



Measuring Nova Scotia's Results In Health Research

Measuring Nova Scotia's Results in Health Research

2014 Updated Report

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EXECUTIVE SUMMARY

This report builds on the “Measuring Nova Scotia’s Results in Health Research” 2007 report by Collins Consulting. That report was updated by Collins Consulting in 2009. The findings in this report cover the six fiscal years from 2008-09 to 2013-14 using a variety of published data sources and related indicators of health research funding success.

The Canadian Academy of Health Sciences (CAHS) impact framework for health research identifies five (5) impact categories with associated indicators. The impact framework demonstrates how research activity (funding and capacity) informs decision making, eventually resulting in changes in the health and economic and social prosperity of a population. This report has used the CAHS framework as a way to organize the indicators measuring Nova Scotia’s results in health research. The following are just some of the highlights of the information gathered focusing on health research funding (research activity), the ability of health researchers to provide new information, (advancing knowledge) and health research leveraging of additional funding (economic impact).

Research Activity

- Since 2009, the landscape for health research has continued to evolve and change in Nova Scotia and nationally. Generally there is less funding available for researchers now than there was in the early to mid-2000s. CIHR continues to be the predominate funder of health research nationally with Nova Scotia ranked fifth (5th) amongst the provinces receiving CIHR grants and awards.
- In terms of CIHR funding, Nova Scotia continues to excel in clinical research (31% as compared to 17% nationally). Infection and immunity along with neurosciences, mental health and addiction researchers make up the bulk of clinical research.

Advancing Knowledge

- The quality of Nova Scotia’s health research outputs continue to be high and adds value to the health research knowledge pool through publications. Nova Scotia is in seventh (7th) place nationally for publishing research results and fourth (4th) nationally for its rate of interprovincial collaboration.
- Overall, the average yearly number of health research articles published by Nova Scotia researchers between 2008 and 2013 was 1096 and trending remains stable.

Broad Social and Economic Impacts

- The CAHS indicators include broad social and economic impacts such as research and development (R&D) in the pharmaceutical and medicine manufacturing. In the Atlantic Provinces pharmaceutical R&D has been stable with biotechnology R&D doubling in expenditures.
- Nova Scotia, along with Alberta, are leading in terms of growth of health sector employment and the province’s universities ranked fourth (4th) nationally in graduating students with undergraduate degrees.
- Nova Scotia ranked seventh (7th) nationally with 49 patent applications between 2006 and 2011.
- For every dollar invested by the Nova Scotia Health Research Foundation (NSHRF), the return on that investment is \$8.23 which is an 11% increase since the Collins Consulting Report in 2009.

1.0 INTRODUCTION

1.1 Purpose of the Report

In 2007 and 2009, NSHRF commissioned Collins Management Consulting & Research Ltd. to undertake an economic analysis of Nova Scotia's health research performance from 2000 to 2008. This current report updates these two reports to include data from 2008 - 2013, using a variety of published data sources and related indicators of health research funding success to add 6 years of data to the previous analysis. It is important to capture new information to update historical information so as to monitor and track the changes in the health research enterprise in Nova Scotia.

The structure of this report uses the Canadian Academy of Health Sciences (CAHS) impact framework for health research, this report focuses on health research funding (research activity), the ability of health researchers to provide new information, (advancing knowledge) and health research leveraging of additional funding (economic impact).

1.2 Data Sources

The following data sources were used to complete this report.

- Statistics Canada;
- Federal research organizations and granting councils;
- National organizations and foundations that fund health research in Canada;
- Provincial organizations and foundations;
- Science-Metrix and Observatoire des sciences et des technologies (OST)

1.3 Report Limitations

As with any study, there are limitations to this analysis. The main limitations are:

- Data quality
 - The aggregate data on research projects funded by some organizations is adjusted as final project counts, related costs and funding levels are available. This means that the historical data used in this report may vary to some degree from the data that were available at the time of data collection between January and March 2015.
- Data definitions
 - Data were not necessarily distinct. This means that for some funding organizations a clear distinction between health and non-health research was not always presented. Where possible health-specific codes were used to identify health specific data.
- Data availability and Accessibility
 - Lack of data available. There were limitations in both the availability and comparability of information available. For example, it was difficult to obtain data from some health charities, not for profits and government agencies.

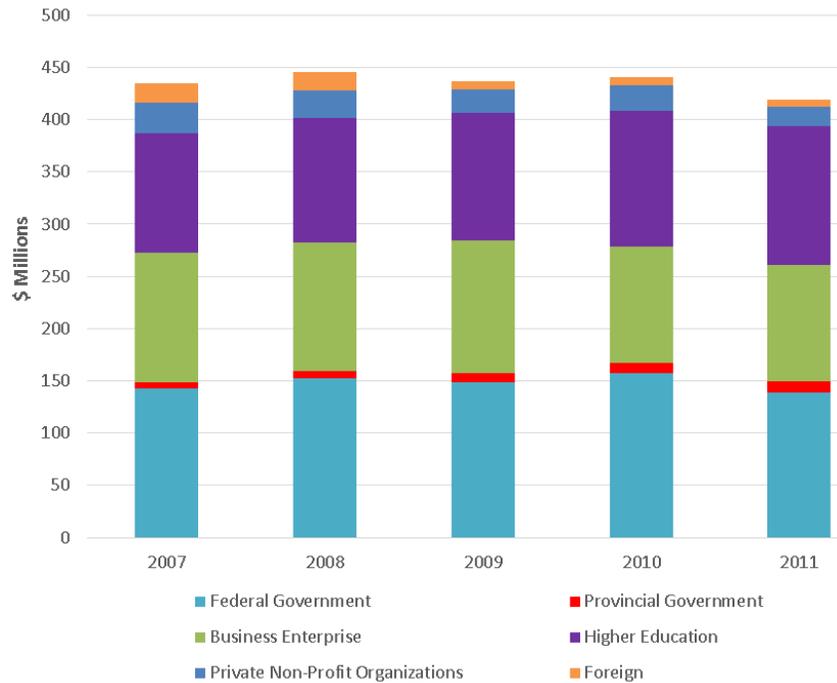
2.0 RESEARCH ACTIVITY

For the purpose of this study, research activity is defined as the funding of health research in Nova Scotia. National and provincial health research funding organizations are highlighted along with information on research and development expenditures.

2.1 Gross Domestic Expenditures on Research and Development (R&D)

Figure 1 below presents the annual gross domestic expenditures on research and development (GERD) on the natural sciences in Nova Scotia, including engineering, mathematical, life and physical sciences. The figure is meant to be illustrative of R&D spending in the province in terms of trends and sources of funding between 2007 and 2011 (the most recent year for which data was available). For the purpose of this report, GERD data related to research and development was used because health research spending falls primarily within natural sciences data. GERD data related to research and development in the social sciences and other areas is available through Statistics Canada but is not as complete for all performing and funding sectors (as natural sciences data) and therefore not included in this report.

Figure 1: Provincial Gross Domestic Expenditures on Research and Development, in the Natural Sciences and Engineering, by Funding Sector, for Nova Scotia, 2007-08 to 2011-12.



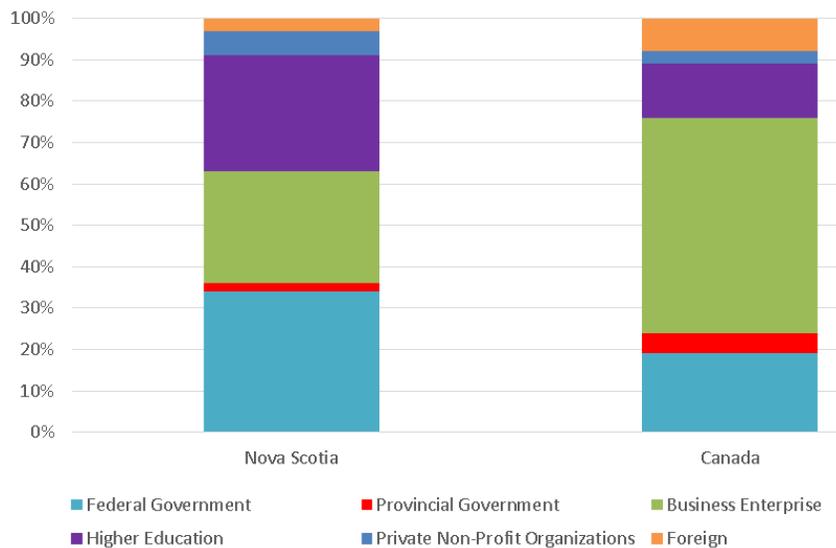
Source: Statistics Canada, GERD Statistics, Catalogue 88-221-X

- Total GERD in the natural sciences in Nova Scotia from 2007 to 2011 totaled approximately \$2.1 billion, which is an 11% increase when compared to 2002 to 2006, which was approximately \$1.9 billion.

- The federal government sector has decreased funding from \$157 million in 2010 to 139 million in 2011, which is an 11.5% decrease in funding. It however remains the largest financial contributor to R&D in the province.
- The higher education sector was the second highest contributor to GERD in Nova Scotia from 2007-2011, spending \$619 million and continues to trend upwards in funding levels.
- The business enterprise sector is the third largest contributor, with \$596 million in total, which has remained stable.
- The sector with the most growth each year is the Provincial Government sector, averaging an additional \$10 million each year since 2007.
- Investment by the Private Non-Profit Organizations and Foreign sectors are both on the decline.

Figure 2 compares the relative share of GERD spending in natural sciences by the same six sectors for Canada and Nova Scotia. The figure shows the proportion of total spending by each sector over the 2007-2011 time frame.

Figure 2: Average Percentage Distribution of GERD (Natural Sciences and Engineering) by Funding Sector, Nova Scotia and Canada, 2007-08 to 2011-12.



Source: Statistics Canada, GERD Statistics, Catalogue 88-221-X

- Nova Scotia has a higher portion (34%) of federal government spending on R&D in the natural sciences than in the country as a whole (19%). Nova Scotia has maintained the higher portion of federal spending since 1995 and during this time, has been trending down (Federal spending accounted for 37.5 per cent of Nova Scotia GERD compared to 18.0 per cent of GERD spending at the national level between 1995 and 2006¹).
- Business spending on R&D in the natural sciences accounts for a smaller share of total funding in Nova Scotia than nationally. The 27% share of business R&D spending on all natural

¹ Source: Measuring NS Results in Health Research, 2009 Update, page. 6

sciences R&D in Nova Scotia is about half of the 52% that business contributes to GERD at the national level. This remains consistent from the previous reporting period of 1995 to 2006.

