Monitoring of the **National Breast Cancer Research Framework**

A Report by the Canadian Breast Cancer Research Collaborative

August 2016

Canadian Breast Cancer Foundation | Fondation canadienne du cancer du sein

Canadian Cancer Society | Société canadienne du cancer

CIHR IRSC
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Fondation cancer du sein du Québec

Quebec Breast Cancer Foundation

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1 Executive Summary

In 2015, an estimated 25,000 women and 220 men were diagnosed with breast cancer. It is the most common cancer diagnosed in women, accounting for more than ¼ of all new cancer cases. Canadian women have a 1 in 9 chance of developing breast cancer in their lifetime. In the same year, a predicted 5,000 women and 60 men died of the disease. It is the second most common cause of cancer death in women, after lung cancer.

Currently, breast cancer research is being undertaken across a wide range of fields; it is anticipated that new research will ultimately lead to future improvements in breast cancer prevention, screening and treatment. In order to maximize the impact of breast cancer research in Canada, a large scale effort was made to develop a strategic framework for the funding of breast cancer research in Canada.

In 2007, a process to define strategic priorities for breast cancer research in Canada was started. This process included developing reports on the progress in key areas of research and the results of national and international breast cancer research prioritization exercises. Workshops, interviews and surveys were undertaken to assess the perceived priorities of stakeholders involved in breast cancer research, funding, care and advocacy. A national meeting was convened in which stakeholders set research priorities and identified system gaps and challenges. Finally, a working group of leading researchers distilled the results of the meeting into a set of 17 research priorities, 6 research themes and 6 calls to action. These were published in a 2009 report, "National Breast Cancer Research Framework/Cadre National de Recherche sur le Cancer du Sein: A Roadmap for Research".

In 2013, the Canadian Breast Cancer Research Collaborative, a collaboration between key governmental and voluntary sector funders of breast cancer research in Canada, agreed to support a project to monitor implementation of the National Breast Research Framework, culminating in the publication of this report.

This report provides an analysis of funding for breast cancer research in Canada over the period 2007-2013. This range includes the initiation of the National Breast Cancer Research Framework and shows the extent to which the Framework was adopted by breast cancer research funders over the subsequent 6 years. Data was drawn from cancer research funding data in Canada collected by the Canadian Cancer Research Alliance (CCRA) and represents approximately $442M of funding allocated to breast cancer grants between 2007 and 2013. Overall, there was a 29% increase in funding for breast cancer research over that period.

The Framework outlined 17 research priorities. To assess the trajectory of funding for each priority, 2789 breast cancer research projects funded between 2007 and 2013 were coded to priorities as appropriate, and funding was analyzed for each priority.

The highest level of funding from 2007 to 2013 was for Priority 11 - Discovery and development of new treatments for breast cancer. After this, the next highest levels of funding were for the 3 priorities focusing on cancer biology, Priority 1 - The genetic and epigenetic basis of breast cancer development, Priority 2 - Deciphering the molecular pathways implicated in breast cancer initiation and Priority 3 - Understanding the cause of metastatic breast cancer and identifying new avenues for interventions. Priorities focused on early detection/biomarkers, Priority 8 - Better approaches to early detection and diagnosis and Priority 9 - Development and evaluation of new biomarkers (including biomarkers for diagnosis) and the optimization of treatments for individual patients - Development and evaluation of new biomarkers (including biomarkers for diagnosis) and the optimization of treatments for individual patients, received the next highest level of funding. This was followed by lower levels of funding for the remaining priorities. One priority, Priority 16 - Developing mechanisms to link clinical trial data with administrative health databases for studies on long-term outcomes and late effects, received no funding at all.

In general, funding increased for most priorities. Some increases were dramatic. Between 2007 and 2013, funding more than doubled for Priority 7 - Interventions to study the influence of lifestyle and environmental factors on the risk of developing breast cancer, Priority 8 - Better approaches to early detection and diagnosis, Priority 10 - Clinical setting/clinical trials to assess clinical sensitivity and specificity of new biomarkers and Priority 14 - Analysis of the financial and health-care delivery issues facing breast cancer patients across the cancer continuum.

The mechanisms by which programs were funded was examined. The majority of funding for each priority was allocated through operating grants, with lesser amounts through infrastructure awards, career awards, trainee awards and related support grants. Funding for priorities was also analyzed by whether the program through which funds were allocated were targeted to a specific research area. While the majority of funding for most priorities was allocated through non-targeted (open) programs, there were a few priorities for which funding was primarily allocated through targeted programs. For example, funding for Priority 8 - Better approaches to early detection and diagnosis was primarily allocated through a wide range of targeted programs across funders.

Funding for priorities was also analyzed by geographic location of the funded PIs. While funding for most priorities was distributed across the country roughly in line with population levels, there were a few priorities that showed distinct foci, indicating areas of research strength in particular cities.

In addition to analyzing funding trends, this report attempted to assess the impact of the Framework on funders. Despite an expected time delay between publication of the Framework and adoption into funding programs and applications, there is some evidence that the Framework has helped to frame partnering initiatives and resulted in significant collaborative funding programs.

In the original Framework report, relatively large funding increases were recommended for many of the priorities. We also noted a significant discrepancy between recommended and actual funding levels, which raised important questions about the challenges of connecting such a Framework to engaging new funding support. Ambitious funding increases are unlikely to materialize without a strong and specific plan for engaging investment sources (donors and decision makers).

The tools and analysis in this document provides new insight on breast cancer research in Canada. Our hope is that strategic investments will continue to be made for the maximization of breast cancer research through collaboration and accelerated translation of discovery into health improvements.

2 Foreword

Welcome from CBCRC

Canada has one of the highest breast cancer rates in the world (International Agency for Research on Cancer, 2012). One in nine Canadian women can expect to develop breast cancer in their lifetimes and an estimated 25,000 women will have been diagnosed with breast cancer in Canada in 2015. And while the good news is that investments in research have contributed to breast cancer mortality rates dropping significantly over the past 20 years, the burden imposed by this disease on patients, survivors, their families, the health care system, and society as a whole remains unacceptable. Certain breast cancer subtypes, and metastatic breast cancer, lack effective treatments; breast cancer survivors experience significant long-term social, psychosocial, and health challenges; and approaches to prevention remain poorly understood. These unmet needs represent an ongoing challenge to be addressed through research, health and medical innovations.

The National Breast Cancer Research Framework was visionary in seeking to maximize the effectiveness of breast cancer research in Canada. Published in 2009, the Framework was the result of more than a year of broad-based consultations, commissioned papers, and a workshop summit, all aimed at creating a roadmap for a coordinated national approach to breast cancer research. The Framework authors recognized then, that while Canada has significant talent and capabilities to conduct breakthrough research, more effective use of resources and increased collaboration was needed to reduce Canada's high breast cancer incidence rates. The Framework represented a call to action for all members of the breast cancer community to increase collaboration around priorities and maximize the effectiveness of our collective research investments. However, a framework is only as good as its implementation and a key commitment of the breast cancer community at that time was to monitor both how the NBCRF was used, and resulting changes in the breast cancer funding landscape.

The Canadian Breast Cancer Research Collaborative (CBCRC) was formed in 2012 as an initiative focused in part on overseeing the implementation and monitoring of the Framework, and addressing a key action item of the 2010 CCRA Pan Canadian Cancer Research Strategy. An open and inclusive initiative, the Collaborative has since served as a forum for its members to discuss research funding partnerships, to raise awareness of the Framework among its stakeholders, and to pool resources for the purpose of monitoring the Framework.

This report provides a brief summary of the Collaborative's work, focusing on the development of a coding system that has been applied to funding data collected by CCRA,

and qualitative descriptions of how member organizations have used the Framework to inform strategic research initiatives. Covering the period 2007 through 2013, this report reveals new insights into the breast cancer funding landscape and the impact of the Framework. In addition to investment trends in the identified priority areas, the reader will also find highlights of how funders have partnered to raise awareness and collaborate within theme and priority areas. It is clear, for example, that research funding has continued to rise during the period, with significant increases in many of the priority areas. In some cases these increases can be attributed to targeted competitions, with particularly large investments made through partnered funding initiatives. At the same time, however, investigator-led competitions continue to dominate the funding landscape, reinforcing the idea that research community engagement in a strategic framework is critical for focusing on priorities.

The members of the Collaborative are proud to share the results of this report for the benefit of the cancer community. With a new way of looking at research investments in a particular cancer site, this monitoring report provides an important case study of a community-led initiative for coordinating cancer investments. More importantly, in sharing this report, the members of the Collaborative look forward to its addition to the CCRA repertoire of analytical tools, for adoption within the breast cancer community and as an important resource to facilitate future collaborations and maximization of breast cancer research investments.

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Thanks to Drs. Morag Park and Eva Grunfeld, original co-chairs of the National Framework Working Group, who provided valuable insights on the development of the National Framework and advice for coding to priorities.

Dr Jim Hudson coded/analysed the data and prepared this report with the invaluable expertise provided by Dr Sian Bevan (Canadian Cancer Society), Brian Bobechko (Canadian Breast Cancer Foundation), Maxime Dumais (Quebec Breast Cancer Foundation), Stefanie Knox (Canadian Breast Cancer Foundation), Dr Stephen Robbins (Canadian Institutes of Health Research) and Jennifer Wilson (Canadian Breast Cancer Foundation).

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3 Introduction and Background

Breast cancer in Canada

In 2015, an estimated 25,000 women and 220 men were diagnosed with breast cancer[1]. It is the most common cancer diagnosed in women, accounting for more than ¼ of all new cancer cases. Canadian women have a 1 in 9 chance of developing breast cancer in their lifetime.

An estimated 157,000 women and 1,000 men are living with a diagnosis of breast cancer[2]. Approximately 40% of women living with cancer have been diagnosed with breast cancer.

In 2015, a predicted 5,000 women and 60 men died of the disease. It is the second most common cause of cancer death in women, after lung cancer.

While the rate of being diagnosed with breast cancer has been stable over the last 2½ decades, the breast cancer death rate has declined approximately 44% since its maximum in 1986. Currently, breast cancer mortality is the lowest it has been since 1950.

It has been suggested that this trend was due to increased mammographic screening and the use of improved drug treatments following breast cancer surgery[3].

The development of mammography and these drug treatments were the result of research carried out in the decades preceding the drop in breast cancer mortality. Currently, breast cancer research is being undertaken across a wide range of fields; it is anticipated that new research will ultimately lead to future improvements in breast cancer prevention, screening and treatment.

Breast cancer research in Canada

The Canadian Cancer Research Alliance (CCRA) is a partnership of governmental and voluntary sector funders of cancer research. Each year, the CCRA analyses cancer research funding data collected from its members. These analyses provide the best estimate of cancer research funding in Canada[4].

In 2013 a total of $498.2M was allocated to cancer research projects by CCRA members[5]. Of this, approximately $74M was used to fund breast cancer research grants. This level

1. Canadian Cancer Society's Advisory. Committee on Cancer Statistics. Canadian Cancer Statistics 2015. Toronto, ON: Canadian Cancer Society; 2015.
2. Made in the previous 10 years, based on 2009 data.
3. Ibid.
4. This represents a lower bound estimate, data from industry and hospital foundations is not included.
5. Canadian Cancer Research Alliance (2015). Cancer Research Investment in Canada, 2013. Toronto: CCRA.

of funding represents a thirty-fold increase over the last 20 years, from a reported $2.4M in 1993[6].

Of all cancer sites, breast cancer research received the largest proportion of funding, accounting for almost 26% of site-specific research funding by CCRA members in 2013. This was followed by prostate cancer (13%) and leukemia (12%)[7].

Breast cancer research in Canada covers a wide range of research areas, including basic research designed to understand the development and progression of cancer, population-based research to understand the risk factors for breast cancer and how breast cancer might be prevented, new methods to diagnose, predict the outcome of and treat breast cancer, as well as research into breast cancer survivorship, outcomes and healthcare delivery. The distribution of breast cancer research across major research areas is very similar to the distribution of Canadian cancer research overall.

