AJNR

Comparison of Advanced Imaging Resources, Radiology Workforce, and Payment Methodologies between the United States and Canada

H.A. Valand, S. Chu, R. Bhala, R. Foley, J.A. Hirsch and R.K. Tu

AJNR Am J Neuroradiol 2018, 39 (10) 1785-1790
doi: https://doi.org/10.3174/ajnr.A5755
http://www.ajnr.org/content/39/10/1785

Comparison of Advanced Imaging Resources, Radiology Workforce, and Payment Methodologies between the United States and Canada

H.A. Valand, S. Chu, R. Bhala, R. Foley, J.A. Hirsch, and R.K. Tu

ABSTRACT

SUMMARY: The purpose of this Practice Perspectives was to review the United States and Canadian approaches to health care access and payment for advanced imaging. The historical background, governmental role, workforce, coding, payment, radiologic challenges, cost, resource intensity, and overall outcomes in longevity are reviewed.

ABBREVIATION: BC = British Columbia

Although Canada and the United States share a 5425-mile border, common heritage, culture, and language,[1] the health care system of each country, payment methodology, and radiologist workforce differ and are detailed below.

Health Systems

Canada. In the post–World War II era, Canada and the United States faced similar hospital and bed shortages. During the 1950s, Premier Tommy Douglas designed a hospitalization plan to address these shortages in rural and low-income regions in the Canadian province of Saskatchewan.[2] The 1984 Canada Health Act mandated that "medically necessary" comprehensive services be provided in the provinces, largely at no cost.[3] Today, Canadians in all 10 provinces and 3 territories enjoy "reasonable access to medically necessary hospital and physician services without paying out of pocket."[4] Administration of health services, including imaging, remains the responsibility of the provinces and territories under the 5 principles of the Canada Health Act: public administration, comprehensiveness, universality, portability, and accessibility.[5]

All provinces and territories have a publicly funded health plan that covers all residents living in each jurisdiction for a minimum of 6–8 months annually, depending on the province or territory.[6] The resident health card permits access to a full range of medical services, including diagnostic imaging at no or minimal out-of-pocket cost. Charging additional fees for medically necessary services is strictly forbidden by the Canada Health Act. Portability of health care services exists for Canadians who travel or work in other provinces, whereby their provincial health system compensates the delivering province at an agreed interprovincial rate.[7]

Six of 10 Canadian provinces prohibit private insurance from covering services that are provided under the provincial health care plan, and 3 of the remaining 4 provinces allow private insurance coverage of these services but at a considerable disadvantage to physicians who decide to opt out from public payers. For example, it is illegal for a physician in Nova Scotia to charge fees that exceed the provincial public rate. Saskatchewan and New Brunswick physicians are not reimbursed if they opt-out of the provincial plan. Only Newfoundland and Labrador authorize private insurance coverage of medical services reimbursable by the public plan without any economic disincentives to opt-out of the provincial health plan.[8] Many Canadians have supplemental insurance for uncovered services, such as prescription drugs, ambulance services, vision, and dental care.[9]

Unlike the United States, payment of Canadian physicians is generally restricted to specialty, as defined by the Royal College of Physicians and Surgeons of Canada and recorded by the provincial medical licensing authorities—that is, in Canada, only a radiologist can provide professional radiology services.[10,11] Professional fees of physicians are negotiated between the province and provincial medical association.[12-18] Canadian CT and MR imaging services are largely hospital-based performed in a hospital setting. Professional fees of Canadian radiologists vary between

Received May 16, 2018; accepted after revision June 14.

From the American University of Integrative Sciences (H.A.V.), Brampton, Ontario, Canada; Vancouver Coastal Health Authority (S.C.), Washington State Radiological Society, Vancouver, British Columbia, Canada; American Society of Neuroradiology (R.B.), Oak Brook, Illinois; Ontario Association of Radiologists (R.F.), Oakville, Ontario, Canada; Massachusetts General Hospital (J.A.H.), Harvard Medical School, Boston, Massachusetts; and Progressive Radiology (R.K.T.), George Washington University, United Medical Center, Falls Church, Virginia.