- Nova Scotia receives a smaller proportion of GERD spending in the natural sciences by foreign organizations (3%) compared to national GERD spending (8%) which remains consistent from the previous report.

2.2 National Health Research Funding

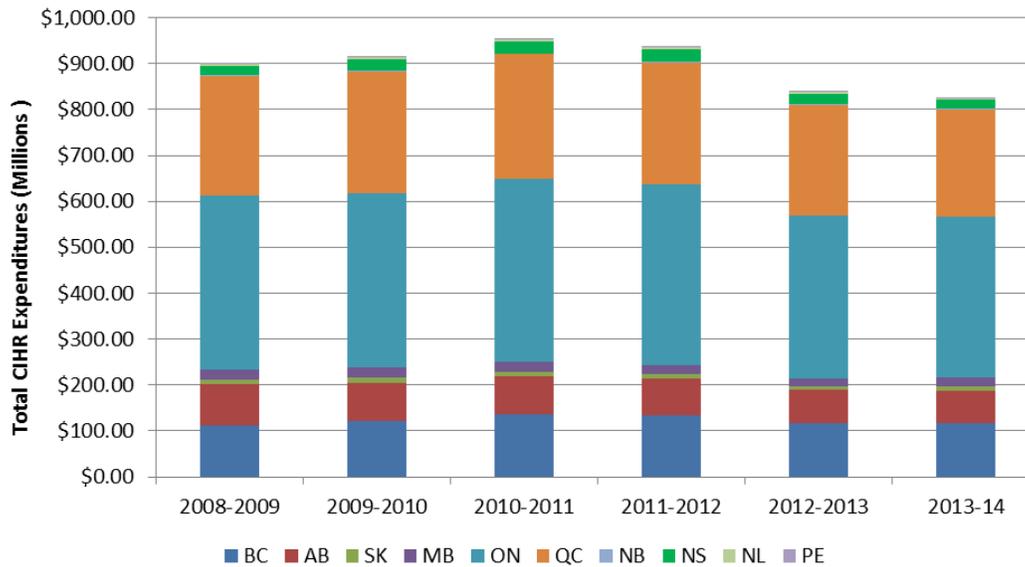
2.2.1 Canadian Institutes of Health Research (CIHR)

Funding

CIHR is the largest source of health research funding in Canada. The analysis of funding levels begins by examining volumes of funding activity and concludes with a review of funding by specific CIHR research themes and institutes.

Figure 3 shows CIHR funding expenditures by province, by year. Data in this section has been obtained from the CIHR Funded Research Database.

Figure 3: CIHR Funding Expenditures by Province, 2008-09 to 2013-14.²



Source: Calculated by NSHRF from CIHR website data: <http://www.cihr.gc.ca>

- Overall, CIHR funding increased between 2008 and 2010 with a slow decrease since 2011. The overall funding between 2000 to 2007 showed Nova Scotia was increasing each year until 2007.

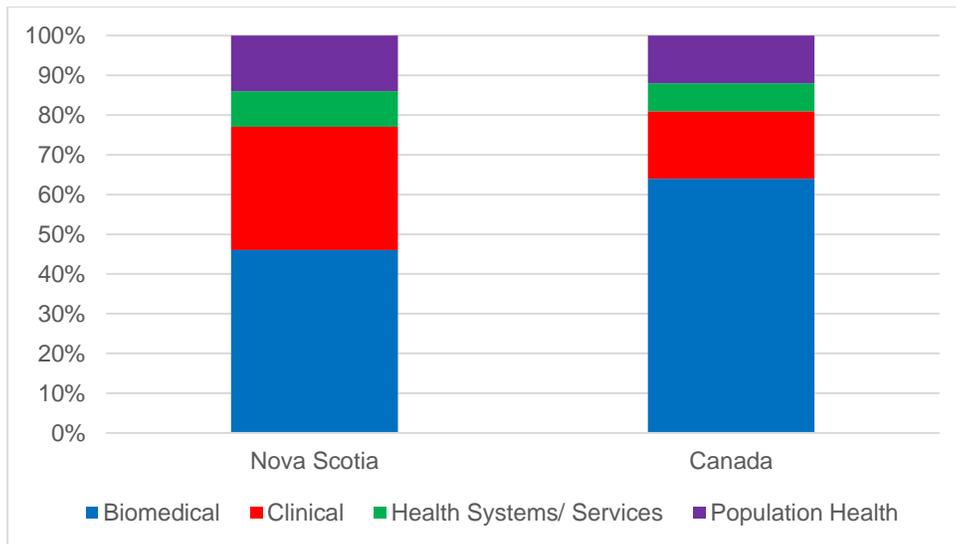
² Data excludes province 'unknown' or 'N/A', as recorded in CIHR Funded Research Database.

- The total value of research grants and awards by CIHR grew from \$900 million in 2008-09 to \$952 million in 2010-11. Between 2000 and 2007 funding was from a low of \$357 million in 2000 to a high of \$909 million in 2007.
- Out of the six fiscal years featured in Figure 3, Nova Scotia's share of CIHR funding peaked at 2.86% in 2009-10. Nova Scotia's share has been declining each year since 2011-12, with 2.84% in 2011-12 to 2.39% in 2013-14. Compared to 2000 to 2007, Nova Scotia's average share was lower with 2.4% of national funding³.
- Nova Scotia has a national ranking of fifth place among all provinces, based on CIHR expenditures, up from sixth⁴ place in the 2000-2008 period.
- Ontario and Quebec receive the largest proportions of CIHR funding, followed by British Columbia. In 2013-14, Ontario and Quebec together received \$584 million, which accounted for 71% of all CIHR national funding. These rankings remain consistent with the previous report.

Research Themes

CIHR categorizes its grants and awards according to the following four research themes⁵: biomedical research; clinical research; health services research; and population health research. Figure 4 indicates the distribution of CIHR grants and awards to Nova Scotia relative to Canada over this time for each theme. It should be noted, however, that not all grants and awards funded through CIHR are assigned a research theme. From 2008-09 to 2013-14, there were one hundred and thirty six (136) CIHR funded grants and awards in Nova Scotia without a research theme (Noted as 'Not applicable/Specified' in the CIHR Funded Research Database). For consistency, these 'N/A' grants/awards were not included in this analysis.

Figure 4: Average Shares of Total CIHR National Funding Awarded in Nova Scotia by CIHR Research Theme, 2008-09 to 2013-14.



Source: Calculated by NSHRF from CIHR website data: <http://www.cihr.gc.ca>

³ Source: Measuring NS Results in Health Research, 2009 Update, page. 18.

⁴ Source: Measuring NS Results in Health Research, 2009 Update, page. 8.

⁵ The Four Themes of CIHR Funded Health Research: <http://www.cihr-irsc.gc.ca/e/48801.html>

- From 2008-09 to 2013-14, Nova Scotia received 2.64% of CIHR total national funding for all four-research themes. This percentage is consistent with the previous reporting period of 2000 to 2007 when it was at 2.52%.
- Within Nova Scotia, grants in biomedical research is the most common theme investigated by researchers, accounting for 46% of CIHR funding shares by research theme. This is lower than the national average for biomedical, at 64%. This trend is consistent with the previous reporting period of 2000 to 2007 where biomedical themed grants/awards accounted for 64% of all research theme funding to NS, although the national percentage was higher at 71%.
- Between 2008-09 and 2013-14, CIHR awarded close to \$2.5 billion dollars nationally to the biomedical research theme, and Nova Scotia received approximately \$47 million of that amount for one hundred and seventy one (171) grants. Between 2000 and 2007, Nova Scotia received \$64 million for two hundred and seventy nine (279) grants/awards for this research theme.
- Nova Scotia has a higher percentage of clinical projects (31%), compared to the national average at 17%. This trend is in-consistent with the previous reporting period, where Nova Scotia was below the national percent of 14% with only 13% funding in the clinical theme. This increase can be explained by funding received through the 'PHAC/CIHR Influenza Research Network' from 2009 to 2012, in which over \$13.9 million in funding was allocated to this national network.
- The research theme with the highest average project amount over the six-year period for Nova Scotia was clinical research. For the prior seven (7) years, from 2000 to 2007, the theme with the highest average project amount was also the clinical.
- The average project amount of clinical themed research in Nova Scotia was \$667,425.00 from 2008 to 2014. This accounted for 5% of national funding totals for the clinical research theme which is more than the time frame 2000 to 2007.
- From 2008-09 to 2013-14, there were forty seven (47) grants/awards awarded to the Clinical theme, which is less than the prior seven (7) years from this research theme which had fifty four (54) grants/awards, so there has been more funding but fewer grants.

Table 1 below compares the average funding amounts per project over the same time period for Nova Scotia and Canada for each of the four themes, as well as the gap between Nova Scotia and Canada in average project size. As noted above, a significant proportion of projects do not have an assigned theme and for consistency not included in the analysis in Table 1 below.

Table 1: Average Project Funding by CIHR Research Theme, Nova Scotia and Canada, 2008-09 to 2013-14.