Canadian breast cancer research is part of a global effort to reduce the impact of breast cancer. In its first global report, the International Cancer Research Partnership reported that approximately $1 billion was allocated to breast cancer research each year from 2005-8 by organizations in Canada, the United States, the United Kingdom and France[8].

National funding strategies for global breast cancer research – development of the National Breast Cancer Research Framework

Although breast cancer research is carried out across the world, in general, research funding is organized at a national level. In order to maximize Canada's contribution to breast cancer research globally, a large scale effort was made to develop a strategic framework for the funding of breast cancer research in Canada.

THE CANADIAN BREAST CANCER RESEARCH ALLIANCE

This strategic framework was initiated by the Canadian Breast Cancer Research Alliance (CBCRA), an alliance of government and voluntary sector organizations brought together to cooperatively fund breast cancer research[9]. From 1993 to 2010, it allocated approximately $200M for breast cancer research grants across a range of fields.

6. Health Canada. Report on the National Forum on Breast Cancer. Ottawa: Minister of Supply and Services Canada. Catalogue H39/305/994E, 1994.

7. Note that only 53% of funds were attributable to site-specific cancers – 47% of funds were spent on projects that could not be attributed to specific sites or were relevant to all cancer types.

8. "Cancer Research Funding from an International Perspective: Report from the International Cancer Research Partnership", ICRP (2012).

9. Initially known as the "Canadian Breast Cancer Research Initiative"

THE NATIONAL BREAST CANCER RESEARCH FRAMEWORK

In 2007, CBCRA began a process to define strategic priorities for breast cancer research and encourage collaboration among funders. Over the next 2 years, the "National Breast Cancer Research Framework" was developed.

A broad set of reports, including research area summaries and results of national and international breast cancer research prioritization exercises, were prepared. These served as background materials for the "National Summit," a meeting of stakeholders involved in breast cancer research, funding, care and advocacy brought together to set research priorities and identify research system gaps and challenges.

After the Summit, a working group of leading researchers was created. This working group distilled the results of the Summit and additional data into a set of 17 research priorities.

Research Priorities

1. The genetic and epigenetic basis of breast cancer development
2. Deciphering the molecular pathways implicated in breast cancer initiation
3. Understanding the cause of metastatic breast cancer and identifying new avenues for interventions
4. The influence of lifestyle and environmental factors on the risk of developing breast cancer
5. The genetics and hormonal causes of breast cancer
6. Understanding the interplay of multicausal factors: genetics and environment
7. Interventions to study the influence of lifestyle and environmental factors on the risk of developing breast cancer
8. Better approaches to early detection and diagnosis
9. Development and evaluation of new biomarkers
10. Clinical setting/clinical trials to assess clinical sensitivity and specificity of new biomarkers
11. Discovery and development of new treatments for breast cancer
12. Clinical trials of new promising therapies
13. Psychosocial and survivorship interventions
14. Analysis of the financial and health-care delivery issues facing breast cancer patients across the cancer continuum
15. Interventions to improve knowledge translation and disseminate best practices in breast cancer across the cancer continuum
16. Developing mechanisms to link clinical trial data with administrative health databases for studies on long-term outcomes and late effects
17. Developing new animal and cellular models to study response to therapeutics and mimic human breast cancer development

Each priority was defined and illustrated by examples of possible research questions. Levels of Canadian funding for research within each priority was estimated (based on

2007 data). Ongoing and upcoming national and international programs focusing on each priority were identified.

Recommendations were made to support research in each priority area. For each priority, approximate funding requirements over the subsequent five years and potential funding mechanisms were proposed. The readiness in Canada to undertake the research, the expected timing of impact and the uniqueness to breast cancer were assessed. Finally, changes to research system and infrastructural supports necessary to enable progress in each research priority area were outlined.

To provide additional perspective, the priorities were organized into 6 overarching themes.

Research Themes

A. Mechanisms of Cancer Development
B. Molecular Detection and Prediction
C. Personalized Medicine
D. Cancer Progression and Dissemination
E. Psychosocial, Survivorship and Health Services
F. Transferring Knowledge into Practice

Finally, a set of 6 "Calls to Action" were made. These were meant as specific action items to be undertaken by all members of the breast cancer research community, to support the Framework and improve the coordination and impact of breast cancer research in Canada.

Calls to action

1. All members of the breast cancer research community are invited to become familiar with the National Framework document and to work together to achieve the ultimate outcome: a world where no person need fear breast cancer;
2. Breast cancer research funders across Canada are asked to adopt a set of guiding principles and to mobilize support for both foundational research and the identified research priorities;
3. Policy and practice influencers are asked to apply existing research findings to policy and practice areas as they relate to breast cancer, cancer and chronic disease, and to engage with researchers and academics to shape future studies aligned with policy development;
4. Industry (e.g., pharmaceutical companies, biotechnology companies, software developers, equipment manufacturers) is encouraged to participate in new collaborative opportunities;
5. Provincial and hospital foundations are asked to allocate 10 per cent of their funds to these national priorities;
6. Donors are encouraged to familiarize themselves with the National Framework and to request that organizations receiving their support embrace these priorities and recommendations.

In December 2009, a detailed report describing the National Breast Cancer Research Framework was released[10].

Monitoring of the National Framework

THE NATIONAL FRAMEWORK AND BROADER CANADIAN CANCER RESEARCH STRATEGIES

In addition to its role in collecting and analyzing cancer research funding data in Canada, the Canadian Cancer Research Alliance has had a key role in promoting the development of national cancer research priorities and strategies.

In 2010, it published its first "Pan-Canadian Cancer Research Strategy"[11]. In this document, it highlighted the development of the National Breast Cancer Research Framework as an example of an "extremely robust" process to select priorities and to improve collaboration for a site-specific cancer. Among its 24 key action items was "Monitor(ing) adoption of the National Breast Cancer Research Framework" and CBCRA was identified as the agency responsible for leading this work.

THE CANADIAN BREAST CANCER RESEARCH COLLABORATIVE

In 2010, CBCRA was disbanded. Shortly after, the Canadian Breast Cancer Research Collaborative (CBCRC), a partnership of the Canadian Breast Cancer Foundation, Canadian Cancer Society, Canadian Institutes of Health Research – Institute of Cancer Research and the Quebec Breast Cancer Foundation was created with a new breast cancer research mandate.

Unlike CBCRA, CBCRC's role was not to administer research grants directly, but to provide a vehicle for monitoring and refreshing the National Framework and to support inter-funder cooperation. It formally took over the role as lead agency for CCRA's action item focused on monitoring the National Framework. In a later report on the completion of its 2010 strategic plan, CCRA identified the creation of CBCRC as a key accomplishment necessary for stewarding and implementing the Framework[12].

As a first step in monitoring the National Framework, CBCRC agreed to support a project to analyze and report on research funding for priorities of the National Breast Cancer Research Framework. This is described in this report.

10. Canadian Breast Cancer Research Alliance (2009). National Breast Cancer Research Framework/Cadre National de Recherche sur le Cancer du Sein. A Roadmap for Research. Toronto: CBCRA.

11. Canadian Cancer Research Alliance (2010). Pan-Canadian Cancer Research Strategy: A plan for collaborative action by Canada's cancer research funders. Toronto: CCRA.

12. Canadian Cancer Research Alliance (2015). Pan-Canadian Cancer Research Strategy, 2010-2014: Final Report. Toronto: CCRA.

Purpose of this report

As a first step in monitoring implementation of the National Breast Cancer Research Framework, we aimed to examine changes in funding for the priority research areas defined by the Framework and to compare these with the granting programs and Framework awareness activities, as a way to understand progress in implementing the Framework. Specifically, we have examined trends in funding for research in each priority area from 2007-2013, and noted funding programs which targeted each priority research area.

As the priorities were the main focus of the National Framework, these were our focus. National Framework themes and calls to action will not be addressed.

4 Methodology

Data Sources

Each year, CCRA collects grant funding data from 42 Canadian cancer research funding organizations as part of its annual cancer research funding survey.

For this monitoring report, we obtained detailed information about 2789 breast cancer research grants which were funded between 2007 and 2013[1]. As in the original Framework report, a breast cancer research grant was defined as one that was assessed as being at least 50% focused on breast cancer.

Coding grants

ESTIMATES OF FUNDING IN THE ORIGINAL NATIONAL FRAMEWORK REPORT

In the original Framework report, funding was estimated using CCRA data about breast cancer research grants.

As part of its annual collection, all grants in the CCRA database are coded using the Common Scientific Outline (CSO), a widely-used classification system for cancer research[2]. The CSO has seven major categories, further divided into 38 subcategories[3].

For each Framework priority, the most closely related CSO subcategory was identified[4]. Funding for each priority was estimated by analyzing the funding for breast cancer research grants coded with the related CSO subcategory. For example, grants coded to CSO subcode "1.4 Cancer Progression and Metastasis" were assumed to be relevant to P3 - Understanding the cause of metastatic breast cancer and identifying new avenues for interventions. Thus, funding for grants relevant to Priority 3 was estimated as the total funding for breast cancer research grants that were coded CSO 1.4.

The original intention in this project was to use CSO subcategories as a surrogate for Framework priorities as well. However, for many priorities, initial analyses indicated that there was a poor correlation between priorities and CSO subcategories (see below).

1. In this report, year refers to a calendar period, from January 1 to December 31.
2. See https://www.icrpartnership.org/CSO.cfm for details.
3. A second version of the CSO was adopted by International Cancer Research Partners in April 2015, which has six major categories divided into 34 subcategories. This project uses version 1 of the CSO.
4. In the Framework report, this was referred to as the CSO subcategory to which the priority was "linked"

A DEDICATED SYSTEM FOR CODING NATIONAL FRAMEWORK PRIORITIES

Thus, to enable more accurate analyses, a dedicated coding system for National Framework Priorities was created as follows:

- The definition and additional information about each priority was extracted from the Framework Report.
- Draft coding guidelines for each priority were created and discussed with the co-chairs of the National Framework Working Group[5].
- Coding guidelines were revised and discussed/approved by representatives of CBCRC.
- Additional issues were dealt with as they arose during coding.

To ensure transparency and agreement in the coding policies, we created detailed descriptions for each priority, and provided types and examples of projects that would and would not be included. These were cross referenced to each original Framework priority and agreed by consensus among the CBCRC members and co-chairs.

CODING GRANTS TO PRIORITIES

Prior to coding, a purpose-built application with database, search, analytics and display functions was created to facilitate efficient and accurate coding.

Grant data was then loaded and each project was coded to 1 or more Framework priorities. When projects were coded to more than 1 priority, a weighting was assigned to each priority. For example, a grant could be assigned 50% Priority 1 and 50% Priority 2. Total weightings for a single grant could not exceed 100% and usually weightings were split evenly between multiple priorities.

AD HOC TAGS

In addition, grants were tagged with one or more of approximately 450 ad hoc tags. Tags were included to facilitate retrieval of similar projects, permit additional, more granular analyses and allow semi-automated checks of coding quality.

TESTING CODING POLICIES

Tags were also used to test the impact of using different coding policies for a particular priority. For example, discussions were held about what types of grants should be included in P3 - Understanding the cause of metastatic breast cancer and identifying new avenues for interventions. Should only grants which described in vivo experiments be included? Was a Principal Investigator's argument that the grant was relevant to metastasis sufficient for inclusion?

5. Drs. Morag Park and Eva Grunfeld

In this case, we tagged all relevant grants one or more of the following tags: “in vivo”; “in vivo, inferred” (eg. including in vivo experiments in a related grant); “in vitro”; “metastasis argument”; “metastasis argument, weak”. Using these tags, we then assessed the impact of each coding policy on funding across the years under study. In this case, the overall trend of funding across years was similar for each tag (though the absolute level of funding was different), indicating that coding policy did not strongly affect the funding trend. In this case, the most inclusive policy was used.

CODING QUALITY AND VALIDATION

To ensure consistency of coding, a single coder coded all of the breast cancer research grants to priorities. A second coder coded approximately 200 of the most challenging projects and inter-coder reliability assessed. Where necessary a final code was assigned after reconciliation by both coders.