Please address correspondence to Raymond K. Tu, MD, MS, FACR, Progressive Radiology, George Washington University, United Medical Center, 7799 Leesburg Pike, Suite 1000N, Falls Church, VA 22043; e-mail: Raymond.Tu@progressiveradiology.net

http://dx.doi.org/10.3174/ajnr.A5755

Table 1: Comparing vital and economic statistics of Canada versus US in 2015[a]

	Canada	US
Population[30]	35.8 million	320.9 million
Uninsured (% of total population)[56]	~0%[b]	10%
Average life expectancy (yr)[26]	82.1	78.7
Per capita health care spending[25,27]	$4734	$9994
Total health care[25,27]	$170 billion	$3.2 trillion
GDP[25,57]	$1.6 trillion	$18.1 trillion
Total health care spending (% of GDP)[25,57]	11.4	17.7

Note:—GDP indicates gross domestic product.

[a] Currency is in US dollars.

[b] According to the Wellesley Institute report, approximately 200,000–500,000 uninsured individuals reside in Canada. They include students, workers from overseas, undocumented refugees, and newly landed immigrants.[58]

the Provinces and Territories of Canada as they are independently negotiated with the medical associations, Ministry of Health and providers.[19]

More than 90% of CT and MR imaging services are delivered in publicly funded hospitals in Canada. CT and MR imaging fees in Canadian provinces are either tied to the provincial fee schedule or negotiated on a regional basis. The remaining CT and MR imaging services are provided at private imaging clinics. According to the Canadian Agency for Drugs and Technologies in Health 2017, there are approximately 561 CT and 366 MR imaging scanners in Canada.[20] Additionally, there are approximately 59 true private payer MR imaging and CT facilities across Canada, located in a subset of provinces in urban areas: British Columbia (BC) ($n = 17$), Alberta ($n = 10$), Quebec ($n = 31$), and Nova Scotia ($n = 1$).[21] In Ontario, there are approximately 184 CT scanners and 120 MR imaging scanners, all in hospitals.[20]

United States. The United States has a multipayer system dependent on the private marketplace or government subsidy. Nongovernment plans include fee for service and prepaid plans. There are 6 government-based plans: Medicare, Medicaid, Children's Health Insurance Program, Tricare, Indian Health Service, and the Veterans Health Administration. Medicare plans are regionalized into 7 Medicare Administrative Contractors, which standardize covered benefits and rates. There are 274 different managed Medicaid plans, each with distinct coverage policies and reimbursement.[22] In 1965, President Lyndon B. Johnson signed the bill that led to Medicare and Medicaid. Medicare is federally funded by tax revenue benefiting largely the elderly (65 years or older) and individuals with disabilities. Medicaid is a federal and state cofunded program for those with limited financial resources.[23] There are 3 basic types of private health insurance plans in the United States: Health Maintenance Organizations, Preferred Provider Organizations, and Point of Service Plans, which combine Health Maintenance and Preferred Provider Organization features.[24]

Spending, Work Force, Coding, and Payment

In 2015, the United States spent $3.2 trillion on total health care, roughly $9994 per capita. Canada spent $170 billion (US dollars), approximately $4734 (in US dollars) per capita, a little more than half that of the United States. Despite these expenditures, the average life expectancy in the United States was 78.7 years, whereas it was 82.1 years in Canada in 2015 (Table 1).[25-27]

Table 2: Examples of differing procedure codes and professional reimbursement for an unenhanced CT of the head in the 10 provinces of Canada[12–18,59–61]

Province	Fee Code	Professional Fee (CaD$)
British Columbia	08690	44.88
Alberta[a]		
Saskatchewan[b]		
Manitoba	7113	49.15
Ontario	X400	43.25
Quebec	08259	33.40
New Brunswick	3166	67.00
Nova Scotia	1105	42.33
Prince Edward Island	8925	83.16
Newfoundland and Labrador	73800	55.53

[a] Benefits for noninvasive diagnostic procedures performed in hospitals and urgent care clinics are payable through hospitals or health authorities.[12]

[b] Not listed in the *Payment Schedule for Insured Services Provided by a Physician,* October 1, 2017, published by the Government of Saskatchewan.

In 2013, the radiology workforce in the United States was 8.14 radiologists per 100,000 with 25,730 radiologists serving a total United States population of 320.9 million.[28] In 2013, the Canadian per capita radiology workforce was 6.82 with 2396 radiologists, serving a Canadian population of 35.16 million.[29,30]

The Canadian procedure codes, including imaging, are unique and individualized to each province with updates as needed. Canadian fee codes for CT and MR imaging are organized along body systems and contrast (without contrast, with contrast, and pre and post contrast). With the exceptions of cardiac CT and CT colonography, Canadian radiologists are paid on a fee-for-service basis. (Table 2).