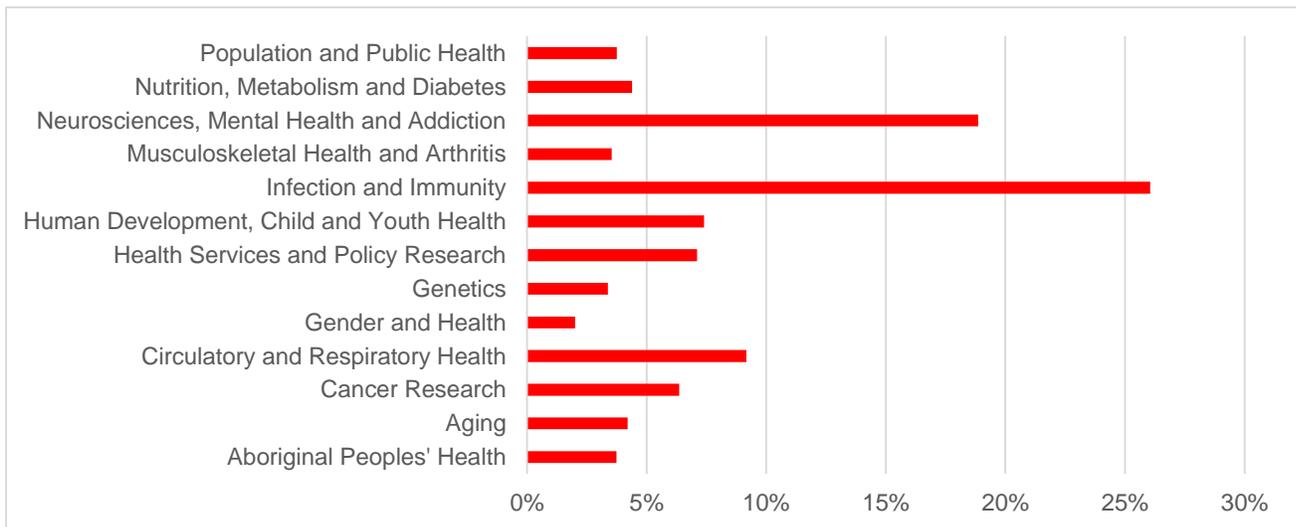
THEME	NOVA SCOTIA (\$)	CANADA (\$)	NS GAP (\$)
Biomedical	\$274,473.00	\$356,022.00	\$-81,549.00
Clinical	\$667,435.00	\$344,427.00	\$323,008.00
Health Systems/Services	\$175,942.00	\$193,788.00	\$-17,846.00
Social/Cultural/Environmental/Population Health	\$166,170.00	\$232,161.00	\$-65,991.00
All Themes	\$276,486.00	\$293,753.00	\$-17,267.00

Source: Calculated by NSHRF from CIHR website data: <http://www.cihr.gc.ca/>

Institutes

CIHR categorizes its grants and awards according to their alignment with its thirteen (13) scientific research institutes. CIHR applicants identify an alignment with the institutes as part of the application process. The findings in Figure 5 are annual averages of the funding for each of the thirteen (13) research institutes per year over the 2008-09 to 2013-14 timeframe. It should be noted, however, that not all grants and awards funded through CIHR are assigned a research institute. From 2008-09 to 2013-14, there were one hundred and twenty one (121) CIHR funded projects and awards in Nova Scotia that were not assigned an institute (Noted as 'Not applicable/ Specified' in the CIHR Funded Research Database) and not included in the chart and analysis below.

Figure 5: Average Total Funding by CIHR Institute for Nova Scotia, 2008-09 to 2013-14.



Source: Calculated by NSHRF from CIHR website data: <http://www.cihr.gc.ca/>

- Nova Scotia's involvement with the institutes has remained fairly consistent since the early 2000s. From 2000 to 2007, the top four CIHR Institutes, ranked by total grant and award funding to Nova Scotia researchers, were: Neurosciences, Mental Health and Addictions; Infection and Immunity; Circulatory and Respiratory Health and Genetics. For 2008-2013, the rankings changed slightly to: Infection and Immunity; Neurosciences, Mental Health and Addiction; Circulatory and Respiratory Health and Human Development, Child and Youth Health.
- From 2008-09 to 2013-14, Nova Scotia received 2.56% of CIHR's national funding for all thirteen (13) Institutes, which is consistent with 2001-2007 years (at 2.53%).
- 2009-10 was the province's strongest year over the last six (6) years, receiving over \$23 million in total funding for all institutes. The province received an average of \$18.7 million per year in grant and award funding for all institutes over the time frame of this report. This is an increase from the 2001-2007 reporting period when Nova Scotia received an average of \$13.7 million per year in funding for all institutes.
- The institute with the highest annual funding average was Infection and Immunity over the last six (6) years with over \$4.8 million. Infection and Immunity accounts for 26.1% of the province's total institute funding, which is a change from the previous period (Neurosciences was Nova Scotia's

strongest institute for funding from 2001-2007). The national average over the last six (6) years (2008-2013) was 13.84% for Infection and Immunity.

- Neurosciences, Mental Health and Addiction is another strong institute for the province (and currently ranks second behind Infection and Immunity), accounting for 22.8% between 2001 and 2007 decreasing to 18.86% of the province’s share of funding by institute between 2008-2013.

2.2.2 Natural Sciences and Engineering Research Council of Canada and Social Sciences and Humanities Research Council

This section documents the financial contribution of the other members of the Tri-Council Agencies: NSERC (Natural Sciences and Engineering Research Council of Canada) and SSHRC (Social Sciences and Humanities Research Council).

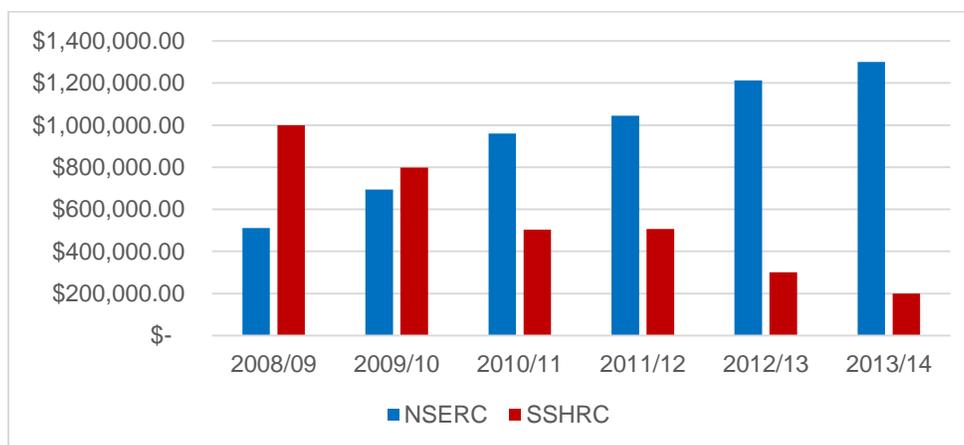
It is worth noting that in 2009, SSHRC determined that it would no longer fund health research. The agency announced that *“Research that is primarily intended to improve health, produce more effective health services and products and/or strengthen the health care system in Canada or internationally (e.g., research concerning the treatment, prevention or diagnosis of a condition, the evaluation of the effectiveness of health programs, the development of health management systems, etc.) is not eligible for consideration at SSHRC”*⁶.

Nova Scotia SSHRC funding related to health in from 2009 to 2013 has been primarily used to support Canada Research Chairs⁷.

For the purpose of this report, we defined ‘Health’ for NSERC grants and awards as ‘Health, education and social services’ as application area of research.

Figure 6 indicates funding by NSERC and SSHRC from 2008-09 to 2013-14 for health research grants and awards.

Figure 6: NSERC and SSHRC Health Research Funding for Nova Scotia, 2008-09 to 2013-14.



Source: Calculated by NSHRF from NSERC and SSHRC online databases

⁶ Source: SSHRC Subject Matter Eligibility: http://www.sshrc-crsh.gc.ca/funding-financement/apply-demande/background-renseignements/selecting_agency-choisir_organisme_subventionnaire-eng.aspx

⁷ Source: SSHRC Awards Search Engine for (funded) ‘Health’ area of research, Nova Scotia, 2008-2013.

- Given the decision to no longer fund health reach, the results in Figure 6 shows that SSHRC funding for health research in Nova Scotia has been rapidly decreasing each year, while NSERC funding is increasing since 2008.
- From 2008-09 to 2013-14, SSHRC awarded \$3,308,554.00 to Nova Scotia researchers, and NSERC awarded to \$5,724,346.00. This is an increase from the previous reporting period of 2001-02 to 2007-08, where SSHRC awarded \$2,093,843.29 to Nova Scotia researchers, and NSERC awarded \$3,288,467.00. Overall, Nova Scotia's share of funding has been increasing since 2008.
- The average project funding has increased during the last six years as illustrated below:

	<u>2000 to 2007</u>	<u>2008 to 2013</u>
NSERC	\$32,240.00	\$42,000.00
SSHRC	\$36,100.00	\$55,000.00

Table 2 indicates funding by CIHR, NSERC and SSHRC from 2008-09 to 2013-14 for health research grants and awards.

Table 2: Nova Scotia Shares of Tri-Council Funding, 2008-09 to 2013-14.

	CIHR		NSERC		SSHRC	
	NS \$	% OF CANADA \$	NS\$	% OF CANADA \$	NS \$	% OF CANADA \$
2004-05	\$16,472,000.00	2.41%	\$334,000.00	2.76%	\$197,000.00	2.06%
2005-06	\$17,057,000.00	2.31%	\$543,000.00	3.80%	\$298,000.00	2.76%
2006-07	\$18,481,000.00	2.38%	\$433,000.00	2.84%	\$305,000.00	2.53%
2007-08	\$20,607,000.00	2.28%	\$272,000.00	1.68%	\$629,000.00	1.73%
2008-09	\$20,005,576.21	2.17%	\$510,135.00	2.0%	\$999,345.00	8%
2009-10	\$26,552,906.94	2.86%	\$694,526.00	2.6%	\$798,915.00	6%
2010-11	\$26,083,092.7	2.71%	\$960,670.00	3.5%	\$503,844.00	5%
2011-12	\$28,060,852.51	2.84%	\$1,045,042.00	3.8%	\$506,450.00	6%
2012-13	\$23,178,122.00	2.76%	\$1,213,213.00	3.9%	\$300,000.00	3%
2013-14	\$19,718,314.00	2.39%	\$1,300,760.00	4.1%	\$200,000.00	3%
Total	\$216,215,864.00	2.51%	\$7,306,346.00	3.10%	\$4,737,554.00	4.01%

Source: Calculated by NSHRF from CIHR, NSERC and SSHRC online databases

- The dominant role of CIHR in funding health research in the province is clear from Table 2:
 - Nova Scotia received less than 3% of national CIHR funding in the past 6 years and that amount has been declining since 2011-12.
 - Nova Scotia's share of SSHRC funding for health related projects has decreased from 8% of the national funding amount to only 3% in 2013-14.