After coding, a simple rule engine was developed to test the correlation between assigned priorities and tags. For example, projects tagged with the tag “assay-metastasis-mouse” would normally be coded to P3 - Understanding the cause of metastatic breast cancer and identifying new avenues for interventions. An automated rule was made to test whether all projects tagged “assay-metastasis-mouse” were indeed coded to Priority 3.

Additional rules were made to take advantage of the correlation between priorities and the subcodes of the Common Scientific Outline, as well as other coding systems which focused on prevention, survivorship and translational research.

More complex rules were created by combining multiple tags and previously assigned codes. Approximately 140 rules were created, and projects whose coding violated those rules were checked and reconciled where necessary.

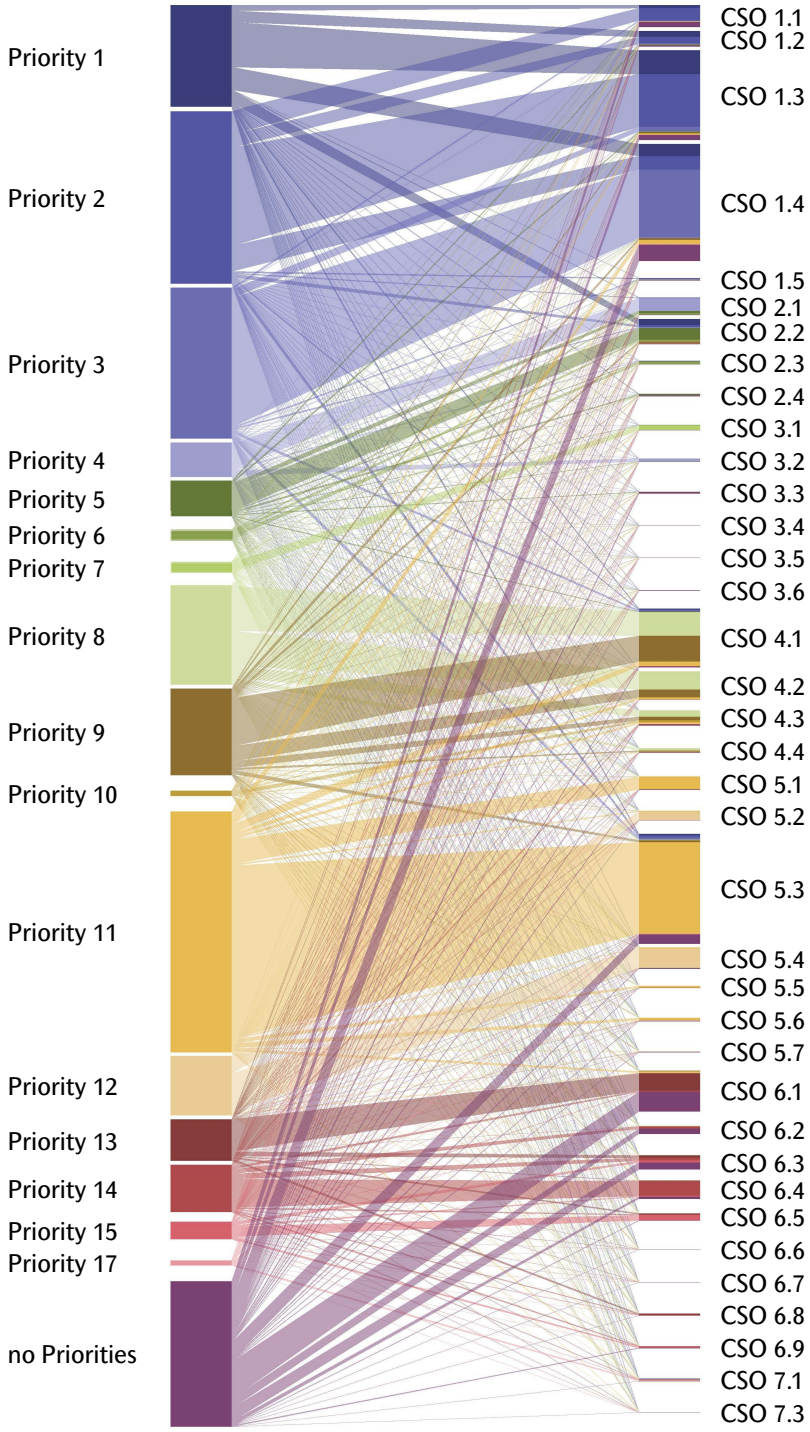
CORRELATION BETWEEN FRAMEWORK PRIORITIES AND CSO SUBCODES

As noted above, initial analyses indicated that there was a poor correlation between some of the priorities and CSO subcategories. After the coding was completed, the correlation between assigned priorities and CSO subcodes for all coded grants was examined.

As seen in the figure below, priorities were indeed correlated with the specific CSO subcodes noted in the original Framework report[6]. However, in many cases the correlation was poor, validating the need for a dedicated coding system. For example, Priority 1 was linked to CSO 1.2 in the original Framework report. While some projects coded Priority were also coded CSO 1.2, the majority were not, and coded CSO 1.1, CSO 1.3, CSO 1.4 etc. instead.

6. This figure includes projects coded to more than 1 priority. When projects coded only to a single priority were included, a very similar figure was produced.

Correlation between Priorities and CSO subcodes



Analyses

PRORATING GRANTS

In analyses of funding, the part of each grant relevant to breast cancer was used. For example, if a $100,000 grant was classified as being 50% relevant to cancer, and of that, 33% focused on breast cancer, $16,500 of funding would be associated with this grant.

In analyses of priorities, the relevant weightings were applied to funding. For example, a $100,000 breast cancer grant coded 50% Priority 1 and 50% Priority 2 would have $50,000 assigned to each priority.

FUNDING TRENDS

Funding increases and decreases were calculated by comparing funding in 2007 and 2013. Figures were not adjusted for inflation.

Additional funds over the 2007 level were calculated for each priority by summing the differences between funding in each subsequent year and the level of funding in 2007.

PROJECT EQUIVALENTS

The number of project equivalents was calculated as the number of grants prorated based on the relevance to breast cancer and the number of priorities assigned to each grant.

PRINCIPAL INVESTIGATORS

To assess the number of principal investigators working on a priority, we counted the number of distinct principal investigators that had at least one operating or career grant coded or partially coded to this priority between 2007 and 2013. Unlike funding, this indicator was not weighted and hence represents a simple count of principal investigators that had a research interest in each priority.

FUNDING MECHANISMS

Each grant in the CCRA data was classified by funding mechanism. A total of 5 different categories were used:

1. Operating grants – grants that support direct costs in conducting specific research projects by identified researchers, including salaries for laboratory staff, costs of supplies etc.
2. Equipment/infrastructure grants – grants that support the costs of new research facilities, equipment, scientific collections, databases etc. needed for conducting research.
3. Career awards – grants that provide protected time for research to accomplished researchers. This mechanism includes salary awards and research chairs.

4. Trainee awards – grants that support trainees during their undergraduate, graduate, or post-graduate training
5. Related support grants – grants that support travel, workshops/symposia and proposal development.

For detailed definitions of funding mechanisms please see the CCRA 2012 investment report[7].

FUNDING PROGRAMS – FOCUSED ON A PARTICULAR RESEARCH AREA VS OPEN TO ALL RESEARCH AREAS

Each grant in the CCRA data was classified by the focus of the program through which the grant was funded. These categories include:

1. Non-site specific; open to all areas of research
2. Non-site specific; focused on 1 or more specific research areas
3. Site-specific; open to all areas of research
4. Site-specific; focused on 1 or more specific research area

This report is focused on breast cancer research and a specific set of research areas. Therefore, we focused on whether a funding program was open to all areas of research (combining 1. and 3. above) or focused on one or more specific research areas (combining 2. and 4. above). For sake of brevity, we refer to these as non-focused/non-targeted and focused/targeted programs respectively.

ANALYSES OF FUNDING ORGANIZATIONS

In analyses of funding organizations the organization's actual funding for each grant was used, even if the grant was administered by another organization. Investment shown for a funder did not include leveraged or partnered funding.

The only exception to using the actual funding of grants by an organization was in analyses of CBCRA and non-CBCRA funding – in this case, funds administered by CBCRA and by non-CBCRA organizations were included.

GEOGRAPHIC ANALYSES OF FUNDING

Geographic analyses of funding were based on the institutional affiliation of the nominated principal investigator. In this report, we have primarily focused on funding at a city level.

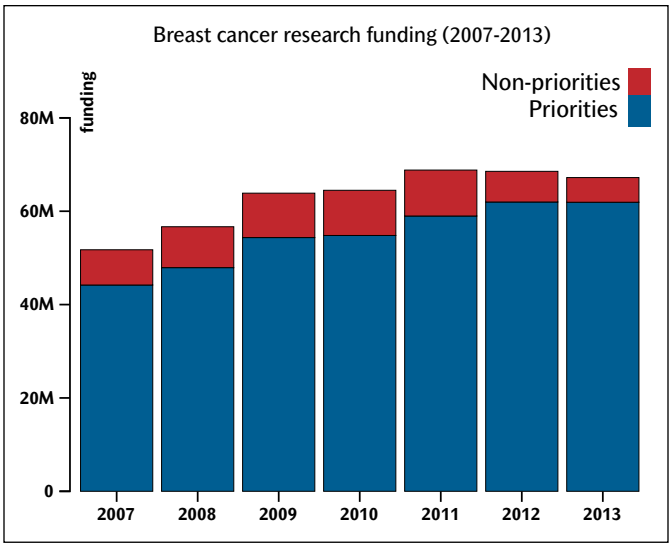
OTHER REPORTING POLICIES

Unless otherwise noted above, we used CCRA analytical policies and reporting conventions as described in its 2012 annual survey of Canadian cancer research investment.

7. Canadian Cancer Research Alliance (2015). Cancer Research Investment in Canada, 2008–2012: The Canadian Cancer Research Alliance's Survey of Government and Voluntary Sector Investment in Cancer Research in 2012. Toronto: CCRA.

5 Results

Breast cancer research funding 2007-13



Approximately $442M of funding was allocated to breast cancer grants from 2007 to 2013[1].

Breast cancer research funding increased by approximately 29% between 2007 and 2013.

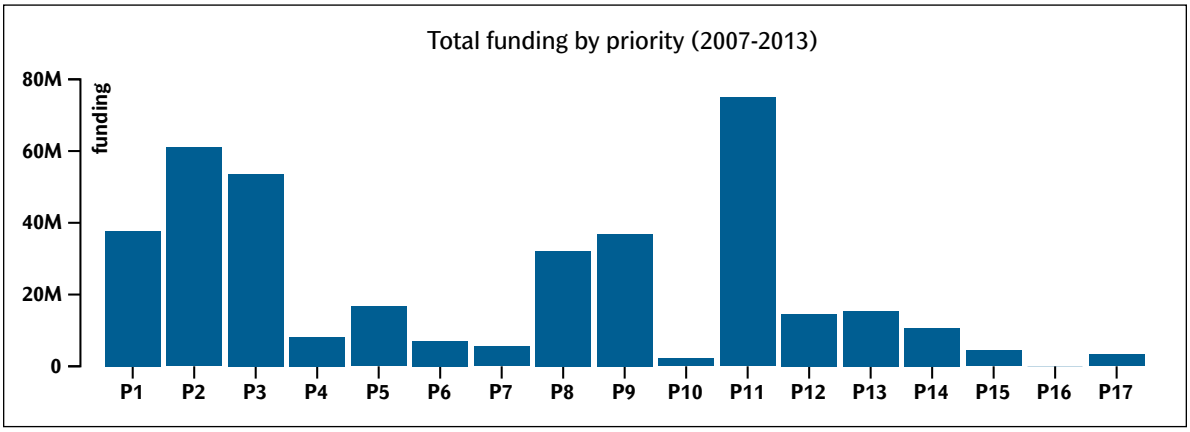
This increase was larger than the overall increase in cancer research funding, which increased approximately 13% over the same period. However, the increase in breast cancer research funding was close to the increase in site-specific funding[2] overall (approximately 31%). Site-specific cancer research funding accounted for an increasingly larger proportion of total funding, increasing from approximately 50 to 58% of total funding from 2007 to 2013.

