernandez-Camblor B, Sanchez-Andrade A. Temporal arteritis in a northwestern area of Spain: study of 57 biopsy proven patients. *J Rheumatol*. 1992;19:277–80.
17. Sonnenblick M, Nesher G, Friedlander Y, Rubinow A. Giant cell arteritis in Jerusalem: a 12-year epidemiological study. *Br J Rheumatol*. 1994;33:938–41.

18. Petursdottir V, Johansson H, Nordborg E, et al. The epidemiology of biopsy-positive giant cell arteritis: special reference to cyclic fluctuations. Rheumatology (Oxford)1999;38:1208–12.
19. Petursdottir V, Johansson H, Nordborg E, Nordborg C. The epidemiology of biopsy-positive giant cell arteritis: special reference to cyclic fluctuations. *Rheumatology (Oxford).* 1999;38:1208–12.
20. Baldursson O, Steinsson K, Bjornsson J, Lie JT. Giant cell arteritis in Iceland. An epidemiologic and histopathologic analysis. *Arthritis Rheum*. 1994;37:1007–12.
21. Statistic Canada. Canada 2011 Census. http://www12.statcan.gc.ca/census-recensement/index-eng.cfm. Accessed Sept 26, 2013.
22. Pereira LS, Yoon MK, Hwang TN, Hong JE, Ray K, Porco T, McCulley TJ. Giant cell arteritis in Asians: a comparative study. *Br J Ophthalmol.* 2011;95:214-6.
23. Lee JL, Naguwa SM, Cheema GS, Gershwin ME. The geo epidemiology of temporal (giant cell) arteritis. *Clin Rev Allergy Immunol*. 2008;35:88-95.
24. Murchison AP, Gilbert ME, Bilyk JR, Eagle RC Jr, Pueyo V, Sergott RC, Savino PJ. Validity of the American College of Rheumatology criteria for the diagnosis of giant cell arteritis. *Am J Ophthalmol*.. 2012;154:722-9.
25. Drehmer TJ, D. Khanna, R.J. Markert, R.A. Hawkins. Diagnostic and management trends of giant cell arteritis: a physician survey J Rheumatol 2005;32:1283-9.

Figure Captions

Figure 1. Number of temporal artery biopsies (TABs) and giant cell arteritis (GCA) cases per year. Linear line of best fit was plotted for the number of TAB cases (R^2=0.6751, $p<0.05$). The GCA cases were determined by multiplying the number of biopsies by the positive-rate of TABs from an Ontario sample during the study period. Error bars denote the upper and lower limits of positive-TAB rate retrieved from the literature.

Figure 2. Total number of temporal artery biopsies performed by medical specialists in Ontario from 2003 to 2012. Other includes cardiac surgery, family medicine, thoracic surgery, vascular surgery, emergency medicine and urology.

Figure 3. Mean number of temporal artery biopsies (TABs) performed per specialist per year and mean number of physicians performing at least one TAB each year. (*) denotes a statistically significant difference compared to the ophthalmology subspecialty.

Figure 4. Mean number of temporal artery biopsies performed per specialty group based on Local Health Integration Units (LHINs) regional population. (*) denotes a statistically significant difference compared to ophthalmologists and plastic surgeons in the region. (‡) denotes a statistically significant difference compared to plastic surgeons in the region. (┼) denotes a statistically significant difference compared to ophthalmologists and general surgeons in the region.

Figure 5. Proportion of all temporal artery biopsies (TABs) performed based on region containing an ophthalmology residency program. Toronto = University of Toronto, Champlain = University of Ottawa, South East = Queen's University, Hamilton = McMaster University, South West = Western University.