- Nova Scotia's NSERC funding has increased annually by 18% from 2008-09 to 2013-14.

2.2.3 Canada Foundation for Innovation (CFI)

CFI funds are allocated for health research infrastructure: state-of-the-art equipment, buildings, laboratories and databases required to conduct research. From 2000 to 2007, CFI has contributed over \$19 million to Nova Scotia in health related projects (maximum CFI contributions). From 2008 to 2013, CFI has contributed over \$4.4 million to Nova Scotia⁸. This decline can be attributed to some projects that received significant funding between the 2000 and 2007 time period, some examples being over \$5.5 million awarded to the Brain Repair Centre in 2006 and over \$2 million being awarded to each Dalhousie University and the IWK Health Centre in 2004 for the Establishment of the Canadian Centre for Vaccinology (Halifax).

Based on the CFI agreement with the government of Canada funding allocation for each of the CFI's funding mechanisms going forward is as follows:

- \$258,000,000* for the John R. Evans Leaders Fund (JELF) for a three-year period covering 2017–18 to 2019–2020. This represents yearly investments of approximately \$86 million (\$66 million in research infrastructure and \$20 million in generated Infrastructure Operating Fund (IOF) money);
- \$552,000,000* for the next Innovation Fund (IF) competition, to be launched in early 2016, with funding decisions expected in June 2017. This represents an investment of approximately \$425 million in
 - research infrastructure and \$127 million in generated IOF funds in the next competition;
 - \$75,000,000* for future Cyberinfrastructure Initiative competitions;
 - Up to \$45,000,000* for future College-Industry Innovation Fund (CIIF) competitions; and
 - Up to \$400,000,000 for the next Major Science Initiatives (MSI) Fund competition covering the five-year period between 2017–18 and 2021–22, with funding decisions expected in September 2016.

*These amounts include Infrastructure Operating Funds (IOF).

2.2.4 Genome Canada

Genome Canada oversees a national strategy to support large-scale genomic and proteomic research projects. The organization, which has centres across the country, invests in and manages large-scale research projects in such areas as agriculture, environment, fisheries, forestry, new technology development and health⁹.

From 2001-2 to 2013-14, Genome Atlantic (a centre through Genome Canada) has contributed \$9,279,146 to three large scale projects (in the Health sector alone) in Nova Scotia. Due to the small number of projects funded for Nova Scotia, trending data was not provided for Genome Canada in this report. Data for Genome Canada/Atlantic was obtained from the Genome Canada Project and Platform Funding Commitments database¹⁰.

⁸ Source: <http://www.innovation.ca/en/OurInvestments/ProjectsFunded/Downloaddatabase>. For the purposes of this report, only funded projects that were categorized under the 'Health Sciences' Research Sector were included in the analysis.

⁹ Text obtained from : http://www.nshrf.ca/sites/default/files/canpaperjune_4_2013_final.pdf, pg. 8

¹⁰ Source : <http://genomereports.ca/>

2.2.5 Research Support Fund

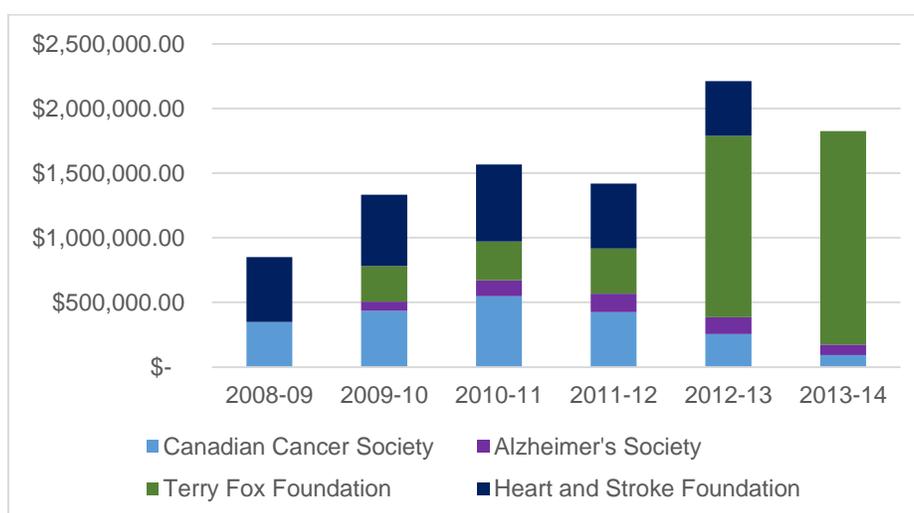
The Research Support Fund helps universities and institutes maintain research environments. The fund can be used to maintain modern labs and equipment; provide access to up-to-date knowledge resources; provide research management and administrative support; meet regulatory and ethical standards; or transfer knowledge from academia to the private, public and not-for-profit sectors¹¹. The Research Support Fund was previously the Indirect Costs Program established in 2003 to reinforce the research investment made by the federal government in the areas of health sciences, engineering, natural sciences, social sciences and the humanities through its three research granting agencies, CIHR, NSERC and SSHRC¹². The Indirect Costs Program was transitioned to the Research Support Fund in 2014. Grants awarded prior to fiscal year 2015-16 were awarded under the terms and conditions of the Indirect Costs Program¹³.

In 2013-14, the Research Support Fund provided over \$11.2 million in grant funding to all institutes in Nova Scotia. Data obtained from the Research Support Fund represents all research areas (not just health related funding) and therefore historical/trending data for this program was not included in this report.

2.2.6 Health Charities

As noted, health research spending is supported by additional organizations outside the public domain. These include private for-profit corporations, private not-for-profit organizations and foreign organizations. CIHR now provides expenditure data on several of the major Canadian health charities, health research organizations and foundations. This section examines health research expenditures in Nova Scotia by four (4) national health charities: Canadian Cancer Society, Alzheimer's Society of Canada, Terry Fox Foundation and Heart and Stroke Foundation of Canada. The Health Charities included in this report build on the previous report to illustrate the changes in funding from national health charities.

Figure 7: Select Non-Profit Organizations, Nova Scotia Funding Approved, 2008-09 to 2013-14.



Source: Various online databases and annual reports

¹¹ Text obtained from : http://www.rsf-fsr.gc.ca/about-au_sujet/faq-foires_aux_questions-eng.aspx

¹² Ibid.

¹³ Source : <http://www.rsf-fsr.gc.ca/apply-demande/grants-subventions/index-eng.aspx>

- The Canadian Cancer Society (CCS) provides research funding through grants and awards. Between 2008-09 and 2013-14, the Canadian Cancer Society awarded \$2.1 million dollars to Nova Scotia health researchers through ten (10) grants/awards. From 2000 to 2007, the Canadian Cancer Society allocated over \$4.2 million to Nova Scotia through nineteen (19) grants/awards. This resulted in an approximate 50% decrease in funding from 2008-2013 compared to 2000-2007 for Nova Scotia. In 2013-14, Nova Scotia ranked eight (8) out of nine (9) provinces (for which data was available) in terms of funding shares received (approximately a 0.90% share of the CCS national funding) which is currently trending down in recent years.
- Between 2008-09 and 2013-14, the Alzheimer Society has provided a total of \$545,649.00 in research funding to Nova Scotia researchers, a large increase (approximately 557%) from the last reporting period of 2004-05 to 2007-08 (earliest year data was available) which totaled \$83,000 to Nova Scotia. The biggest year for funding was 2011-12 when the province received \$141,630 in funding for six (6) projects. Nova Scotia currently ranks five (5) out of eight (8) provinces (for which data was available) in 2013-14 which is less than 2012-13.
- Between 2008-09 and 2012-13, the Heart and Stroke Foundation awarded over \$2.5 million to Nova Scotia researchers, a 16% decrease from 2001-2007 period when the Foundation allocated a total of \$3.1 million to the province. Since 2010-11, funding to Nova Scotia has decreased each year. From 2010-11 to 2011-12, funding dropped over \$94,000 and from 2011-12 to 2012-13, funding decreased annually again by \$78,000. Nova Scotia currently ranks 6 out of 9 provinces in terms of national funding received from this Foundation. Data for 2013-14 was not available.
- Between 2009-10 and 2013-14, the Terry Fox Foundation awarded over \$3.9 million to Nova Scotia researchers, a huge increase (approximately 178%) over the last reporting period of 2001-02 to 2007-08 in which funding for Nova Scotia totaled \$1,463,206. In 2012-13 and 2013-14, the Foundation awarded over \$2.5 million through its Translational Cancer Research Project Program (TFRI). Since 2012, Nova Scotia currently ranks four (4) out of eight (8) provinces (for which data was provided) in terms of national funding received from this Foundation and currently trending up.

2.3 Provincial Health Research Funding

This section focuses on organizations and agencies that exist in the province that support and fund health research.

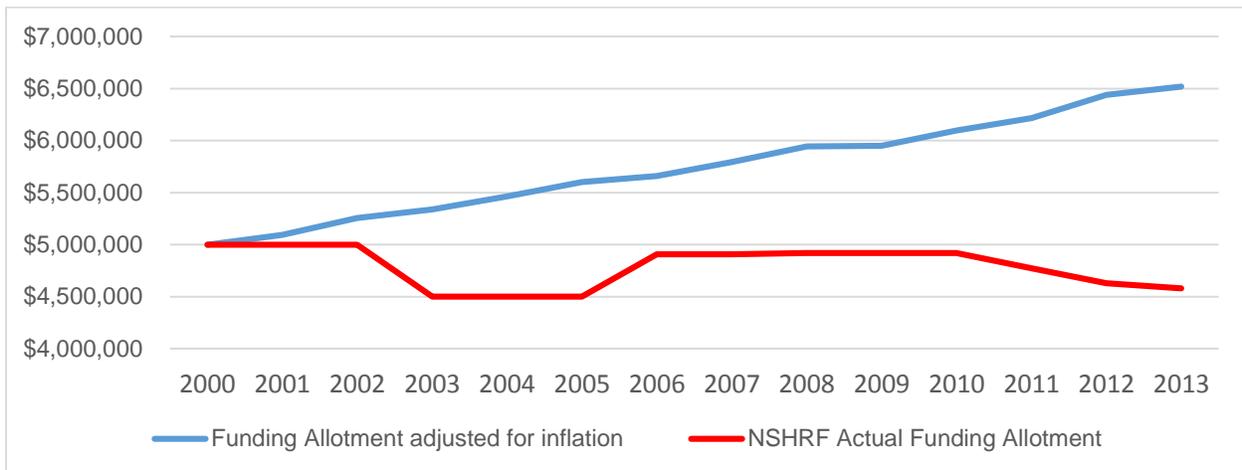
2.3.1 Nova Scotia Health Research Foundation (NSHRF)

Annual Budget

The Nova Scotia Health Research Foundation (NSHRF), created in 2000, runs three programs that directly support the province's health research enterprise. The programs are: Research Enterprise Development Initiatives (REDI) Program, Research Program, and the REAL Knowledge Program. Funding to support NSHRF and its mandate (to improve the health of Nova Scotians through health research) has been decreasing.