Funding for priorities represented approximately 87% of total breast cancer research funding from 2007-2013.

1. All analyses reported here include CCRA projects with breast cancer weightings >=50%. This is the same policy used in the original CBCRA National Framework report (but different from the CCRA investment reports which include projects with weighting >=1% in site-specific analyses).

2. Site-specific funding includes cancer research grants that are coded to specific cancer sites. Non-site specific funding includes grants that are relevant to all cancer types or cannot be associated with specific cancer sites.

Funding by priority - all funders



The highest level of funding from 2007 to 2013 was for P11 - Discovery and development of new treatments for breast cancer.

After this, the next highest levels of funding were for the 3 priorities focusing on cancer biology, P1 - The genetic and epigenetic basis of breast cancer development, P2 - Deciphering the molecular pathways implicated in breast cancer initiation and P3 - Understanding the cause of metastatic breast cancer and identifying new avenues for interventions.

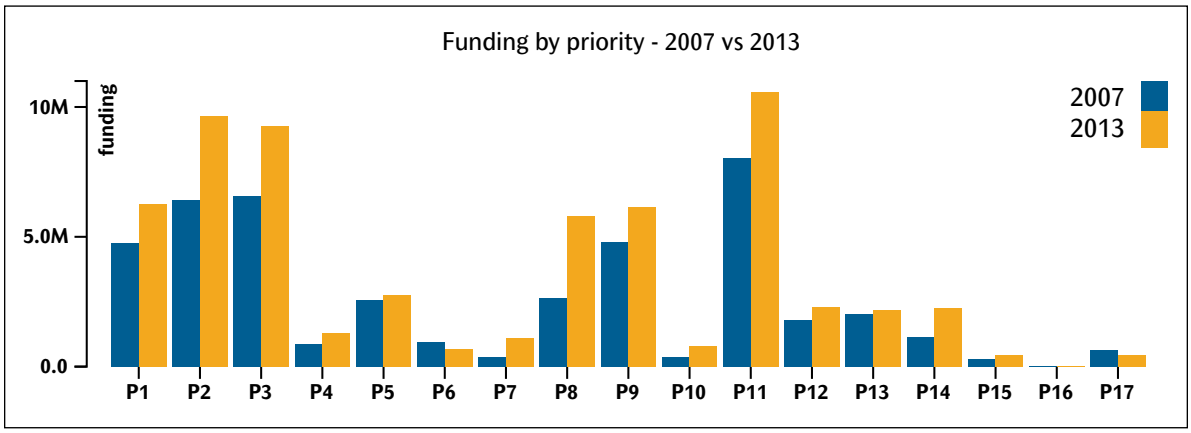
Priorities focused on early detection/biomarkers, P8 - Better approaches to early detection and diagnosis and P9 - Development and evaluation of new biomarkers (including biomarkers for diagnosis) and the optimization of treatments for individual patients, received the next highest level of funding.

This was followed by lower levels of funding for the remaining priorities.

One priority, P16 - Developing mechanisms to link clinical trial data with administrative health databases for studies on long-term outcomes and late effects, received no funding at all. In part, this may be due to its very specific focus. It is also possible that research in this area might not be captured in the CCRA data.

Funding trends - all funders

FUNDING BY PRIORITY - ALL FUNDERS, 2007 VS 2013



Between 2007 and 2013, funding increased by more than the average rate of funding increase over the same period for

- P1 - The genetic and epigenetic basis of breast cancer development,
- P2 - Deciphering the molecular pathways implicated in breast cancer initiation,
- P3 - Understanding the cause of metastatic breast cancer and identifying new avenues for interventions,
- P4 - The influence of lifestyle and environmental factors on the risk of developing breast cancer,
- P7 - Interventions to study the influence of lifestyle and environmental factors on the risk of developing breast cancer,
- P8 - Better approaches to early detection and diagnosis,
- P10 - Clinical setting/clinical trials to assess clinical sensitivity and specificity of new biomarkers,
- P11 - Discovery and development of new treatments for breast cancer,
- P14 - Analysis of the financial and health-care delivery issues facing breast cancer patients across the cancer continuum
- P15 - Interventions to improve knowledge translation and disseminate best practices in breast cancer across the cancer continuum

Between 2007 and 2013, funding increased by less than the average rate of funding increase over the same period for

- P5 - The genetics and hormonal causes of breast cancer,
- P9 - Development and evaluation of new biomarkers (including biomarkers for diagnosis) and the optimization of treatments for individual patients,
- P12 - Clinical trials of new promising therapies
- P13 - Psychosocial and survivorship interventions

Between 2007 and 2013, funding decreased for

- P6 - Understanding the interplay of multicausal factors - genetics and environment
- P17 - Developing new animal and cellular models to study response to therapeutics and mimic human breast cancer development

6 Detailed Analysis

Results: Priority #1 – The genetic and epigenetic basis of breast cancer development

DEFINITION

Cancer is a disease of the genes. This research area will focus on identifying the gene-altering changes underlying cancer initiation and progression. A better understanding of the role played by genetic and epigenetic changes implicated in breast cancer and the discovery of new breast cancer susceptibility genes could lead to better strategies for cancer prevention and treatment.

TYPE OF GRANTS INCLUDED

This priority includes grants which focus on:

- searches for new cancer genes
- epigenetic changes and tumorigenesis
- testing whether specific genes/gene products have a role in tumorigenesis

NATIONAL FRAMEWORK INVESTMENT REQUIREMENTS
(from Framework report, published in 2009, based on 2007 data)

This area was identified as needing new and more investment to encourage research (initiate and enable) through mechanisms such as a broad competition directed to breast and other cancer tumour-initiating cells. This competition would include the opportunity for the funding of small teams and specific targeted initiatives, such as the impact of chromosomal instability on breast cancer development. An amount of $5-10M over five years was proposed for each of the suggested funding mechanisms, for a total of $20M.

Results

$37,658,594 of funding was allocated for this priority between 2007 and 2013. This represents approximately **8.5%** of overall breast cancer research funding over this period.

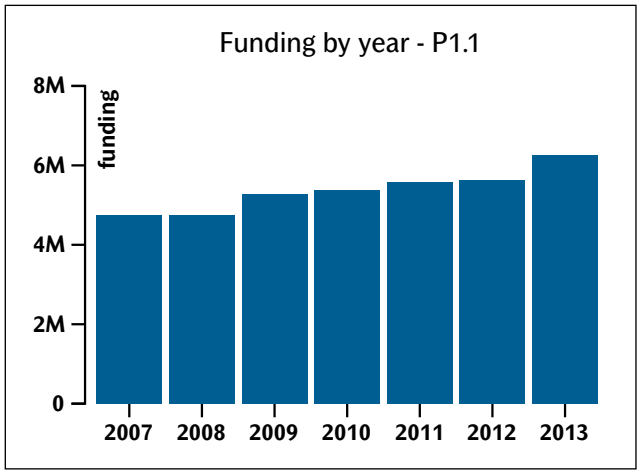
207.9 project equivalents were funded between 2007 and 2013.

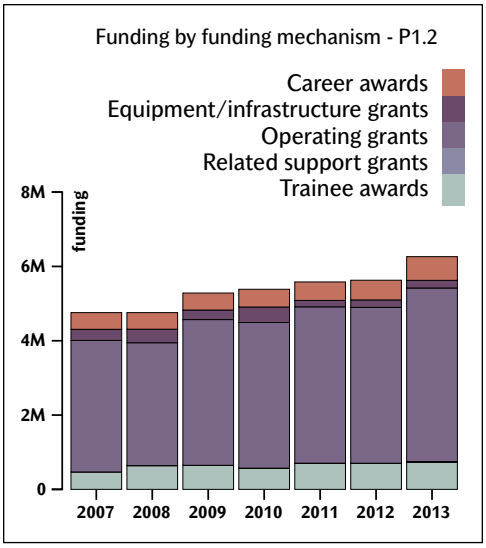
193 principal investigators had at least one operating or career grant coded or partially coded to this priority between 2007 and 2013.

FUNDING BY YEAR (P1.1)

Funding for this priority increased 31% between 2007 and 2013.

This represents a total of approximately $4.4M of additional funds between 2008-2013 over the 2007 level.





Comparison to National Framework investment requirements

While there was an increase in funding, this increase was less than that proposed through the National Framework.

Relatively few initiatives targeted to this priority were undertaken, including a team grant competition focused on breast cancer epigenetics.

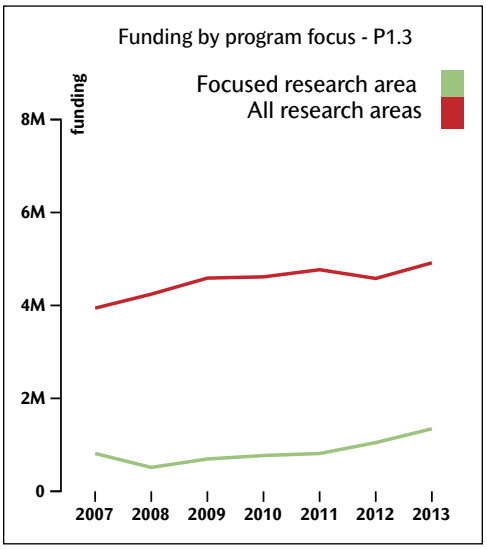
FUNDING BY FUNDING MECHANISM (P1.2)

The majority of funding in each year was allocated through operating grants. The proportion of each type was similar from 2007-2013.

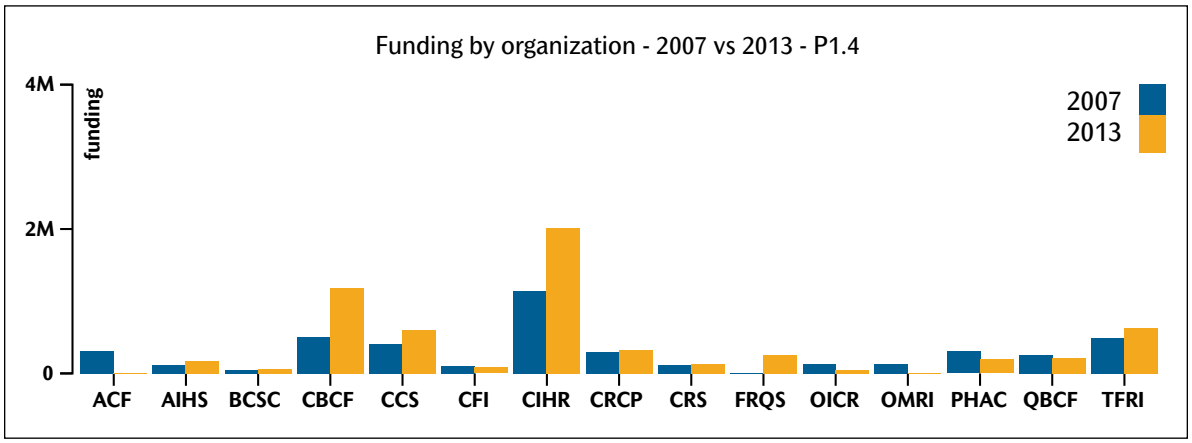
BREAKDOWN BY PROGRAM - FOCUSED ON A SPECIFIC RESEARCH AREA VS OPEN TO ALL RESEARCH AREAS (P1.3)

The majority of funding in each year was allocated through funding programs that were not focused on a specific research area. These proportions did not change substantially across years of the study.

Targeted competitions relevant to this priority included “CIHR’s Team Grant : Canadian Epigenetics, Environment, and Health Research Consortium (CEEHRC)” a CIHR “Catalyst Grant: Bioinformatics Approaches to Cancer Research” and CCS’s “Innovation grants.”