In the United States, the imaging procedures are standardized by the 5-digit Current Procedural Terminology code, a methodology published and owned by the American Medical Association with standing meetings by the Current Procedural Terminology Editorial Panel 3 times a year.[31,32] Medicare payments are based on a relative value unit formula weighted by the work of physicians, professional liability insurance, and practice expense with a geographic variation modifier as defined by the resource-based Relative Value Scale Update Committee, which also has standing meetings 3 times a year to evaluate updates and revisions, and, when approved by the United States Congress, with a conversion factor converting the relative value units into dollars.[33,34] Medicaid reimbursement and private insurance payments use the Medicare rates as a reference, but each plan individually determines the rate.[35]

Radiology Services in Canada

CT and MR Imaging (Advanced Imaging) Wait Times. More CT and MR imaging scanners have been approved in the past decade, but an undersupply continues to exist in every province. The combination of an inadequate number of scanners and underfunding for the operation of these scanners has led to prolonged wait times for both modalities, but especially MR imaging. This issue is occurring with an increasing demand to meet longstanding indications as well as new clinical applications (eg, breast MR imaging and CT colonography) driven by a growing and aging population. The Fraser Institute survey, based on physician recollection and self-reported methodology for "medically necessary

Table 3: Comparison of CT scanner use in Canada versus US (2016)[62]

Scans	Canada	US
Total CT use (hospital + ambulatory + other)		
Total No. (MM)	5.68	82
Per 1000 people	156.6	253.8
Per scanner	10,561.9	6062.8
CT use		
CT in hospital setting		
Total No. (MM)	5.61	65.7
Per 1000 people	154.4	203.3
Per scanner	8973.8[a]	7373.7
CT in ambulatory care setting		
Total No.	79,261	16.3 MM
Per 1000 people	2.2	50.4
Per scanner	2735.3[a]	3532

Note:—MM indicates million.
[a] Data were obtained in 2012. Remainder are from 2015.

Table 4: Comparison of MRI scanner use in Canada versus US (2016)[62]

Scans	Canada	US
Total MRI use (hospital + ambulatory + other)		
Total No. (MM)	2.03	39
Per 1000 people	55.9	120.7
Per scanner	5946.9	3287
MRI use		
MRI in hospital setting		
Total No. (MM)	1.8	16.5
Per 1000 people	49.4	51.1
Per scanner	6485.6[a]	3064.1
MRI in ambulatory care setting		
Total No.	234,308	22.5 MM
Per 1000 people	6.5	69.6
Per scanner	3170.9[a]	3471.2

[a] Data were obtained in 2012. Remainder are from 2015.

elective treatment," reported average Canadian CT wait times ranging from 3 to 6 weeks in 2016 among the provinces and average MR imaging wait times from 4 to 24 weeks.[36] In Ontario (the most populous Canadian province with 38.5% of the population of the country), average wait times were 3 weeks for CT and 6 weeks for MR imaging. The Canadian Institute for Health Information, an agency of Health Canada that collects and reports "essential information on Canada's health systems and the health of Canadians,"[37] reported a median CT wait time ranging from 6 to 34 days and MR imaging wait times from 33 to 84 days. Median CT wait times in Ontario were 6 days and 33 days for MR imaging.[38,39] Outpatients requiring nonurgent advanced imaging services in hospital radiology departments face significant backlogs; however, urgent and emergent priority procedures are completed within acceptable standards.[40] The average wait time in Ontario is 94 days. At 5 days a week, that is ~19 weeks.[41] Because of the high demand and an inadequate supply of available imagining appointments, the system is biased toward patients completing routine imaging protocols versus patients requiring more time-intensive, advanced studies such as breast MR imaging or cardiac CT, which have longer procedural times and longer wait lists.[42]

BC Government Initiative to Close Private Imaging and Surgical Centers. The legality of private, self-pay surgical facilities, such as the BC Cambie Surgery Centre, is under current constitutional challenge. The government of BC has recently announced a desire to close private imaging centers in the province.[43] That contrasts with some other provinces outside BC that permit private-pay imaging and surgical centers. BC physicians are not allowed to balance bill for services provided in a public hospital or community care facility or charge extra technical/facility fees for "medically necessary services."[44] Enrolled doctors, however, may operate clinics for nonmedically necessary services such as cosmetic surgery.