Figure 8 illustrates NSHRF's annual funding allotment and the impact of inflation on NSHRF's provincial budget.

Figure 8: Inflation impacts on NSHRF Provincial Grant, 2000-01 to 2013-14.



Source: Nova Scotia Health Research Foundation (NSHRF)

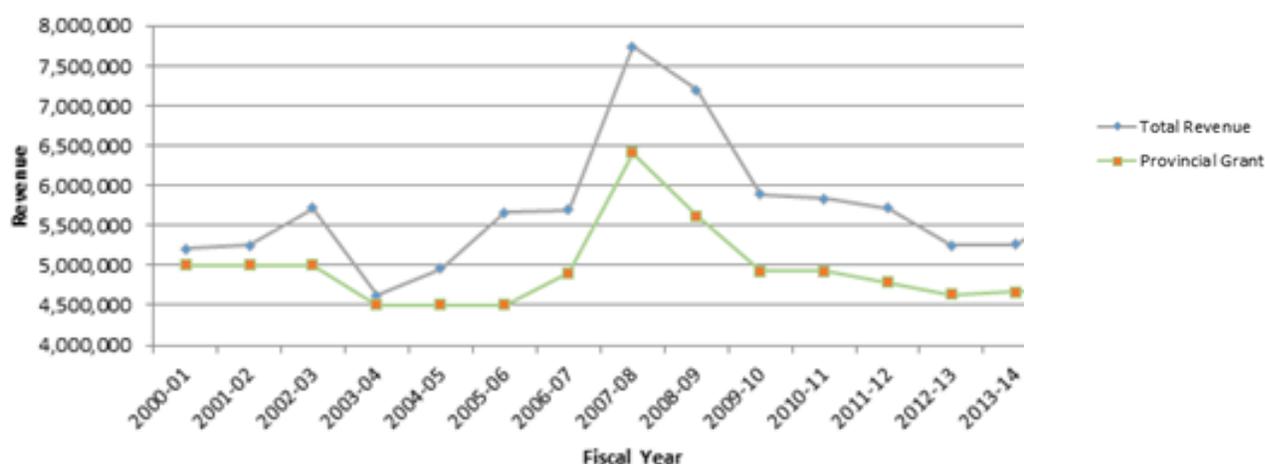
The chart illustrates two important concepts: NSHRF's core funding (annual provincial grant) and the impact of inflation on NSHRF that core grant. The adjustment for inflation was calculated using Bank of Canada inflation rates. The blue line on Figure 8 is adjusted for what NSHRF's grant would be if the organization's core funding had kept pace with inflation rates over time. Generally speaking, the trend for NSHRF since 2000 has been decreased funding.

- NSHRF's actual annual core funding (provincial grant) has been decreasing each year since 2010, which means the gap between the annual grant and grant adjusted for inflation continues to widen.
- As a result of inflation, there were \$1.9 million less funds available in 2013-14 for health research in the province than if consistent levels of funding matched to inflation were available to NSHRF, as shown by the gap between the blue and red lines in Figure 8.

The NSHRF has used an entrepreneurial approach to compensate for the decreasing provincial grant. The entrepreneurial funds represent income that is derived through sources outside the normal government grant process. Revenues raised through entrepreneurial activities include, but not limited to, providing expertise on a cost recovery basis (e.g. evaluation services), providing peer review services for national organizations (e.g. Public Health Agency of Canada), management services for the research enterprise and consulting. These funds are used to support grants, awards and special projects that fall outside the normal regulatory distribution as required on the provincial grant.

Figure 9 shows the provincial grant and the total revenue from 2000 to 2015.

Figure 9: Provincial Grant and NSHRF Total Revenue, 2000-01 to 2013-14.



Note: 2007/08 and 2008/09 had additional year end funding. These were unique events.

Program Funding

NSHRF funding amounts are different in Tables 3 and 4. Table 3 shows the funding provided by NSHRF only, whereas Table 4 includes 'Matching' funding from third-party sources. For Table 3 below, we define the programs to be:

- *Health Research Grants:* Project Grants, Establishment Grants, Development/Innovation Grant.
- *Student Awards and Research Trainee Program:* Student Research Award, Scotia Support Grant, Scotia Scholars^{OM} Award (all levels).
- *Matching Grants:* Regional Partnership Program, Partnership for Health System Improvement.
- *Capacity and RCA Grants/Awards:* Competitive Capacity Program, Research Capacity Awards.
- *REAL Knowledge Program:* Knowledge Program Grants/Awards.
- *REDI Program:* Research Enterprise Development Initiatives (REDI)

Table 3: Nova Scotia Health Research Foundation Funding, by Program.

NSHRF Programs	2004-05 to 2008-09	2009-10 to 2013-14
Health Research Grants	\$9,198,654.27	\$8,241,245.00
Student Awards and Research Trainee Program	\$7,780,950.25	\$3,976,780.00
Matching Grants	\$2,929,612.00	\$3,119,604.00
Capacity and RCA Grants/Awards	\$221,090.10	\$499,466.00
REAL Knowledge Program	\$164,576.00	\$2,656,408.00
REDI Program		\$1,524,392.00
Total	\$20,294,882.62	\$20,017,895.00

Source: NSHRF Access database and website

Health research grants receive the largest amount of funding. Health research grants, student awards and research trainee grants and matching grants are for the conduct of health research. Awards under the REDI and REAL Knowledge Programs are typically smaller in amount and support individuals, teams, universities and institutions to help them develop their research skills, research capacity, or ability to use or share research knowledge.

NSHRF total funding for its programs has remained stable in the two time periods (above in table 3).

Based on the information gathered from NSHRF's database, the program with the largest decrease of funds is Student Awards and Research Trainee Program, with a 48% decrease in funding in the 2009-10 to 2013-14 period compared to 2004-05 to 2008-09. From 2000 to 2010, NSHRF funded students and research trainees primarily through its Student Research Awards (SRA) Program. In 2011, NSHRF conducted a consultation with the research community in Nova Scotia to review its student funding structure. As a result, NSHRF launched its Research Trainee Program, which consists of the Scotia Support Grant and the Scotia Scholars Award. When comparing 3 years' worth of funding data for each program (Student Research Awards from 2008 to 2010, and Research Trainee Program from 2011 to 2013), the Research Trainee Program was able to fund 22% more students (including Undergraduates) than the previous Student Research Awards model.

The program with the largest increase (1514%) in funding is the REAL Knowledge Program¹⁴.

Leveraging of Research Funding

Table 4 provides details on leveraged health research funding for NSHRF. Leveraging is also described as matching funding by some organizations. In addition to the direct funding NSHRF provides, other organizational partners and funding organizations increase the amount of funding available for research here in Nova Scotia; thus creating more capacity for the health research enterprise.

The data in Table 4 is primarily based on two programs, the Regional Partnership Program (RPP) and the Partnerships for Health Systems Improvement (PHSI). The RPP program was launched for the last time in November and December 2012¹⁵. The data also includes additional funding received by BIOTIC (a multi-site medical imaging center).

In Table 4, 'Partner' refers to funding obtained from sources that are external to Nova Scotia, either on a national or international basis.

TABLE 4: NSHRF MATCHING PROGRAM LEVERAGING RESULTS, 2008 TO 2013.

Year	CIHR Totals (\$)	NSHRF Totals (\$)	Partner Totals (\$)	Totals (\$)
2008-09	\$1,446,235.00	\$562,618.00	\$1,312,121.00	\$3,320,974.00
2009-10	\$701,993.00	\$489,878.00	\$212,115.00	\$1,403,986.00
2010-11	\$1,064,517.00	\$404,288.00	\$369,288.00	\$1,838,093.00
2011-12	\$1,534,612.00	\$538,468.00	\$778,468.00	\$2,851,548.00
2012-13	\$2,449,950.00	\$669,474.00	\$1,094,125.00	\$4,213,549.00
2013-14	\$1,445,455.00	\$454,878.00	\$1,948,493.86	\$3,848,826.86

¹⁴ Data source: NSHRF Access database, 'total funds approved' for funded grants/awards.

¹⁵ Source: <http://www.cihr-irsc.gc.ca/e/22510.html>

Totals	\$8,642,762.00	\$3,119,604.00	\$5,714,610.86	\$17,476,976.86
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Source: NSHRF Access database and website

- Since 2008, NSHRF has contributed over \$3.1 million to its Matching Program.
- This support from NSHRF attracted an additional \$14.3 million in health research funding in the province.
- This result means that for every dollar contributed by NSHRF in its matching program, these health research projects and researchers leveraged an additional \$8.23¹⁶.

The Collins Management Consulting & Research Ltd. report in 2009, calculated leveraged funding using matching program data (RPP and PHSI programs), proposal development and team development awards funding. From 2000-2008, leveraged funding based on these calculations amounted to \$7.40 in external funding for each dollar provided by NSHRF. The proposal development grant formally ended in 2009 and team development awards was later moved in the REDI program in 2010. In addition to the financial leveraging the REDI investments create opportunities for skill development, team development and other catalytic activity which creates additional returns on investments for more highly skilled employees, more applications for funding and a more innovative research environment is created.