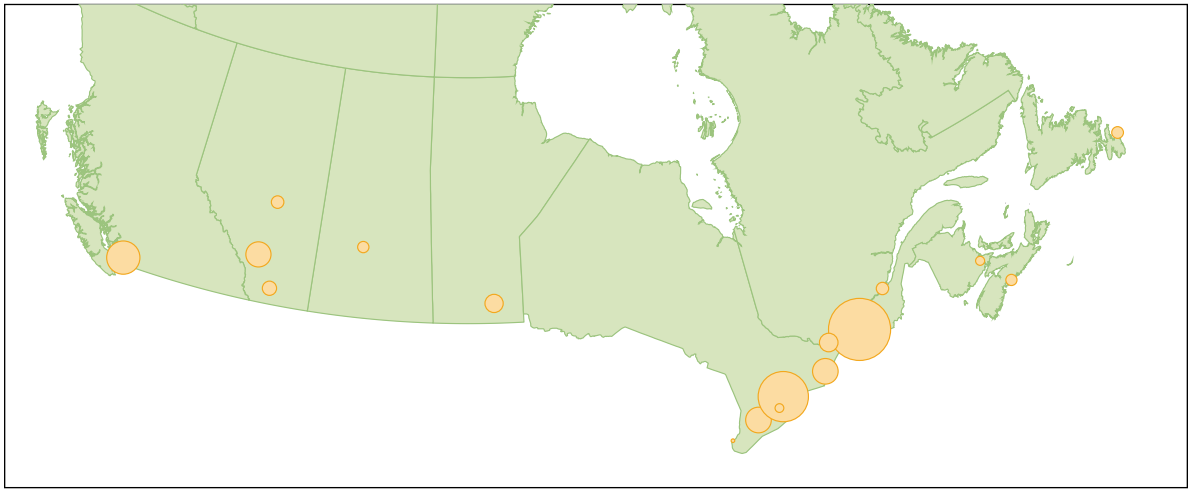


FUNDING BY ORGANIZATION - 2007 VS 2013 (P1.4)



Between 2007 and 2013, CIHR, CBCF, FRQS and CCS substantially increased their funding for this priority. Over the same time interval, ACF and a few others decreased their funding for this priority.

GEOGRAPHY OF FUNDING



Funding was allocated to recipients in Montreal, Toronto, Vancouver and a number of other cities. There were small increases in funding to PIs in Montreal, Toronto, Ottawa and Vancouver, and small decreases in funding to recipients in Calgary, LethBridge and Hamilton between 2007-2013.

Results: Priority #2 – Deciphering the molecular pathways implicated in breast cancer initiation

DEFINITION

Cancer initiation is thought to result from alterations to the molecular machinery regulating the normal functioning of cells. This research priority will study these alterations and the factors influencing them, and the consequences of these alterations on breast cancer initiation. The results of this research could be highly clinically relevant through the identification of molecular pathways that could be targeted by new therapeutic interventions to block cancer initiation.

TYPE OF GRANTS INCLUDED

This priority includes grants which focus on:

- non-genetic changes and cancer initiation
- cellular phenotypes relevant to cancer initiation such as cellular senescence, immortalization, proliferation, apoptosis, defective DNA-damage sensing/repair, etc.
- signal transduction in cancer relevant pathways
- normal gene function where convincing data exists that gene is highly relevant to cancer

NATIONAL FRAMEWORK INVESTMENT REQUIREMENTS
(from Framework report, published in 2009, based on 2007 data)

This area was determined to require additional investment (enable) given that the CBCRA/CIHR TAGS projects are funded only until 2009. An amount of $22M has been proposed to finance a portfolio of funding mechanisms over the next five years. These include a specific RFA on Translation Acceleration Grants (team grants) for $5-7M over three to five years; encouragement of operating grants in this area (e.g., by funding the top grants through a priority announcement) for $2M annually; and launching an open competition for small teams (two or three Principal Investigators) and existing teams for $2-3M per year.

Results

$61,042,034 of funding was allocated for this priority between 2007 and 2013. This represents approximately **13.8%** of overall breast cancer research funding over this period.

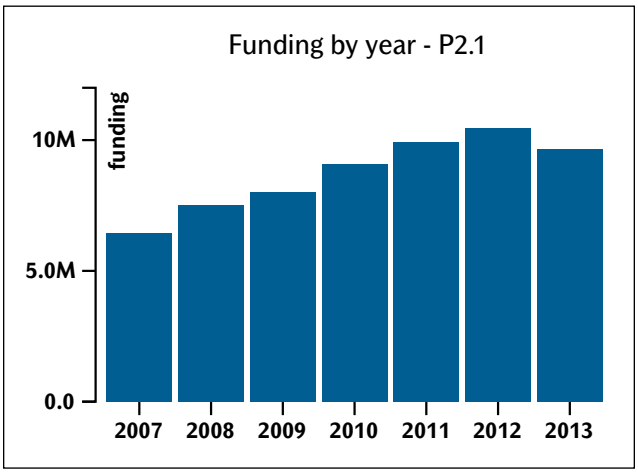
347.3 project equivalents were funded between 2007 and 2013.

277 principal investigators had at least one operating or career grant coded or partially coded to this priority between 2007 and 2013.

FUNDING BY YEAR (P2.1)

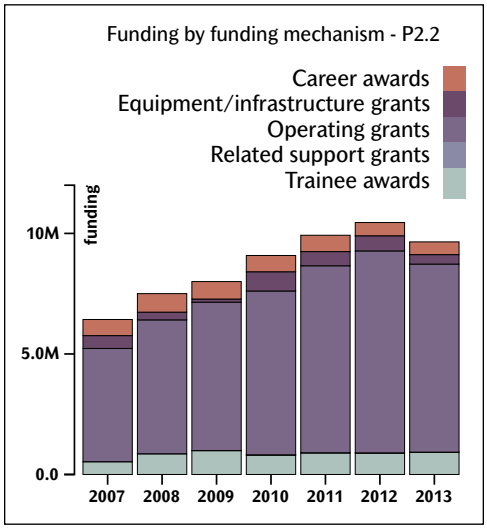
Funding for this priority increased 50% between 2007 and 2013.

This represents a total of approximately $16.0M of additional funds between 2008-2013 over the 2007 level.



Comparison to National Framework investment requirements

While there was an increase in funding, this increase was less than that proposed through the National Framework.



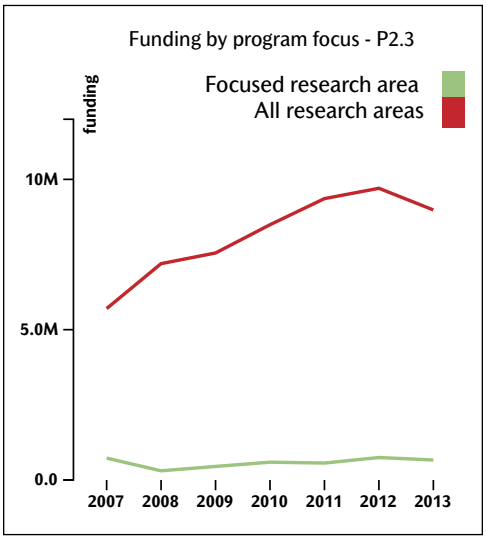
Very few initiatives targeted to this priority were undertaken, the majority of funding was allocated through non-targeted programs.

FUNDING BY FUNDING MECHANISM (P2.2)

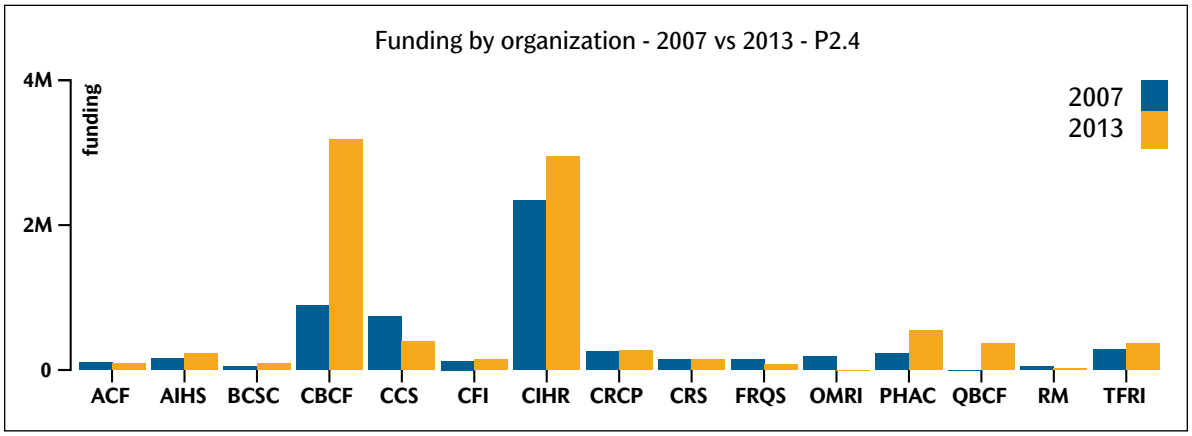
The majority of funding in each year was allocated through operating grants. The proportion of each type was similar from 2007-2013.

BREAKDOWN BY PROGRAM - FOCUSED ON A SPECIFIC RESEARCH AREA VS OPEN TO ALL RESEARCH AREAS (P2.3)

The majority of funding in each year was allocated through funding programs that were not focused on a specific research area. These proportions did not change substantially across years of the study.

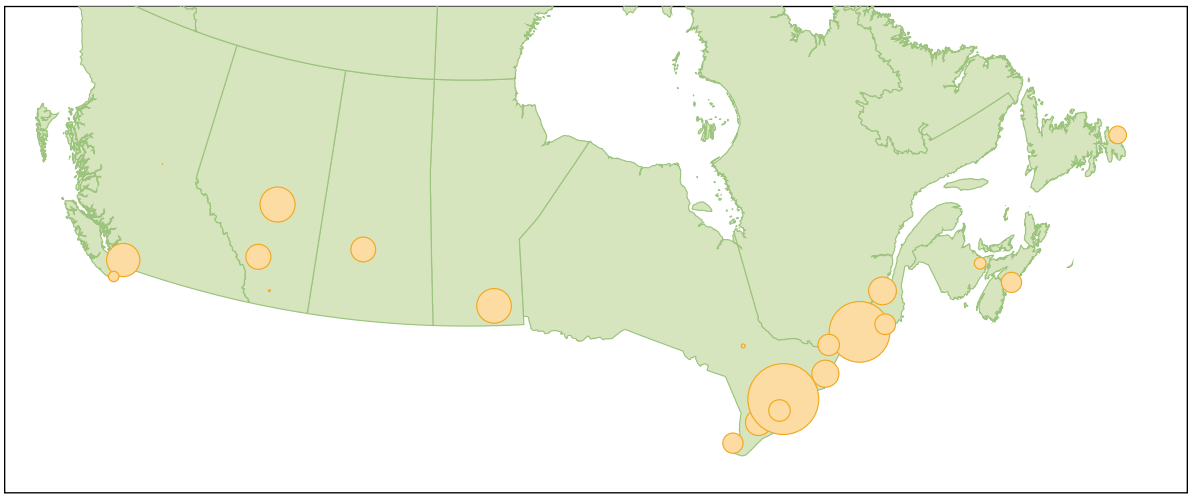


FUNDING BY ORGANIZATION - 2007 VS 2013 (P2.4)



Between 2007 and 2013, CBCF, CIHR and QBCF substantially increased their funding for this priority. Over the same time interval, CCS, OMRI, OICR and a few others decreased their funding for this priority.

GEOGRAPHY OF FUNDING



Funding was allocated to recipients in Toronto, Montreal, Edmonton, Winnipeg and a number of other cities. There were substantial increases in funding to PIs in Saskatoon, Edmonton, Toronto and Montreal from 2007-2013.

Results: Priority #3 – Understanding the cause of metastatic breast cancer and identifying new avenues for interventions

DEFINITION

Metastatic breast cancer results in mortality and is still poorly understood. Therefore, gaining a better understanding of the process of invasion of cancer cells throughout the body is critical and should result in the development of new strategies for treatment of metastatic breast cancer.