The Uninsured. All Canadians have provincial government health insurance. There are approximately 28.2 million uninsured United States citizens (Table 1),[45] 9% of the United States population according to the 2016 National Center for Health Statistics report.[46] In Canada, the Aboriginal population has access difficulties; "medically necessary" services for Aboriginals are the direct responsibility of the provinces, though the federal government does provide some services for mental health, chronic conditions, and prescription drugs.[47] The confusing and bureaucratic "patchwork" of coverage and the often rural location of Aboriginals have led to challenging care for this community.

Professional Liability Insurance Cost. Professional liability insurance costs differ between Canada and the United States. California legislated a $250,000 cap on noneconomic damages and fostered the low professional liability insurance rate for radiology. State-filed malpractice premiums of diagnostic radiologists in California range from $5729 to $21,095, with an average of $10,934; low-risk physicians receive a discount up to 50% on state-filed rates.[48] Greater than 90% of Canadian physicians are members of the Canadian Medical Protective Association, a mutual legal defense association that aims to decrease medical-legal risk for its members and improve the safety of health care. In BC, the annual fees (premiums) for diagnostic radiologists are near the median with other Canadian physicians, CaD$5280 in 2016 (~$3830 US dollars).[49] The actual fees paid may be less because each provincial medical association negotiates with the provincial government to subsidize a portion of the fees paid. In BC, the government rebated nearly half of the annual fee, CaD$2597 (~$1884 US dollars), to radiologists. In the United States, the malpractice claim rate of radiologists is approximately 7%,[50] compared with a Canadian malpractice claim rate of 1.9% in 2013 per the Canadian Medical Protective Association report of 46 claims against radiologists.[51] Nearly all 2396 radiologists in Canada were covered by the Canadian Medical Protective Association.

Advanced Imaging Equipment Funding and Use

Funding of Radiology Equipment. In Canada, each provincial ministry of health funds most hospital operating budgets, either

Table 5: Neuro CT procedures in 2016 in the US [63]

CT Procedure Categories	Total CT Procedure (MM)	% of All CT Procedures	% of CT Sites Performing
Spine	6.4	8%	87%
Brain	15.3	19%	94%
Head and neck	7.2	9%	90%
Total neuro CT procedure	28.9	36%	
Total CT procedures	82	100%	

Note:—Neuro indicates neurologic; MM, million.

Table 6: All versus neuro CT and MR scans/1000 people

Scans/1000 People	Neuro CT	All CT	Neuro MRI	All MRI
Canada	31[a]	156.6	14.2[c]	55.9
US	96.4[b]	253.8	65.2[d]	120.7

Note:—Neuro indicates neurologic.
[a] According to the Canadian Agency for Drugs and Technologies in Health, total neurologic CT examinations were 19.8% of all CT examinations in 2017.
[b] Based on the Medical Information Division benchmark report, total neurologic (spine, brain, and head and neck) CT examinations were 36% of all CT examinations in 2016.
[c] According to the Canadian Agency for Drugs and Technologies in Health, total neurologic MRI examinations were 25.4% of all MR imaging examinations in 2017.
[d] Based on the Medical Information Division benchmark report, total neurologic (spine, brain, and head and neck) CT examinations were 54% of all MR imaging examinations in 2016.

Table 7: Neuro MRI procedures in 2016 in the US[64]

MRI Procedure Categories	Total MRI Procedures (MM)	% of All MRI Procedures	% of MRI Sites Performing
Spine	9.5	24%	99%
Brain (nonvascular)	8.8	22%	97%
Head and neck	3.0	8%	84%
Total neuro MRI procedure	21.3	54%	
Total MRI procedures	39	100%	

Note:—MM indicates million.

directly or indirectly through Regional Health Authorities. Hospital imaging equipment purchases involve some combination of an approval of the health authority, ministry of health capital equipment funding, or funds raised through the charitable foundation of the hospital. The ministry/health authority controls operating budgets and approval of capital purchases. In the United States, except for the Veterans Administration and large government-owned hospitals, manufacturers and providers negotiate imaging equipment costs directly with the hospitals and facilities.[52]