Therefore, for consistency, NSHRF calculated its leveraged funding amounts for the 2008-2013 reporting period using only matching program and BIOTIC funding (as this project was funded through NSHRF's REDI Program). This amounts to \$8.23 in external funding for each NSHRF dollar (NSHRF dollar being defined as NSHRF approved funds for Matching Program/BIOTIC funding).

2.3.2. Other Funding Organizations in Nova Scotia

The following section was obtained from a report entitled *Understanding the Nova Scotia Health Research Enterprise: Review and Data Analysis*¹⁷ (May 2013) prepared for NSHRF by Gardiner Pinfold Consultants Inc. This report explored the current state of health research in the province and the issues facing the health research enterprise in Nova Scotia from 2006-2011. The purpose of the following section is to highlight sources of health research activity funding in the province other than that of NSHRF.

Dalhousie Medical Research Foundation

The Dalhousie Medical Research Foundation (DMRF) is an independent, external funding agency established for the sole purpose of funding excellence in medical research at Dalhousie Medical School and its affiliated research institutions. The Foundation focuses its support on the Faculty of Medicine's four identified areas of research emphasis: neuroscience; cancer; cardiovascular research; and immunity, inflammation, and infectious diseases.

The DMRF provides approximately \$2 million annually in funding for research, equipment and infrastructure, training, and senior research chairs. It is also the largest non-government funding agency supporting local cancer research providing roughly \$600,000 to the Beatrice Hunter Cancer Research Institute each year. The Foundation receives no government funding and is supported entirely through public donations. Its contributions are often used as matching grants to leverage support from national

¹⁶ Leveraging is defined as: Partnership \$/NSHRF

¹⁷ http://www.nshrf.ca/sites/default/files/nspaper_june_24_2013_final.pdf

granting agencies.

Universities

Nova Scotia is home to ten (10) universities, the most per capita of anywhere in Canada. Nova Scotia's universities offer internal awards of varying amounts. Funding levels vary by institution, department, and faculty.

Nova Scotia Health Authority

In 2015, Nova Scotia, through legislation changed from nine district health authorities to one health authority and the IWK Health Centre. The majority of health research undertaken by the Nova Scotia Health Authority (NSHA) is conducted by, or in collaboration with the NSHA sites in Halifax (in particular with the previous named Capital Health District Health Authority). In 2013-14, there were over \$21.5 million in research funding administered through Capital Health¹⁸. The majority of these grants/awards (48%) were sourced by industry¹⁹.

IWK Health Centre

The IWK Health Centre, the largest children's hospital in the region, invested \$1.4 million in research through the IWK Foundation in 2013-14²⁰. These funds foster research capacity by investing in people, equipment, and projects.

The Nova Scotia Research and Innovation Trust (NSRIT)

The province of Nova Scotia established the Nova Scotia Research and Innovation Trust (NSRIT) in 2001 to provide matching funds for approved infrastructure projects. NSRIT matches CFI's approved funding by providing an additional 40% of a project's eligible infrastructure cost. The remaining 20% of funding is secured through the research institution, industry partners, or other government partners. NSRIT matching funds benefit researchers in health and life sciences, ocean technology, clean technology, and information and communications technology. Since 2001, NSRIT has matched \$66 million research investments in Nova Scotia²¹.

3.0 ADVANCING KNOWLEDGE

This section examines the quality of health research in Nova Scotia using available bibliometric data. This sheds light on how Nova Scotia compares across Canada and how the province's health research quality is improving over time. As part of that analysis, this section presents two common, high-level measures of research quality:

- *Average Relative Impact Factor*, or the relative impact of research as described by a quantitative impact rating of scientific publications reporting research findings;
- *International Collaborations* that reflect the extent to which research activities in a given jurisdiction are operating on the international level.

¹⁸ Source: Capital Health Research Annual Report 2013-2014, page 28.

¹⁹ Source: Capital Health Research Annual Report 2013-2014, page 28.

²⁰ Source: <http://digitallibrary.iwkfoundation.org/i/330558-the-2014-gratitude-report>, pg. 13

²¹ Source: <http://nsrit.ca/>

3.1 Average Relative Impact Factor (ARIF)

The average relative impact factor (ARIF) indicator is a proxy for the *quality* or *impact* of the journals in which a researcher or research group publishes. The ARIF is based on the number of citations a research paper published in a peer-reviewed journal receives.

The two assumptions underlying the ARIF are:

- A researcher's work has value when it is judged by peers to have merit, and, as a result, is made available in a peer-reviewed journal; and
- The ARIF normalizes the bibliometric approach underlying the measuring of citations by recognizing that the number of citations varies within different fields of research.

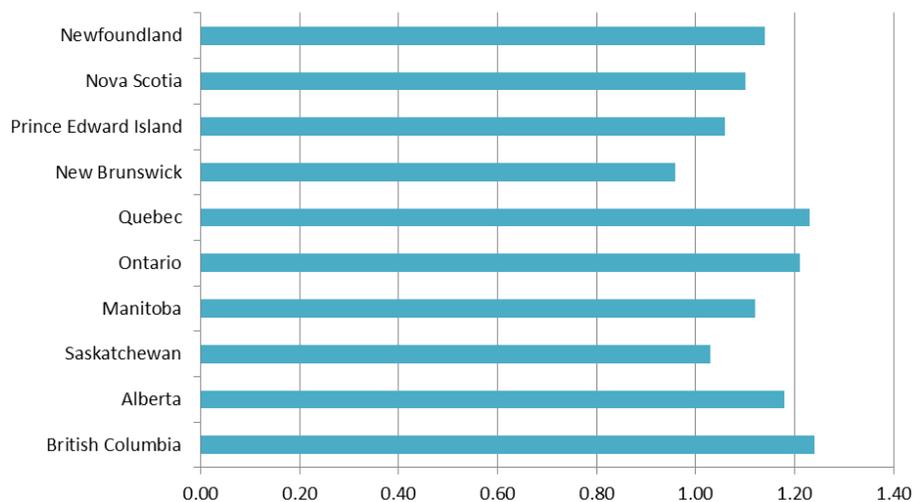
The ARIF is an average of impact factors (IF) across fields and subfields of a science discipline and is calculated in three steps:

- **Impact Factor:** Thomson Scientific, a publishing company, annually calculates the impact factor for each journal the company publishes. The IF is the number of citations a journal receives relative to the total number of papers published that year. Articles and papers receive the IF of the journal in which they are published.
- **Relative Impact Factor:** The IF of each paper is normalized within a scientific field by dividing each paper's IF by the average IF of each paper in that same field.
- **Average Relative Impact Factor:** The ARIF is the average of the RIFs for all articles published by a particular unit, such as a researcher, research group, or province.

An ARIF above 1.0 indicates that papers published by a particular researcher (or province) are cited more often than all other papers in that research field on average in the world. An ARIF below 1.0 indicates that the papers from a particular researcher (or province) are cited less often and have a lower impact than the average, and that a researcher publishes in journals that have a lower impact - and quality - than the world average.

Figure 10 compares the ARIF across several jurisdictions, including all Canadian provinces.

Figure 10: ARIF (Average Relative Impact Factor) by Selected Health Fields, by Province, Average from 2008-09 to 2013-14.



Source: Calculated by OST database using Thomson Scientific data

- The quality of Nova Scotia's output is very high, based on the ARIF analysis undertaken by OST and Science-Metrix using the Thomson Scientific publishing data.
- Nova Scotia's ARIF of 1.10 places it above the world average of 1.0 for quality of published articles, based on the last years of data. This result ranks the province in seventh (7th) position among Canadian provinces. This is an increase from 1996-2007 period in which Nova Scotia reported an ARIF of 1.08²² but still ranked seventh (7th).
- The ARIF for Nova Scotia has remained relatively constant on an annual basis over the last six (6) years.

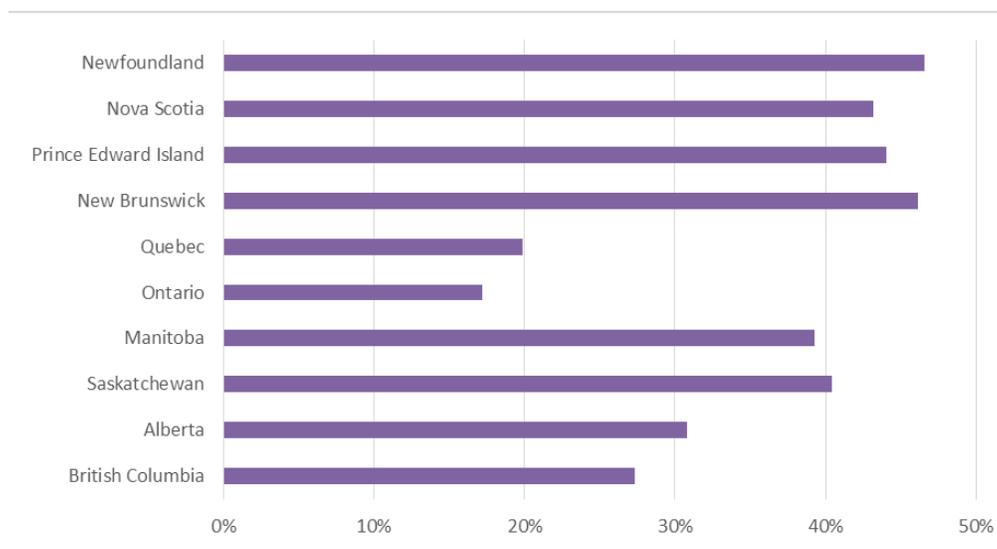
²² Source: Measuring NS Results in Health Research, 2009 update, pages 31.

3.2 Interprovincial Collaboration

Interprovincial collaboration is one indicator of the relative intensity of scientific collaboration between provinces. The rate is calculated by dividing the number of papers with at least one author with address in another province by the province's total number of publications.

Figure 11 compares the average interprovincial collaboration rates over the 2008-09 to 2013-14.

Figure 11: Interprovincial Collaboration Rate for Health Research Fields, All Provinces, Average, 2008-09 to 2013-14.