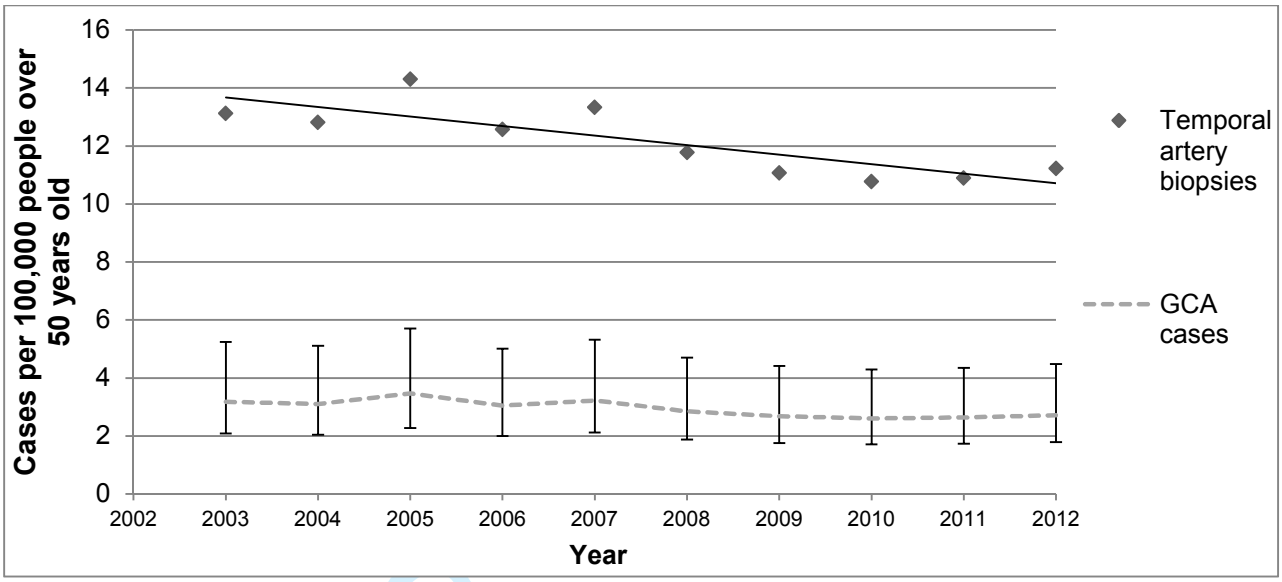


Figure 1.

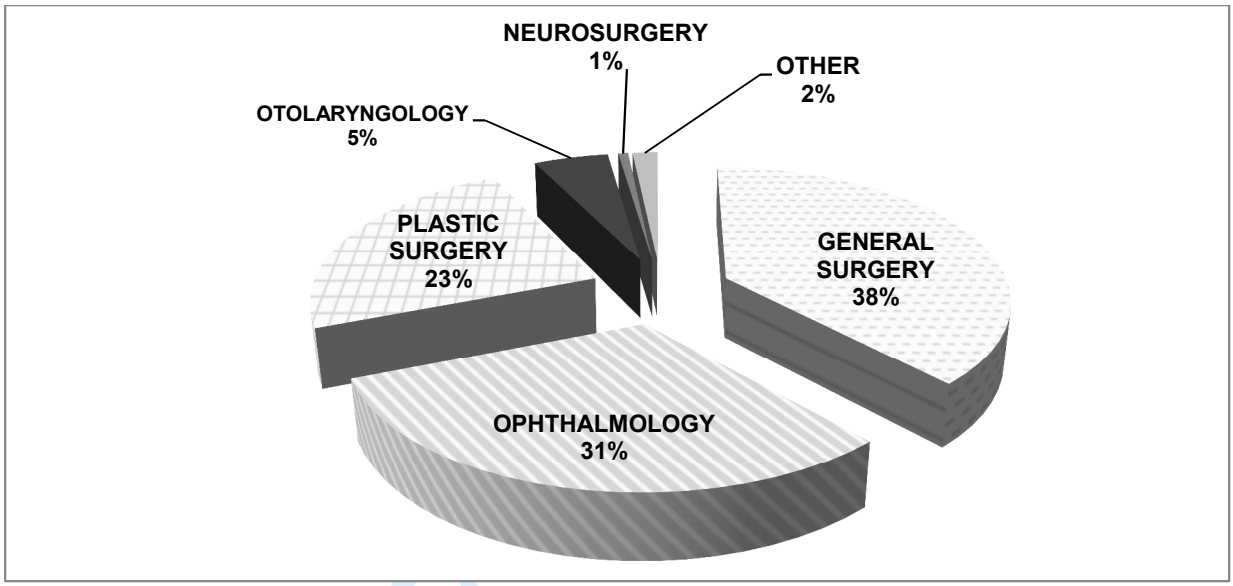
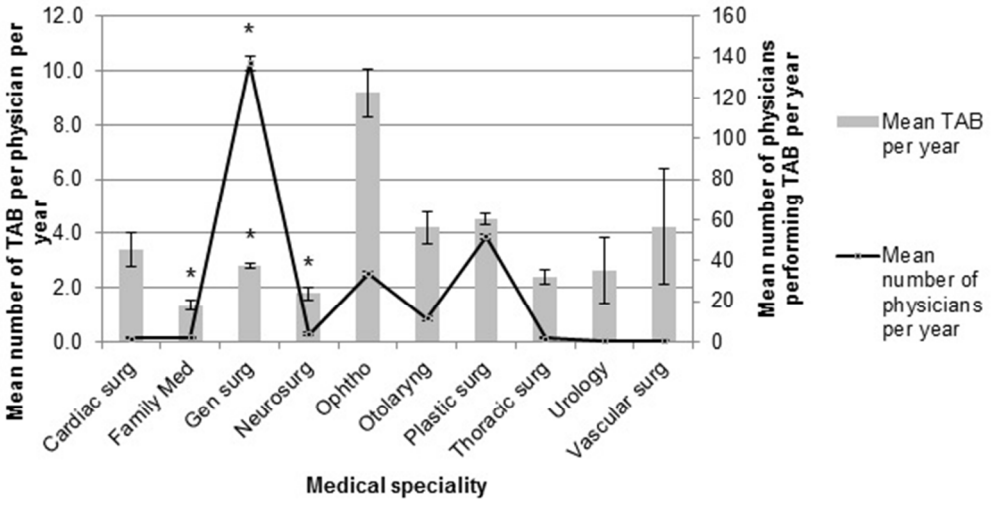