Advanced Imaging Use and Units. The variation in the volume of advanced imaging procedures in Canada and the United States is marked (Tables 3 and 4). The Organization for Economic Cooperation and Development 2016 reported 157 CT procedures per 1000 individuals in Canada and 254 CT procedures per 1000 individuals in the United States. The number of MR imaging scans in Canada was 56 per 1000, while in the United States, the number was 121 per 1000 individuals. As of 2015, the 9.48 MR imaging units per million Canadian inhabitants was dwarfed by the United States ratio of 38.96 MR imaging units per million. During the same year, Canada had 15.01 CT units per million individuals, compared with 40.98 units per million in the United States[53,54] The proportionally lower number of CT and MR imaging units in Canada is accompanied by the need for greater numbers of procedures per unit per day. For CT, 10,600 examinations were performed on average in 2015 on each CT unit in Canada, while an average of 6100 examinations were performed on each CT unit in the United States. For MR imaging in 2015, an average of 5900 examinations were performed each year in Canada, while this number was 3300 in the United States.[55]

According to the Canadian Agency for Drugs and Technologies in Health 2017 report, there were approximately 1 million neurologic CT procedures, 19.8% of 5.68 million total CT procedures.[20] The United States performs 29.5 million neurologic CT procedures, 36% of 82 million (Table 5). Correcting for the population difference between the United States and Canada, the CT use/1000 Canadians is 31 (19.8% of 156.6 all CT procedures/1000 Canadians) versus 96.4 neurologic CT procedures/1000 Americans (Table 6). In comparison with Canada, the United States performs ~3 times as many neurologic CT examinations/1000 individuals. Similarly, the neurologic MR imaging use/1000 individuals in Canada is 14.2 neurologic MR imaging/1000 Canadians versus 65.2 neurologic MR imaging/1000 Americans (4.6 times higher) (Tables 6 and 7).

CONCLUSIONS

The American and Canadian systems both strive to provide health care to their citizens. The system in United States uses standardized coding within a dual system of government and private payer health insurance. The Canadian universal coverage is largely funded from tax revenue collected by the federal legalization payments and provincial government but is independently administered by provinces and territories using different coding and payment policies. The Canadian health system, including advanced imaging, is highly regulated and accounts for the per capita expenditure for health care in Canada being more than half that of the United States. As the United States struggles with increasing health care expenditures, Canada is struggling with the demand for greater access. The United States population is 10 times that of Canada, with health care costs nearly twice as high per beneficiary. The explanation of less expensive care and longer outpatient procedure wait times is complex, though perhaps due to a less adverse malpractice climate in Canada compared with the United States. Delivery in a nonprofit Canadian Government–controlled system may be an oversimplification; perhaps differing populations, poverty rates, and medical conditions served despite similar culture and origins may account for the apparent discordance of health care cost and access.

Disclosures: Joshua A. Hirsch—*UNRELATED*: *Consultancy*: Medtronic; *Grants/Grants Pending*: Harvey L. Neiman Health Policy Institute.

REFERENCES

1. Canada FAQ. What countries does Canada have borders with? http://www.canadafaq.ca/what+countries+canada+borders+with/. Accessed April 10, 2018