TYPE OF GRANTS INCLUDED

This priority includes grants which focus on:

- role of specific genes in metastasis
- screens for metastasis genes
- metastasis-relevant phenotypes, such as mechanisms of tumour dormancy and reactivation, homing to particular tissues, tumour cell invasion

NATIONAL FRAMEWORK INVESTMENT REQUIREMENTS
(from Framework report, published in 2009, based on 2007 data)

This area was identified as needing new and additional investment to encourage research (initiate and enable). While some areas have received funding, key questions in other areas are not currently funded.

Researchers determined a need for approximately $20M over the next five years to fund two specific initiatives:

- encouraging operating grants in this area (funding top grants through priority announcement) ($5M over three to five years)
- and a specific RFA (team grant) on metastatic mechanisms in breast cancer ($15M over three to five years).

Results

$53,680,307 of funding was allocated for this priority between 2007 and 2013. This represents approximately **12.2%** of overall breast cancer research funding over this period.

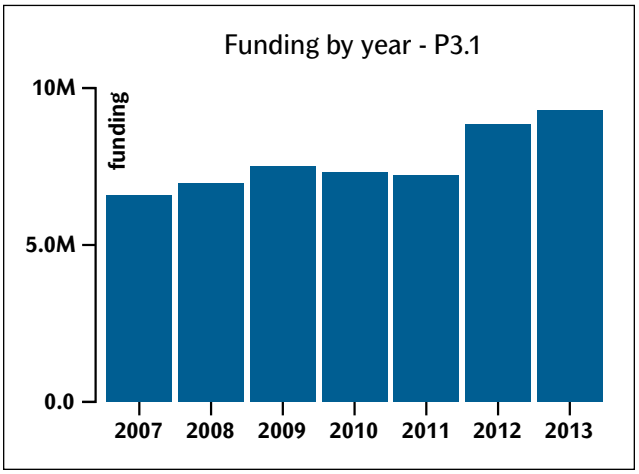
318.5 project equivalents were funded between 2007 and 2013.

241 principal investigators had at least one operating or career grant coded or partially coded to this priority between 2007 and 2013.

FUNDING BY YEAR (P3.1)

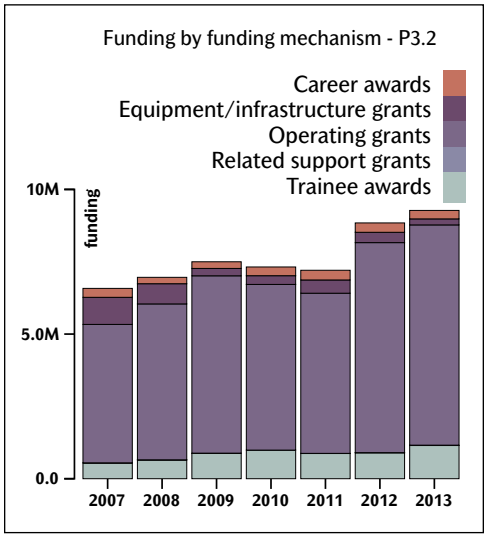
Funding for this priority increased 41% between 2007 and 2013.

This represents a total of approximately $7.6M of additional funds between 2008-2013 over the 2007 level.



Comparison to National Framework investment requirements

While there was an increase in funding, this increase was less than that proposed through the National Framework.



A number of operating grants focusing on this area were funded, as were a small number of grants funded through targeted competitions.

FUNDING BY FUNDING MECHANISM (P3.2)

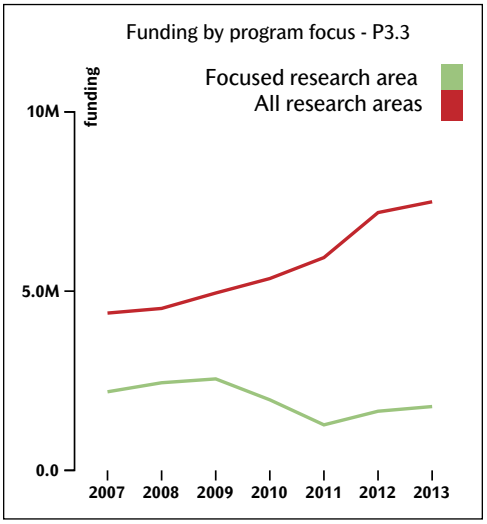
The majority of funding in each year was allocated through operating grants. The overall increase in funding was mainly due to increased funding through operating grants.

While the proportion of each type was roughly similar, funding for training awards increased while funding for equipment/infrastructure decreased from 2007-2013.

BREAKDOWN BY PROGRAM - FOCUSED ON A SPECIFIC RESEARCH AREA VS OPEN TO ALL RESEARCH AREAS (P3.3)

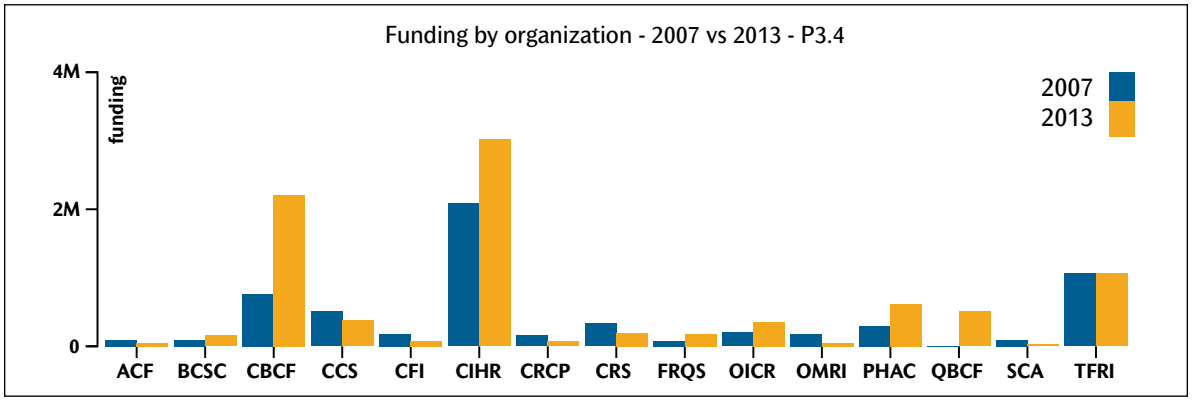
The majority of funding in each year was allocated through funding programs that were not focused on a specific research area.

The proportion of grants funded through metastasis-specific competitions decreased slightly from 2011. This was in part due to the ending of the CBCRA "New Approaches to Metastatic Disease" grant program.



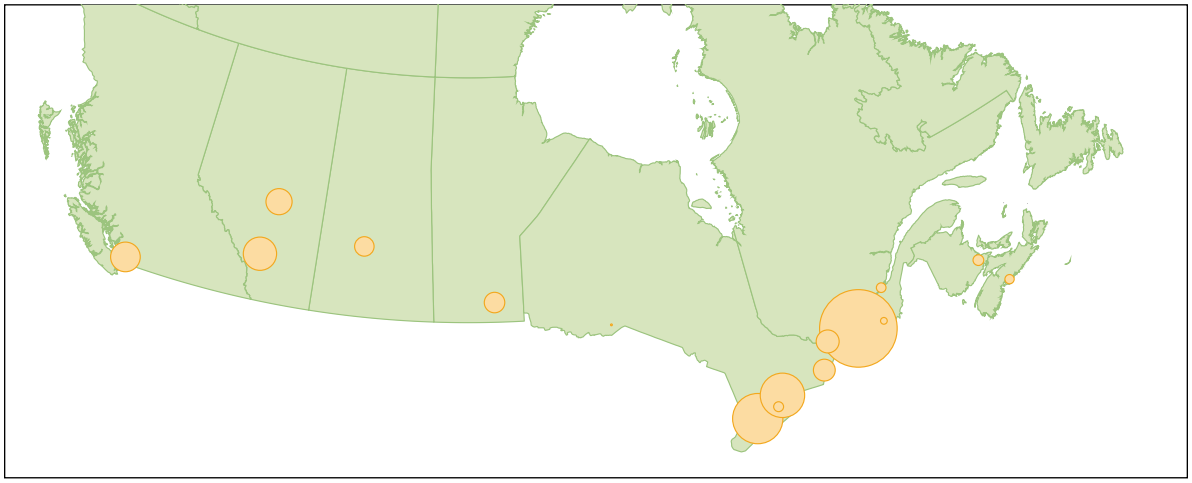
Other focused grant competitions included CRS's "Strategic Grant on Genomics and Proteomics of Metastasis" and ACRI's "Breast Cancer to Bone Metastases (B2B) Program."

FUNDING BY ORGANIZATION - 2007 VS 2013 (P3.4)



Between 2007 and 2013, CBCF, CIHR, and QBCF substantially increased their funding for this priority. Over the same time interval, CRS and CCS slightly decreased their funding for this priority.

GEOGRAPHY OF FUNDING



Funding was allocated to recipients in Montreal, London, Toronto, Calgary and a number of other cities. There were increases in funding to PIs in Toronto, Moncton, Ottawa, Quebec, Winnipeg and Edmonton among others between 2007-2013 and a slight decrease in funding to recipients in Montreal over the same period.

Results: Priority #4 – The influence of lifestyle and environmental factors on the risk of developing breast cancer

DEFINITION

Research in this priority area will attempt to identify modifiable risk factors implicated in the development of breast cancer. This could lead to the development of new prevention strategies and interventions.

TYPE OF GRANTS INCLUDED

This priority includes grants which focus on:

- modifiable risk factors for breast cancer, including environmental exposures, occupational exposures, dietary factors, light exposure/circadian rhythms and medical treatments affecting breast cancer risk
- animal model studies testing lifestyle interventions on risk
- biological mechanisms of modifiable risk factors - (non-hormonal)

NATIONAL FRAMEWORK INVESTMENT REQUIREMENTS
(from Framework report, published in 2009, based on 2007 data)

It was decided that this area requires an ongoing investment similar to its current funding level (sustain). Several funders (as outlined above) have already selected significant initiatives that will include breast cancer requirements. Therefore the proposed approach is to partner with agencies such as CPAC on its Canadian Partnership for Tomorrow Project to monitor progress within the National Cohort Study, and to identify which findings are relevant to breast cancer. This process will help to identify breast cancer-specific projects on an as-needed basis.

Results

$8,136,455 of funding was allocated for this priority between 2007 and 2013. This represents approximately **1.8%** of overall breast cancer research funding over this period.

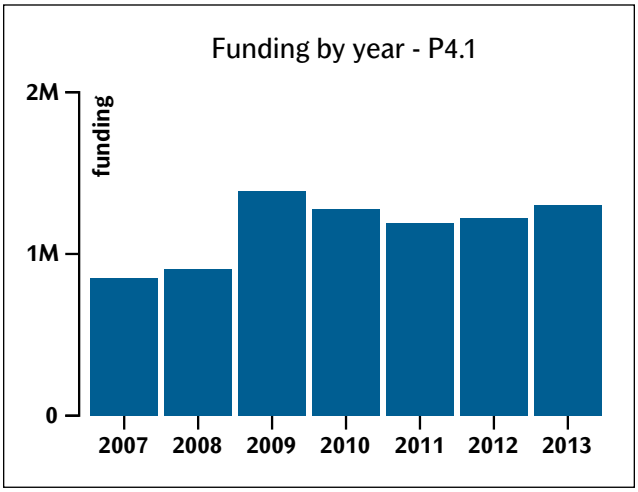
67.2 project equivalents were funded between 2007 and 2013.

65 principal investigators had at least one operating or career grant coded or partially coded to this priority between 2007 and 2013.