Figure 2.



164x84mm (96 x 96 DPI)

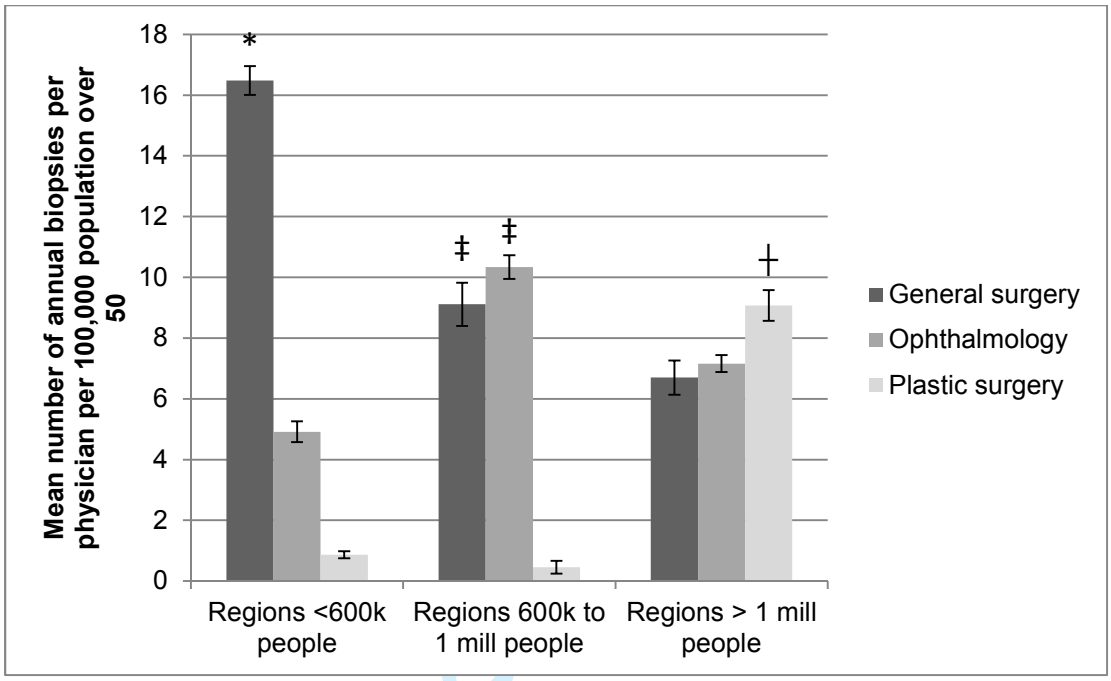


Figure 4.