Source: Calculated by OST database using Thomson Scientific data

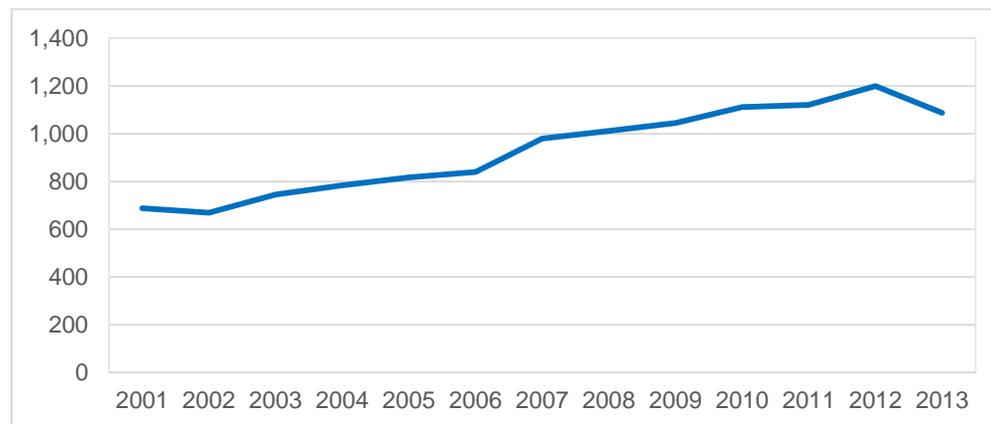
- Over one third of the publications by Nova Scotia health researchers over the 2008-2013 period included interprovincial collaboration. Other Atlantic provinces had high interprovincial rates of collaboration as well. An average of one third of publications by Nova Scotia health researchers, between 1994 and 2007, included interprovincial collaboration as well. From 2004 to 2007, Nova Scotia ranked second in terms of average levels of collaboration with an average rate of 39.6 per cent²³.
- This result is the most likely related to the small size of the Atlantic Provinces, since specialist researchers in these provinces may be more likely to find potential collaborators outside their home province.

²³ Source: Measuring NS Results in Health Research, 2009 update, pages 32-33.

3.3 Growth in Health Research Publications

Figure 12 shows the annual changes in the number of research articles published by Nova Scotia health researchers over the 2008-09 to 2013-14 timeframe. For this report, we define 'health research' publications to be Biomedical Research, Clinical Medicine, Health, Social Sciences and Psychology for field selection in the OST database.

Figure 12: Publications in Health Science Research Articles for Nova Scotia, 2001 to 2013-14.



Source: Calculated by OST database using Thomson Scientific data

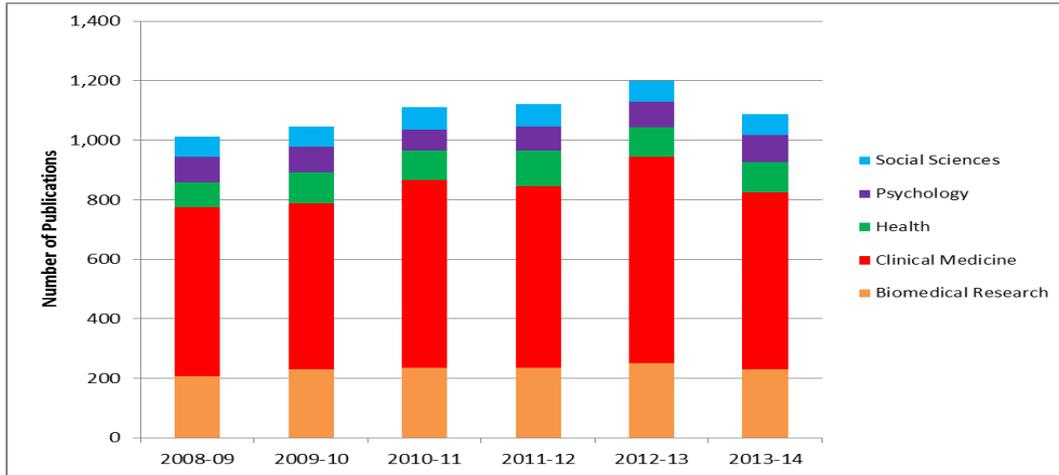
- Between 2008 and 2013, Nova Scotia health researchers published six thousand five hundred and seventy four (6,574) research papers. According to analysis undertaken by (OST) and Science-Metrix, the growth patterns in the level of output for Nova Scotia generally matched Canadian and global output patterns²⁴.
- Overall, the average yearly number of health research articles published by Nova Scotia researchers between 2008 and 2013 was one thousand ninety six (1096). During the 1990s, Nova Scotia health researchers published an average of five hundred and twenty seven (527) research papers annually; and between 2000 and 2007, the annual average has climbed by more than one third to seven hundred and six (706) papers. In 2000 to 2007, Nova Scotia ranked 5th out of 10 provinces (for which data was provided), and in 2008-2013 it dropped to 6th place (surpassed by Manitoba).

²⁴ Source: Measuring NS Results in Health Research, 2009 update, page 34.

3.4 TRENDS IN HEALTH RESEARCH CATEGORIES

Figure 13 indicates the number of published research articles by Nova Scotia health researchers from 2008-09 to 2013-14, categorized by biomedical research; clinical medicine; health; psychology and social sciences.

Figure 13: Published Health Research Articles by Selected Fields for Nova Scotia, 2008-09 to 2013-14.



Source: Calculated by OST database using Thomson Scientific data

- Clinical medicine dominates the number of research publications among Nova Scotia health researchers, accounting for 3,655 articles over the 2008-2013 timeframe and 56% of all articles published in the five fields. This trend remains the same with the previous reporting period (2000 to 2007) with clinical medicine accounting for 57% of all health publications in Nova Scotia with 3,545 publications.
- In the past two years, more than 1,288 articles have been published in the clinical medicine field by Nova Scotia health researchers. Close to 22% of publications in this field were in the areas of Neurology/Neurosurgery and General and Internal Medicine.
- Popular areas of publication under the Health category include Public Health and Health Policy and Services. From 2000 to 2013, there have been 238 publications in Public Health and 254 in Health Policy and Services. From 2000 to 2007, Health Policy and Services averaged 10 publications per year, and from 2008 to 2013 it has averaged 29 publications per year.
- Growth in biomedical research, which accounted for 21% of all published articles, has begun to increase annually from 2008 to 2012. From 2008 to 2013, the average amount of biomedical articles published per year was 231. This is a slight decrease from 2000-2007 when biomedical research accounted for 23% of all health research related articles in Nova Scotia. Publications in this field decreased from 250 in 2012 to 230 in 2013. From 2000 to 2007, Nova Scotia ranked 6th out of 10 provinces in biomedical research publications, and maintains that same position for the 2008 to 2013 period.
- Publications in Social Sciences and Psychology have remained stable since 2008, with an average of 83 publications per year in Social Sciences and an average of 83 publications per year in Psychology. From 2000 to 2007, the average amount of publications per year for Psychology was sixty five 65 and forty nine 49 for Social Sciences. This is comparable to national averages for publications in this field.

4.0 BROAD SOCIAL AND ECONOMIC IMPACTS

The estimated economic impacts of health research spending in Nova Scotia has been extracted from the ***National Alliance of Provincial Health Research Organizations (NAPHRO) Econometric Project: Final Report***²⁵(2013). The report provided NAPHRO with quantitative evidence to demonstrate returns on investment from health research and development (R&D) at the provincial level, with a particular focus on research and technological productivity.

As the description of the data used in the economic impact analysis indicates, both additional and more accurate data have become available in the past six years, improving the overall value of the analysis presented in this report.

4.1 Pharmaceutical Research and Development (R&D) Spending

Data on R&D spending in the pharmaceutical sector (from both Statistics Canada and the PMPRB) show a strong concentration of R&D in Ontario and Quebec, reflecting the concentration of pharmaceutical firms in Ontario and Quebec.

R&D spending for pharmaceutical and medicine manufacturing between 1997 and 2011 was measured using BERD data (Business Enterprise Expenditures on Research and Development- Statistics Canada) which averaged \$14,642,857 annually for the Atlantic Provinces and is trending down.

R&D spending for pharmaceutical and medicine manufacturing, 2002 to 2011 PMPRB data (Patented Medicine Prices Review Board) for the Atlantic Provinces averaged \$20,490,000 annually. Nova Scotia has experienced a relatively steady increase in pharmaceutical research and development funding since 2011. There was a major increase in funding for 2012.

4.2 Biotechnology Research and Development (R&D) Spending

The data on private biotechnology R&D spending shows an overall strong growth, indicating a doubling of expenditure, after adjustment for inflation.

Biotech R&D spending between 1997 and 2005 in the Atlantic Provinces averaged \$10,200,000 annually which is trending slightly up in 2005 over 2004.

In Table 5, Biotech spending by provinces in Canada is displayed.

²⁵ Information for this section was obtained from Science-Metrix NAPHRO Econometric Project Final Report : http://www.nshrf.ca/sites/default/files/sm_final_report_naphro_econometric_project_vfinal_revised_0.pdf

Table 5: Biotech R&D Spending, 1997-2005²⁶.

Province	Absolute			Share of national total			Per capita		
	Average	GI	Trend	Average	GI	Trend	Average	GI	Trend
Alberta	81,000,000	1.65		6.9%	0.78		26.1	1.48	
Atlantic	10,200,000	0.76		1.1%	0.96		4.3	0.77	
British Columbia	253,000,000	2.77		20.9%	1.31		61.7	2.66	
Manitoba	39,000,000	3.82		3.2%	1.81		33.5	3.72	
Ontario	380,200,000	2.17		33.9%	1.03		31.6	1.99	
Quebec	367,000,000	1.96		31.9%	0.93		49.3	1.90	
Saskatchewan	19,000,000	0.70		2.0%	0.33		18.9	0.71	
Prov Average	164,200,000	n.a.	n.a.	14.3%	n.a.	n.a.	32.2	n.a.	n.a.
Gini Coefficient	0.76	n.a.	n.a.	n.a.	n.a.	n.a.	0.30	n.a.	n.a.
Canada	1,915,666,667	2.12		100.0%	n.a.	n.a.	36.9	2.00	

Note: In 2002 constant Canadian dollars.