2. Brown L, Tayolor D. The Birth of Medicare. Canadian Dimension. July 3, 2012. https://canadiandimension.com/articles/view/the-birth-of-medicare. Accessed March 27, 2018
3. Henderson JW. *Health Economics and Policy*. Cincinnati: South-Western College Pub; 1999:395
4. Government of Canada. Canada's health care system. About Medicare. https://www.canada.ca/en/health-canada/services/canada-health-care-system.html. Accessed April 20, 2017
5. Justice Law's Website-Government of Canada. Canada Health Act, RSC 1985, c. C-6. Updated January 2018. http://laws-lois.justice.gc.ca/eng/acts/C-6/page-1.html#h-3. Accessed June 28, 2018
6. Government of Canada. A Canadian's guide to working, studying, volunteering or retiring in a foreign country. https://travel.gc.ca/travelling/publications/living-abroad. Accessed April 30 2018
7. Senate of Canada. The Health Canada Act. 17.4 Portability. https://sencanada.ca/content/sen/committee/372/soci/rep/repoct02vol6part7-e.htm. Accessed May 4, 2018
8. Parliament of Canada. Madore O, Tiedemann M. Private Health Care Funding and Delivery Under the Canada Health Act. Updated December 28, 2005. http://www.res.parl.gc.ca/Content/LOP/ResearchPublications/prb0552-e.htm. Accessed January 31, 2018
9. Government of Canada. Canada's health care system. Updated August 22, 2016. https://www.canada.ca/en/health-canada/services/canada-health-care-system.html. Accessed March 30, 2018
10. College of Physicians & Surgeons of British Columbia. Understanding Your Physician's Credentials. https://www.cpsbc.ca/physician_search/credentials. Accessed April 2, 2018
11. The College of Physicians and Surgeons of Ontario. What's Public (and What's Not) About Doctors. http://www.cpso.on.ca/Public-Information-Services/Find-a-Doctor/What%E2%80%99s-Public-(and-What%E2%80%99s-Not)-About-Doctors. Accessed April 2, 2018
12. British Columbia Government. British Columbia Ministry of Health. Medical Services Commission Payment Schedule, July 1, 2017. https://www2.gov.bc.ca/assets/gov/health/practitioner-pro/medical-services-plan/msc-payment-schedule-july-2017.pdf. Accessed January 27, 2018
13. Alberta Government. Updated Alberta Health Care Insurance Plan. Medical Governing Rules List. April 1, 2017. https://open.alberta.ca/dataset/8d90a766-e1d3-4b2c-a21f-4178cca65112/resource/1edd1e62-e8f7-43b4-acca-498a9b2874b7/download/somb-medical-rules-2017-01.pdf. Accessed January 27, 2018
14. Government of Saskatchewan. Payment Schedule for Insured Services Provided by a Physician. Published October 1, 2017. https://www.ehealthsask.ca/services/resources/Resources/physician-payment-schedule-oct-17.pdf. Accessed November 28, 2017
15. Manitoba Physician's Manual. *The Minister of Health (Manitoba)*. Published April 1, 2018. https://www.gov.mb.ca/health/documents/physmanual.pdf. Accessed September 17, 2017
16. Ontario Ministry of Health and Long-Term Care. Published Schedule of Benefits: Physician Services Under the Health Insurance Act, December 22, 2015 (effective March 1, 2016). http://www.health.gov.on.ca/en/pro/programs/ohip/sob/physserv/sob_master20160401.pdf. Accessed May 1, 2018
17. Régie de l'assurance maladie (Québec). Manuel des Médecins Spécialistes-Rémunération à l'acte. http://www.ramq.gouv.qc.ca/SiteCollectionDocuments/professionnels/manuels/syra/medecins-specialistes/150-facturation-specialistes/manuel-specialistes-remuneration-acte-RFP.pdf. Accessed November 23, 2017
18. Nova Scotia Medical Services Insurance. Physician's Manual 2014. http://msi.medavie.bluecross.ca/wp-content/uploads/sites/3/2015/07/PhysicianManual.pdf. Accessed November 27, 2017
19. Canadian Medical Association. Module 8: Physician Remuneration Options. https://www.cma.ca/Assets/assets-library/document/en/practice-management-and-wellness/module-8-physician-remuneration-options-e.pdf. Accessed on May 6, 2018