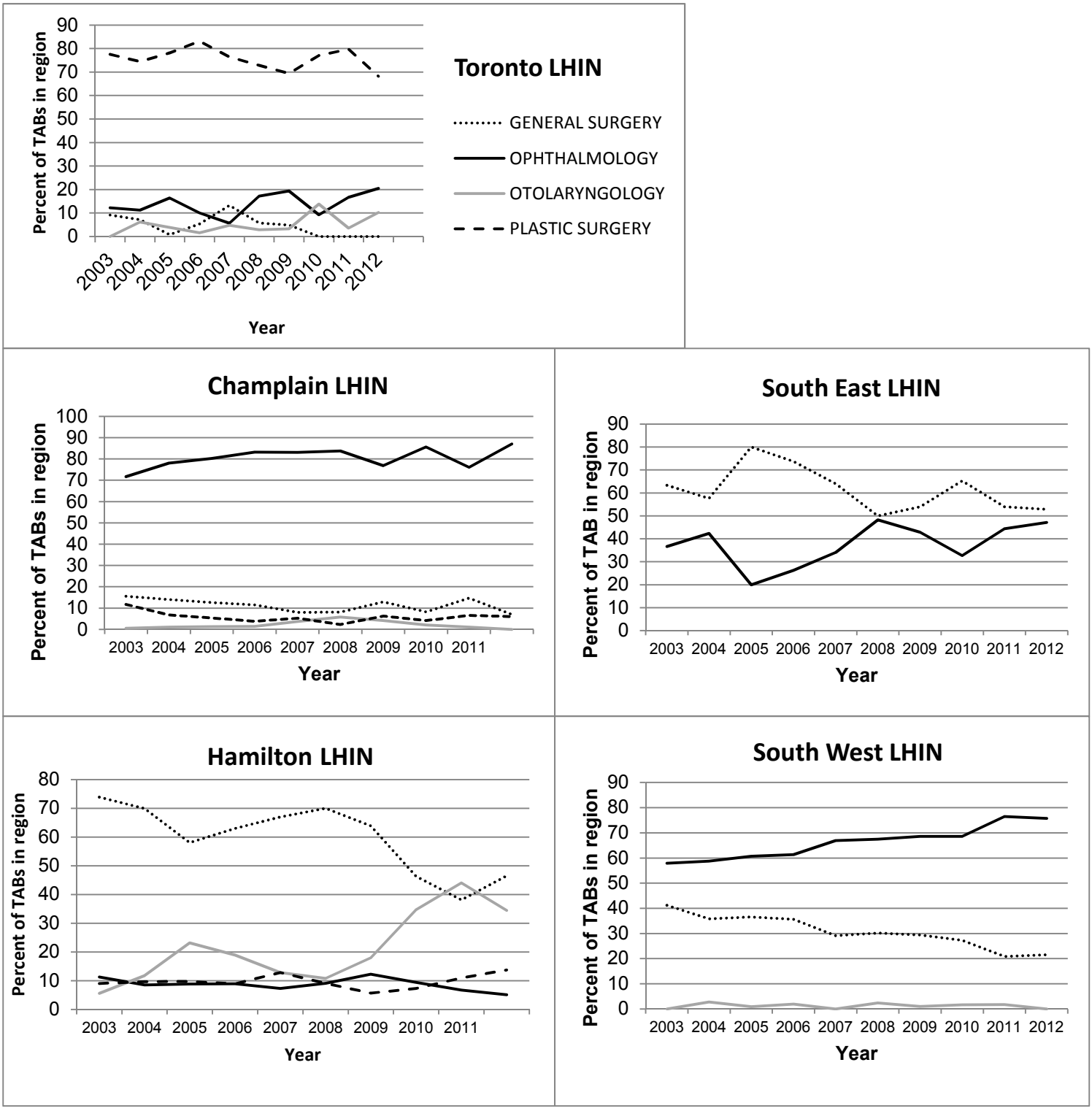

Toronto LHIN
GENERAL SURGERY
OPHTHALMOLOGY
OTOLARYNGOLOGY
PLASTIC SURGERY
Percent of TABs in region
Year
Champlain LHIN
Percent of TABs in region
Year
South East LHIN
Percent of TAB in region
Year
Hamilton LHIN
Percent of TABs in region
Year
South West LHIN
Percent of TABs in region
Year

Figure 5.