Source: Computed by Science-Metrix using data from Statistics Canada

4.3 Employment

The number of people employed in health occupations has increased steadily over the past two decades, with Nova Scotia and Alberta leading in terms of growth. Although inconsistencies and gaps in the available data make it difficult to make meaningful interpretations of employment trends in health research and development, the data shows that Ontario and Quebec are central in their role in the health research system. The labour force in health organizations from 1987 to 2011 has been trending up for Nova Scotia.

Health occupations in Nova Scotia averaged 28,004 from 1987 to 2011. The applied sciences occupations is trending up and the ratio of health occupations to all occupations is 7.2% and is trending up between 1997 and 2005.

4.4 Education

Graduates of health-related programs between, 1993 and 2010, had an average of seven hundred and eighty two (782) graduates which has been trending up. Starting in 2009 Nova Scotia was above the national average of graduates (10.3%) at 12.2%.

Nova Scotia has many highly qualified researchers and it ranked third in Canada in 2006 in terms of the number of PhDs as a percentage of total provincial population²⁷.

Table 6 on the following page shows graduates of health programs by provinces (1st Cycle). First cycle graduates means completion of a first level university program that usually lasts 3 years.

²⁶ Table obtained from: Science-Metrix NAPPHRO Econometric Project: Final Report, Table XXVII.

²⁷ Source: http://www.nshrf.ca/sites/default/files/nspaper_june_24_2013_final.pdf, pg. 9

Table 6: Graduates of health-related programs (1st cycle), 1993-2010²⁸.

Province	Absolute			Share of total	
	Average	CAGR	Trend	Average	Trend
Alberta	1,864	4.3%		14.2%	
British Columbia	1,586	5.3%		10.1%	
Manitoba	645	3.6%		12.1%	
New Brunswick	415	3.4%		10.9%	
Newfoundland and Labrador	281	5.3%		11.9%	
Nova Scotia	782	3.2%		12.2%	
Ontario	5,617	4.6%		9.0%	
Prince Edward Island	82	6.0%		14.9%	
Quebec	3,338	2.6%		10.1%	
Saskatchewan	576	3.5%		14.6%	
Prov Average	1,519	4.2%	n.a.	12.0%	n.a.
Gini Coefficient	0.54	n.a.	n.a.	0.09	n.a.
Canada	15,185	4.0%		10.3%	

Source: Computed by Science-Metrix using data from Statistics Canada

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4.5 US Patent Applications³⁰

The province that filed the highest number of patent applications (between 2006 and 2011) is Ontario, with a 43% share of Canada's patent applications. Next is Quebec (29% share), British Columbia (18%) and Alberta (8%). When accounting for the relative population size of provinces, British Columbia ranks first, slightly ahead of Quebec and Ontario. As was the case in biotechnology, inequalities across provinces are significantly reduced when normalizing by the population size.

Most provinces experienced a decrease in production between 2006–2008 and 2009–2011, with GIs (Growth Index) below 1.00, a result that is aligned with the national trend (GI of Canada = 0.88). In fact, only Saskatchewan and Nova Scotia increased their numbers of patent applications between the first and second halves of the study period, whereas British Columbia had a stable production. This is also reflected in their shares of Canada's patent applications in health.

The US patent Applications in biotechnology based on location of investors from 2006 to 2011 had forty nine (49) applications and Nova Scotia ranked seven (7) out of ten (10) provinces.

Table 7 shows patent applications by provinces. It also shows patents for all of Canada compared to the world.

²⁸ Table obtained from: Science-Metrix NAPHRO Econometric Project Final Report, Table XXXIII.

²⁹ Ibid, Table XV.

³⁰ Text obtained from Science-Metrix NAPHRO Econometric Project Final Report, pg. 24.

Table 7: US Patent applications in biotechnology based on the location of inventors, 2006-2011.³¹

Province	Applications			Provincial Share of Applications			Applications per Million Inhabitants		
	No.	GI	Trend	%	GI	Trend	No.	GI	Trend
Ontario	1,403	0.97	■ ■ ■ ■ ■ ■ ■ ■	46.6	1.00	■ ■ ■ ■ ■ ■ ■ ■	18.0	0.94	■ ■ ■ ■ ■ ■ ■ ■
Quebec	791	0.99	■ ■ ■ ■ ■ ■ ■ ■	26.2	1.02	■ ■ ■ ■ ■ ■ ■ ■	16.9	0.96	■ ■ ■ ■ ■ ■ ■ ■
British Columbia	404	0.91	■ ■ ■ ■ ■ ■ ■ ■	13.5	0.93	■ ■ ■ ■ ■ ■ ■ ■	15.3	0.87	■ ■ ■ ■ ■ ■ ■ ■
Alberta	288	0.89	■ ■ ■ ■ ■ ■ ■ ■	9.6	0.92	■ ■ ■ ■ ■ ■ ■ ■	13.3	0.84	■ ■ ■ ■ ■ ■ ■ ■
Saskatchewan	156	1.14	■ ■ ■ ■ ■ ■ ■ ■	5.2	1.16	■ ■ ■ ■ ■ ■ ■ ■	25.4	1.09	■ ■ ■ ■ ■ ■ ■ ■
Manitoba	113	0.92	■ ■ ■ ■ ■ ■ ■ ■	3.8	0.93	■ ■ ■ ■ ■ ■ ■ ■	15.5	0.88	■ ■ ■ ■ ■ ■ ■ ■
Nova Scotia	49	1.23	■ ■ ■ ■ ■ ■ ■ ■	1.6	1.24	■ ■ ■ ■ ■ ■ ■ ■	8.7	1.22	■ ■ ■ ■ ■ ■ ■ ■
New Brunswick	19	n.c.	■ ■ ■ ■ ■ ■ ■ ■	0.6	n.c.	■ ■ ■ ■ ■ ■ ■ ■	4.2	n.c.	■ ■ ■ ■ ■ ■ ■ ■
Newfoundland	10	n.c.	■ ■ ■ ■ ■ ■ ■ ■	0.3	n.c.	■ ■ ■ ■ ■ ■ ■ ■	3.3	n.c.	■ ■ ■ ■ ■ ■ ■ ■
Prince Edward Island	9	n.c.	■ ■ ■ ■ ■ ■ ■ ■	0.3	n.c.	■ ■ ■ ■ ■ ■ ■ ■	10.5	n.c.	■ ■ ■ ■ ■ ■ ■ ■
Unknown	85	0.85	■ ■ ■ ■ ■ ■ ■ ■	2.8	0.88	■ ■ ■ ■ ■ ■ ■ ■	n.a.	n.a.	n.a.
Canada	3,011	0.97	■ ■ ■ ■ ■ ■ ■ ■	100.0	n.a.	n.a.	15.0	0.94	■ ■ ■ ■ ■ ■ ■ ■
Australia	1,557	1.07	■ ■ ■ ■ ■ ■ ■ ■	100.0	n.a.	n.a.	12.3	1.03	■ ■ ■ ■ ■ ■ ■ ■
United Kingdom	3,791	1.04	■ ■ ■ ■ ■ ■ ■ ■	100.0	n.a.	n.a.	10.2	1.02	■ ■ ■ ■ ■ ■ ■ ■
United States	45,232	0.98	■ ■ ■ ■ ■ ■ ■ ■	100.0	n.a.	n.a.	24.7	0.95	■ ■ ■ ■ ■ ■ ■ ■
World	78,545	1.08	■ ■ ■ ■ ■ ■ ■ ■	100.0	n.a.	n.a.	1.9	1.04	■ ■ ■ ■ ■ ■ ■ ■

Note: Data on the number of applications shows that in the first year, applications were published at the USPTO (i.e., 2001) and in the four subsequent years, publication data might lead to some biases (data not shown, see Section 7.2). Thus, data are only presented for the 2006–2011 period, and the GI computed has the ratio of 2009–2011 over 2006–2008. The sum of shares can exceed 100% due to collaboration.

Source: Computed by Science-Metrix using USPTO data from PATSTAT

5. SUMMARY

The data presented in this report was organized using the CAHS health research impact framework. The study focused on research activity, advancing knowledge and broad social and economic impacts.

In Nova Scotia, the total gross expenditures in research and development (GERD) has increased by 11% since 2006.

Even with an overall increase, the health research sector which is predominantly funded by CIHR has been declining over the study period. Nova Scotia is in fifth (5th) place among all provinces based on CIHR expenditures while Ontario and Quebec at top place among the provinces with 71% of all CIHR expenditures.

Over the last six years, the health research enterprise in Nova Scotia has been experiencing a decline in health research activity. This was not the case in 2000 to 2007 when funding from national organizations was increasing. Provincially, funding has been declining as well since the mid-2000s. This can be explained in part by changes to national funding priorities and programs for the last 8 years, the global economy and austerity approaches by both the federal and provincial governments. This has put a strain on the ability of provincial organizations to provide matching funding for national and international awards. The expectation of many national and international funding organizations is that researchers must find matching funds to receive funding. The NSHRF's return on investment (ROI) through matching funds has increased from \$7.40 for the period 2000 to 2008 to \$8.23 over the last six (6) years.

Nova Scotia continues to have a strong focus on clinical research (31% as compared to 17% nationally). Infection and immunity along with neurosciences, mental health and addiction researchers make up the bulk of clinical research.

³¹ Ibid, Table XV.

The quality of Nova Scotia's health research outputs continue to be high and add value to the health research knowledge pool through publications. Nova Scotia is in seventh (7th) place nationally for publishing research results and fourth (4th) nationally for its rate of interprovincial collaboration. The province is experiencing a slight down turn in the number of health research publications from 2012 to 2013 after having steady growth between 2001 and 2012.

In terms of the broad social and economic impacts, research and development (R&D) in the pharmaceutical and medicine manufacturing in the Atlantic Provinces has been stable with biotechnology R&D doubling expenditures. Nova Scotia along with Alberta are leading in terms of growth of health sector employment and the province's universities ranked fourth nationally in graduating students with undergraduate degrees. Even though Nova Scotia is small, we are ranked seventh (7th) nationally with 49 patent applications between 2006 and 2011.

Based on the information included in this report, health research in Nova Scotia continues to make a contribution to and have an impact on the health and the socio economic well-being of Nova Scotians.