20. Ottawa: Canadian Agency for Drugs and Technologies in Health. The Canadian Medical Imaging Inventory, 2017; CADTH OPTIMAL USE REPORT. http://www.cadth.ca/sites/default/files/pdf/canadian_medical_imaging_inventory_2017.pdf. Accessed April 3, 2018
21. Canadian Association for Health Services and Policy Research. The Private Provision and Insurance of Diagnostic Imaging Services in Canada. https://www.cahspr.ca/en/presentation/52413982f44a7df3179aa9c3. Accessed May 6, 2018
22. Kaiser Family Foundation. Total Medicaid MCOs. https://www.kff.org/medicaid/state-indicator/total-medicaid-mcos/?currentTimeframe=0&sortModel=%7B%22colId%22:%22Location%22,%22sort%22:%22asc%22%7D. Accessed April 10, 2018
23. Medicare.gov. How is Medicare funded? Medicare Trust Funds. https://www.medicare.gov/about-us/how-medicare-is-funded/medicare-funding.html. Accessed July 25, 2017
24. Snyder L, Rudowitz R. c May 20, 2015. http://www.kff.org/medicaid/issue-brief/medicaid-financing-how-does-it-work-and-what-are-the-implications/. Accessed July 20, 2017
25. Canadian Institute for Health Information. National Health Expenditure Trends, 1975 to 2016. https://secure.cihi.ca/free_products/NHEX-Trends-Narrative-Report_2016_EN.pdf. Accessed January 27, 2018
26. The World Bank. Life Expectancy at Birth (years). https://data.worldbank.org/indicator/SP.DYN.LE00.IN?locations=CA-US. Accessed January 30, 2018
27. Centers for Medicare & Medicaid Services Historical. Highlights. National Health Expenditure Data. Last Updated January 8, 2018. https://www.cms.gov/Research-Statistics-Data-and-Systems/Statistics-Trends-and-Reports/NationalHealthExpendData/NationalHealthAccountsHistorical.html. Accessed January 27, 2018
28. Center for Disease Control. Table 84. Doctors of medicine, by place of medical education and activity: United States and outlying U.S. areas, selected years 1975–2013. https://www.cdc.gov/nchs/data/hus/2015/084.pdf. Accessed January 27, 2018
29. Canadian Medical Association. Number of Physicians by Province/Territory and Specialty, Canada, 2013. https://www.cma.ca/Assets/assets-library/document/en/advocacy/policy-research/physician-historical-data/2013-01-spec-prov.pdf. Accessed June 12, 2017
30. The World Bank. Population, Total. https://data.worldbank.org/indicator/SP.POP.TOTL?end=2016&locations=US-CA&start+=1960&view=chart&year_high_desc=false. Accessed December 7, 2017
31. Leslie Mazwi TM, Bello JA, Tu R, et al. **Current procedural terminology: history, structure, and relationship to valuation for the neuroradiologist.** *AJNR Am J Neuroradiol* 2016 Jul 14. [Epub ahead of print] CrossRef Medline
32. Hirsch JA, Leslie-Mazwi TM, Nicola GN, et al. **Current procedural terminology: a primer.** *J Neurointerv Surg* 2015;7:309–12 CrossRef Medline
33. UCSF Medical Group. RVU & RBRVS Basics. http://medgroup.ucsf.edu/data-warehouse/rvu-rbrvs-basics. Accessed February 18, 2018
34. Hirsch JA, Silva E 3rd, Nicola GN, et al. **The RUC: a primer for neurointerventionalists.** *J Neurointerv Surg* 2014;6:61–64 CrossRef Medline
35. Centers for Medicare & Medicaid Services. Final Policy, Payment, and Quality Provisions in the Medicare Physician Fee Schedule for Calendar Year 2018. https://www.cms.gov/Newsroom/MediaReleaseDatabase/Fact-sheets/2017-Fact-Sheet-items/2017-11-02.html. Accessed April 22, 2018
36. Barua B, Ren F. Waiting Your Turn: Wait Times for Health Care in Canada, 2016 Report. Fraser Institute. https://www.fraserinstitute.org/studies/waiting-your-turn-wait-times-for-health-care-in-canada-2016. Accessed December 5, 2017
37. Canadian Institute for Health Information. CIHI Overview Board of Directors Governance Handbook, 2017. https://www.cihi.ca/sites/default/files/document/governance-handbook-update-aug-2017-en-web.pdf. Accessed December 5, 2017
38. Canadian Institute for Health Information. Wait Times for CT Scan (2017). http://waittimes.cihi.ca/procedure/ctscan?show=5090#year. Accessed January 23, 2018