FUNDING BY YEAR (P4.1)

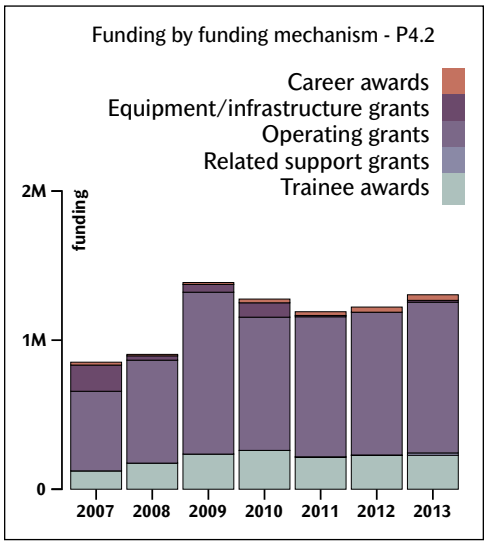
Funding for this priority increased 53% between 2007 and 2013.

This represents a total of approximately $2.2M of additional funds between 2008-2013 over the 2007 level.



Comparison to National Framework investment requirements

There was an increase in funding, which was greater than that proposed through the National Framework.



Additional funding was primarily for grants funded through open operating grant competitions, as well as a smaller number of grants funded through targeted programs.

FUNDING BY FUNDING MECHANISM (P4.2)

The majority of funding in each year was allocated through operating grants. The increase in funding was mainly due to greater funding through operating grants and, to a lesser degree, trainee awards.

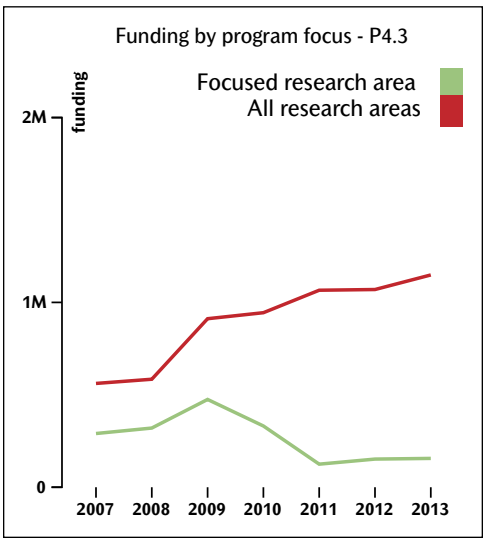
The proportion of each type was similar from 2007-2013.

BREAKDOWN BY PROGRAM - FOCUSED ON A SPECIFIC RESEARCH AREA VS OPEN TO ALL RESEARCH AREAS (P4.3)

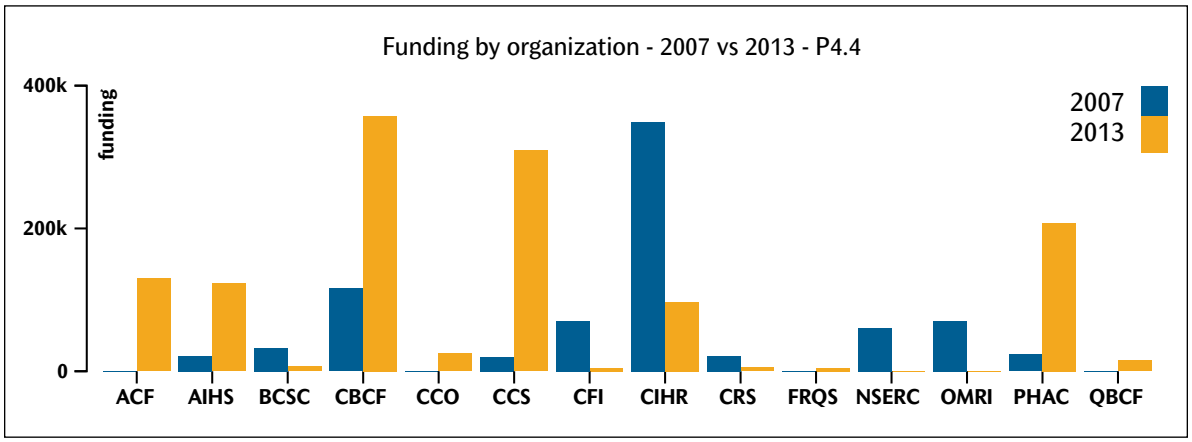
The majority of funding in each year was allocated through funding programs that were not focused on a specific research area.

The proportion of grants funded through area-specific competitions decreased slightly from 2010.

Area-specific competition included CBCRA's "Translational Acceleration Grant Program for Breast Cancer", the CCS "Prevention Initiative", CIHR's "Operating Grant Priority Announcement: Gender, Sex and Health" grant program and grants funded through AIHS's "Alberta Cancer Prevention Legacy Fund."



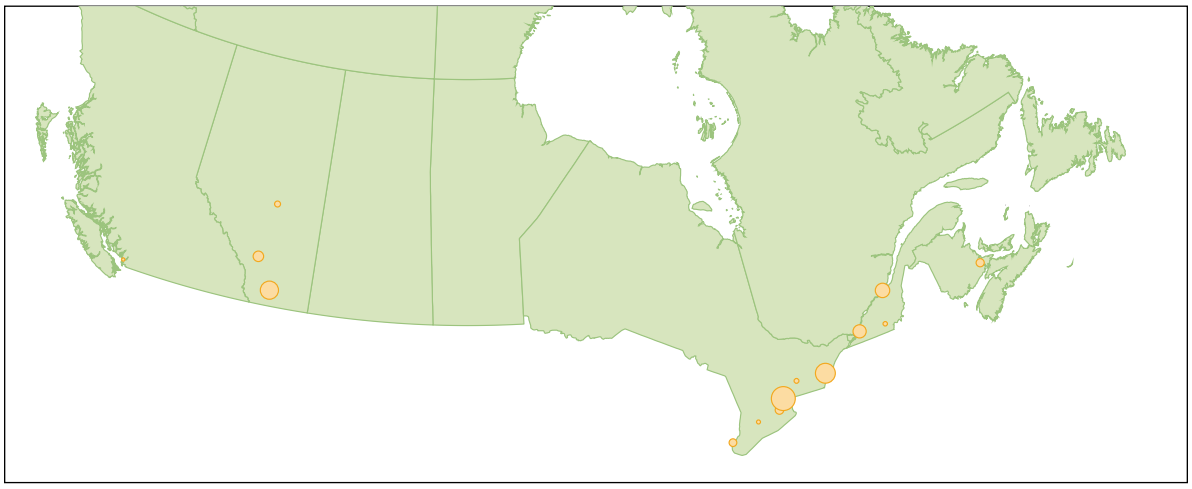
FUNDING BY ORGANIZATION - 2007 VS 2013 (P4.4)



Between 2007 and 2013, CCS, CBCF, PHAC and ACF substantially increased their funding for this priority. Over the same time interval, CIHR, CFI and NSERC decreased their funding for this priority.

It is notable that CIHR-administered funding was roughly similar in 2007 and 2013, though the proportion of this funding originating from partnered agencies increased in 2013.

GEOGRAPHY OF FUNDING



Funding was allocated to recipients in Toronto, Kingston, Lethbridge and a number of other cities. There were increases in funding to PIs in Toronto, Lethbridge and Edmonton from 2007-2013 and a decrease in funding to recipients in Kingston, Montreal and Windsor over the same period.

Results: Priority #5 – The genetics and hormonal causes of breast cancer

DEFINITION

Certain genes or hormonal factors have been linked to the development of breast cancer in some groups of individuals. This research priority explores this link in more detail, and could lead to the development of new interventions or treatments to reduce the risk of breast cancer in certain populations.

TYPE OF GRANTS INCLUDED

This priority includes grants which focus on:

- germline genetic alterations that influence breast cancer risk
- hormones/hormonal state and breast cancer risk
- mechanism of hormone-induced carcinogenesis

NATIONAL FRAMEWORK INVESTMENT REQUIREMENTS
(from Framework report, published in 2009, based on 2007 data)

It was decided that this area needs more investment to encourage research (enable) since, with the exception of the National Cohort Study, which is not breast cancer specific, no other initiatives specific to breast cancer are in place. Researchers indicate that this area of research requires about $9M in investment over the next five years. This amount would be used for targeted RFAs such as the Translation Acceleration Grants addressing the deciphering of molecular pathways implicated in cancer initiation ($5-7M over three to five years – the same RFA listed under CSO Code 1.3), developing Canadian involvement in international cohorts ($1-2M over two years) and ongoing partnering with the Canadian Partnership for Tomorrow Project to ensure breast cancer-specific data is collected and made available.

Results

$16,650,631 of funding was allocated for this priority between 2007 and 2013. This represents approximately **3.8%** of overall breast cancer research funding over this period.

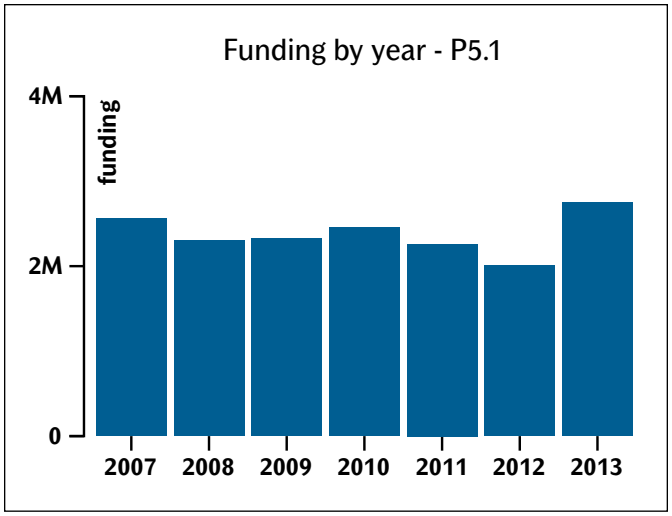
69.4 project equivalents were funded between 2007 and 2013.

58 principal investigators had at least one operating or career grant coded or partially coded to this priority between 2007 and 2013.

FUNDING BY YEAR (P5.1)

Funding for this priority increased 8% between 2007 and 2013.

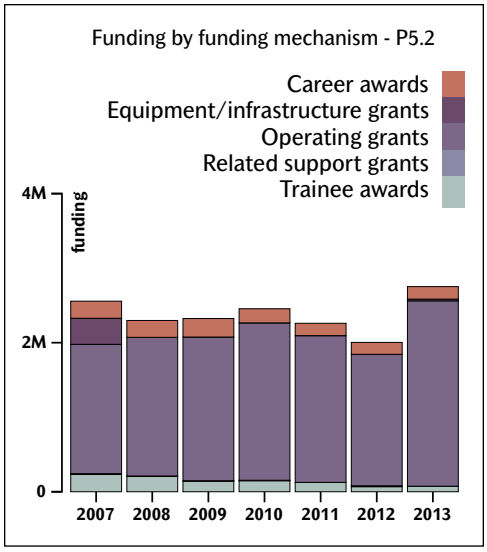
However, since funding dropped between 2008-2012, this represented a decrease of $1.2M of funding between 2008-2013 relative to the 2007 level.



Comparison to National Framework investment requirements

There was an overall decrease in funding; this is in contrast to the funding increase that was proposed through the National Framework.

Grants included one Translation Acceleration Grant funded through CBCRA. It is possible that grants focused on Canadian involvement in international cohorts would not be captured in the breast cancer data used for this report.



FUNDING BY FUNDING MECHANISM (P5.2)

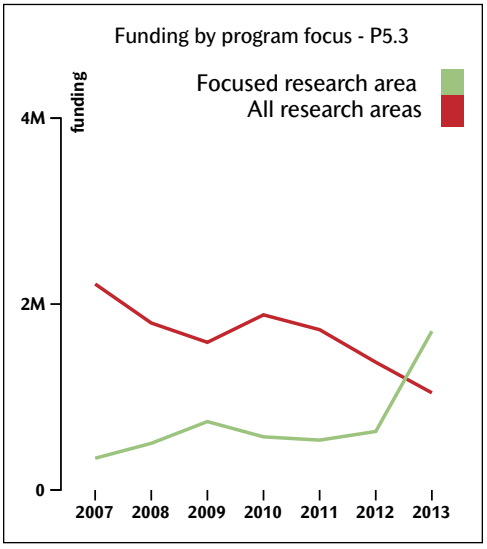
The majority of funding in each year was allocated through operating grants.