39. Canadian Institute for Health Information. Wait Times for MRI Scan (2017). http://waittimes.cihi.ca/procedure/mri?show=5090#year. Accessed January 23, 2018
40. Canadian Institute for Health Information. Wait Times for Priority Procedures in Canada, 2017. https://www.cihi.ca/sites/default/files/document/wait-times-report-2017_en.pdf. Accessed May 28, 2018
41. Ministry of Health and Long-term Care. Surgery and Diagnostic Imaging Results. Diagnostic Scans. http://www.ontariowaittimes.com/SurgeryDI/EN/Data.aspx?view=1&Type=0&Modality=3&ModalityType=22,25&city=toronto&pc=&dist=0&hosptID=0&str=&period=0&expand=0. Accessed April 22, 2018
42. Legislative Assembly of Ontario. Ontario Best Practice Guidelines for Managing the Flow of Patients Requiring an MRI or CT Examination. http://www.ontla.on.ca/library/repository/mon/23006/292809.pdf. Accessed May 6, 2018
43. British Columbia Government. Fair access to public health care for all British Columbians. https://news.gov.bc.ca/releases/2018HLTH0027-000559. Accessed May 6, 2018
44. Medicare Protection Act, RSBC 1996, c. 286, ss. 18(1), 18(2). http://www.bclaws.ca/civix/document/id/complete/statreg/E3tlc96286. Accessed April 22, 2018
45. Kaiser Family Foundation. Key Facts about the Uninsured Population. September 19, 2017. https://www.kff.org/uninsured/fact-sheet/key-facts-about-the-uninsured-population/. Accessed October 20, 2017
46. Clarke TC, Norris T, Schiller JS. Early Release of Selected Estimates Based on Data from the 2016 National Health Interview Survey. Division of Health Interview Statistics, National Center for Health Statistics. https://www.cdc.gov/nchs/data/nhis/earlyrelease/earlyrelease201705.pdf. Accessed July 20, 2017
47. Palmer K, Tepper J, Nolan M. Indigenous Health Services Often Hampered by Legislative Confusion. healthydebate. September 21, 2017. http://healthydebate.ca/2017/09/topic/indigenous-health. Accessed January 24, 2018
48. California's Medical Malpractice Insurance History. https://www.gallaghermalpractice.com/state-resources/california-medical-malpractice-insurance/. Accessed January 24, 2018
49. Doctors of BC. 2016 CMPA Rebates. https://www.doctorsofbc.ca/sites/default/files/2016cmpatable.pdf. Accessed April 3, 2018
50. Jena AB, Seabury S, Lakdawalla D, et al. **Malpractice risk according to physician specialty.** *N Engl J Med* 2011;365:629–36 CrossRef Medline
51. Perspective. Canadian Medical Protective Association. March 2017. https://www.cmpa-acpm.ca/static-assets/pdf/advice-and-publications/perspective/com_17_perspective_march-e.pdf. Accessed October 25, 2017
52. Auditor General of British Columbia. Health Funding Explained 2. March 2017. http://www.bcauditor.com/sites/default/files/publications/reports/FINAL_HFE2_2.pdf. Accessed March 31, 2018
53. OECD. Magnetic resonance imaging (MRI) units (indicator). https://data.oecd.org/healtheqt/magnetic-resonance-imaging-mri-units.htm. Accessed January 30, 2018
54. OECD. Computed tomography (CT) scanners. https://www.oecd-ilibrary.org/social-issues-migration-health/computed-tomography-ct-scanners/indicator/english_bedece12-en. Accessed January 30, 2018
55. Diagnostic Exams. Organisation for Economic Co-operation and Development. Health Care Utilisation. https://stats.oecd.org/index.aspx?queryid=24879. Accessed April 12, 2017
56. Kaiser Family Foundation. Uninsured Rates for the Nonelderly by Race/Ethnicity. https://www.kff.org/uninsured/state-indicator/rate-by-raceethnicity/?dataView=0&currentTimeframe=1&sortModel=%7B%22colId%22:%22Location%22,%22sort%22:%22asc%22%7D. Accessed December 7, 2017
57. The World Bank. GDP (Current US$). https://data.worldbank.org/indicator/NY.GDP.MKTP.CD?end=2015&locations=CA-US&start=2015&view=bar. Accessed January 26, 2018
58. Barnes S. Health Care Access for the Uninsured in Ontario: Symposium Report. Wellesley Institute. http://www.wellesleyinstitute.com/wp-content/uploads/2017/01/Health-Care-Access-for-the-Uninsured-Symposium-Report.pdf. Accessed April 5, 2018
59. Government of New Brunswick. New Brunswick Physicians' Manual. May 18, 2017. http://www2.gnb.ca/content/dam/gnb/Departments/h-s/pdf/en/Physicians/new_brunswick_physicians_manual.pdf. Accessed April 8, 2018
60. Master Agreement between the Medical Society of Prince Edward Island and the Government of Prince Edward Island and Health PEI: April 1, 2015–March 31, 2019. http://www.gov.pe.ca/photos/original/doh_masteragree.pdf. Accessed April 22, 2018
61. Medical Care Plan, Dept. of Health & Community Services (Newfoundland & Labrador). Medical Payment Schedule. June 1, 2013. http://www.health.gov.nl.ca/health/mcp/providers/Full_MCP_Payment_Schedule-03_13_14.pdf. Accessed April 8, 2018
62. OECD.Stat. Health Status. http://stats.oecd.org/index.aspx?DataSetCode=HEALTH_STAT. Accessed December 6, 2017
63. IMV Medical Information Division. *IMV 2016 CT Benchmark Report.* Des Plaines; IMV; Accessed March 14, 2018
64. IMV Medical Information Division. *IMV 2016 MR Benchmark Report.* Des Plaines; IMV; Accessed March 4, 2018