There was a peak of infrastructure funding in 2007, but this was primarily due to a single CFI grant.

Funding through training grants decreased from 2007-2013.

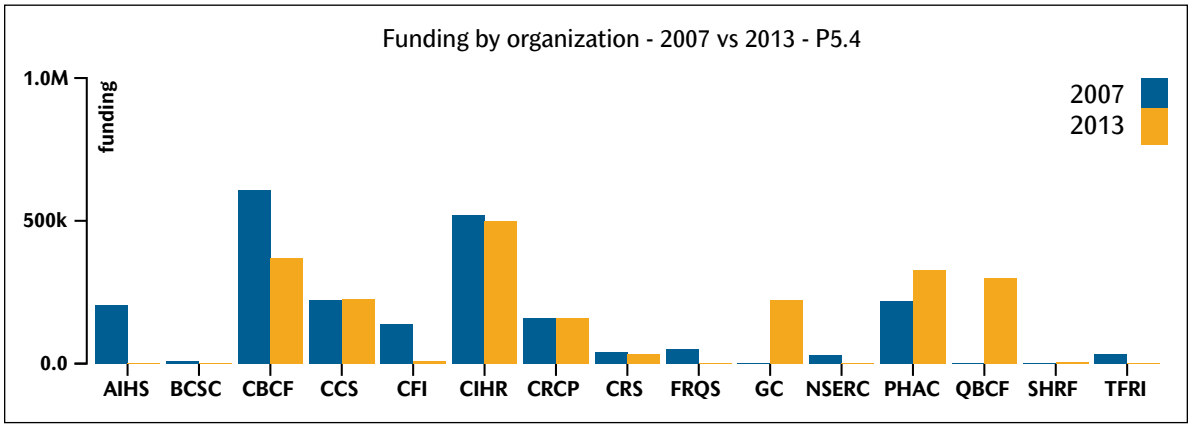
BREAKDOWN BY PROGRAM - FOCUSED ON A SPECIFIC RESEARCH AREA VS OPEN TO ALL RESEARCH AREAS (P5.3)

The majority of funding in each year was allocated through funding programs that were not focused on a specific research area, except for 2013.



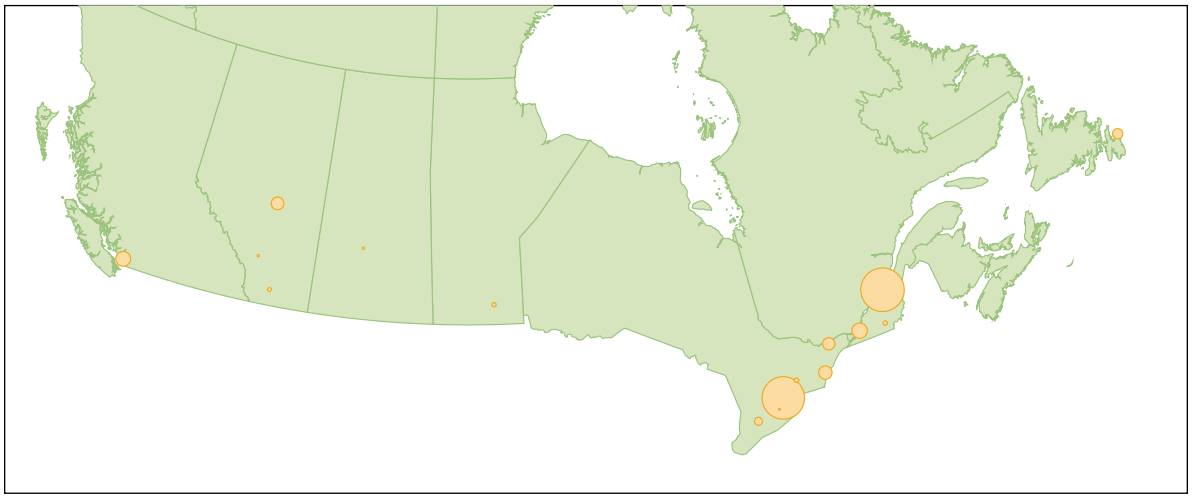
The 2013 increase in area-specific funding was largely due to a large team grant funded through Genome Canada (with funding from Genome Canada, QBCF, PHAC and Genome Quebec). It is notable that this opportunity was aligned with a CIHR Signature Initiative, which was informed by the National Framework.

FUNDING BY ORGANIZATION - 2007 VS 2013 (P5.4)



Between 2007 and 2013, GC and QBCF substantially increased their funding for this priority. Over the same time interval, CBCF, AIHS and CFI decreased their funding for this priority.

GEOGRAPHY OF FUNDING



Funding was allocated to recipients in Quebec City, Toronto and a number of other cities. There were substantial increases in funding to PIs in Quebec City from 2007-2013 and a decrease in funding to Toronto, St. John's and Edmonton over the same period.

Results: Priority #6 – Understanding the interplay of multicausal factors: genetics and environment

DEFINITION

The interaction of genes with lifestyle factors (gene-environment interaction) could play an important role in breast cancer risk. Research in this priority area will study the interaction of different factors, such as genetic predisposition or exposure to a certain environment, on the risk of developing breast cancer. The results of this research could have an important impact in the development of new breast cancer prevention interventions.

TYPE OF GRANTS INCLUDED

This priority includes grants which focus on:

- interaction of lifestyle factor and genotype on breast cancer risk
- etiological studies examining both genetic and environmental factors
- intermediate markers affected by dietary and genetic factors

NATIONAL FRAMEWORK INVESTMENT REQUIREMENTS
(from Framework report, published in 2009, based on 2007 data)

This area was determined to require investment (initiate), as no current or emerging breast cancer research programs were identified in Canada.

Over the next five years, this area of research will require about $7.5M for two special RFAs. One will evaluate gene- environment interactions in the etiology of breast cancer (with special consideration to polymorphisms). The other will build on the findings of genome sequencing and environmental research to explore the environmental interactions and biological implications of the genome sequencing. The requirement for the full $7.5M is conditional on the genome sequencing project yielding important data that would justify further exploration.

Results

$7,057,810 of funding was allocated for this priority between 2007 and 2013. This represents approximately **1.6%** of overall breast cancer research funding over this period.

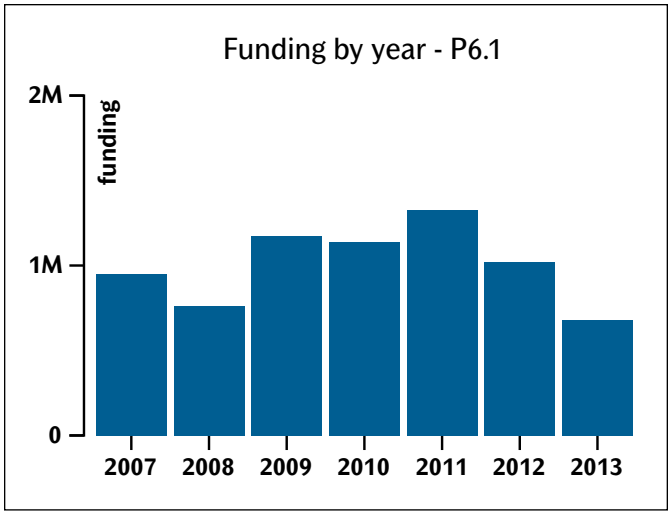
21.4 project equivalents were funded between 2007 and 2013.

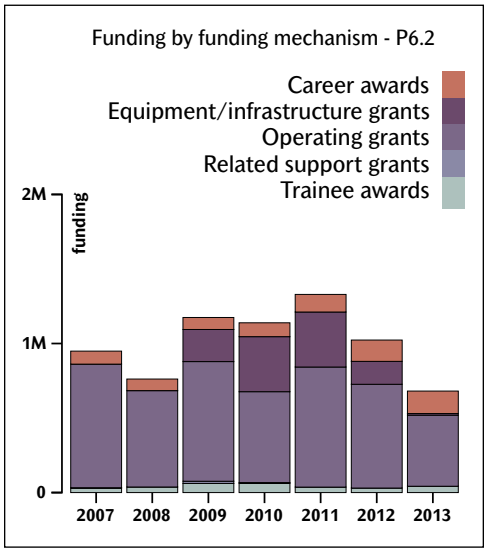
17 principal investigators had at least one operating or career grant coded or partially coded to this priority between 2007 and 2013.

FUNDING BY YEAR (P6.1)

Funding for this priority decreased 28% between 2007 and 2013.

However, due to an increase in funding from 2009-2012, there was an increase of $0.4M of overall funding between 2008-2013 relative to the 2007 level.





Comparison to National Framework investment requirements

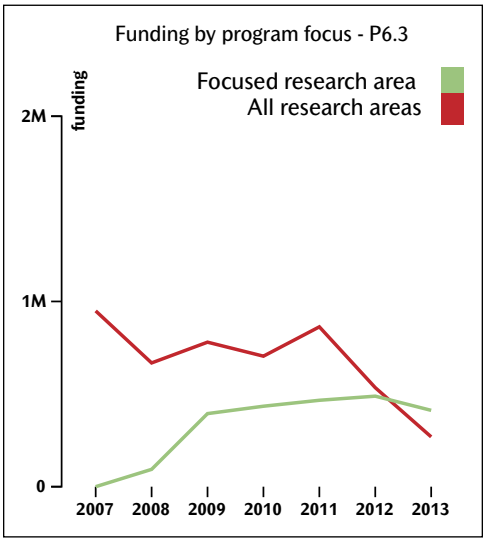
This change in funding this was less than that proposed through the National Framework.

Grants included a large team grant focusing, in part, on gene-environment interactions in breast cancer.

FUNDING BY FUNDING MECHANISM (P6.2)

The majority of funding in each year was allocated through operating grants.

There was a peak of infrastructure funding between 2009-2012 - this was largely due to a single CFI grant.

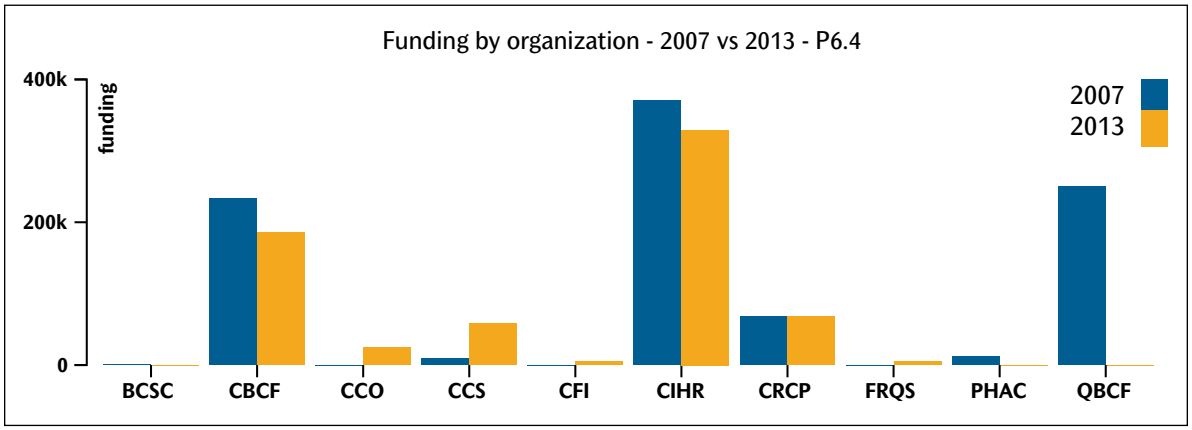


BREAKDOWN BY PROGRAM - FOCUSED ON A SPECIFIC RESEARCH AREA VS OPEN TO ALL RESEARCH AREAS (P6.3)

In 2007, all funding for priority 6 was allocated through non-area-specific programs. The proportion of grants funded through targeted programs increased from 2008-2013, until in 2013, research area-specific programs were responsible for the majority of funding.

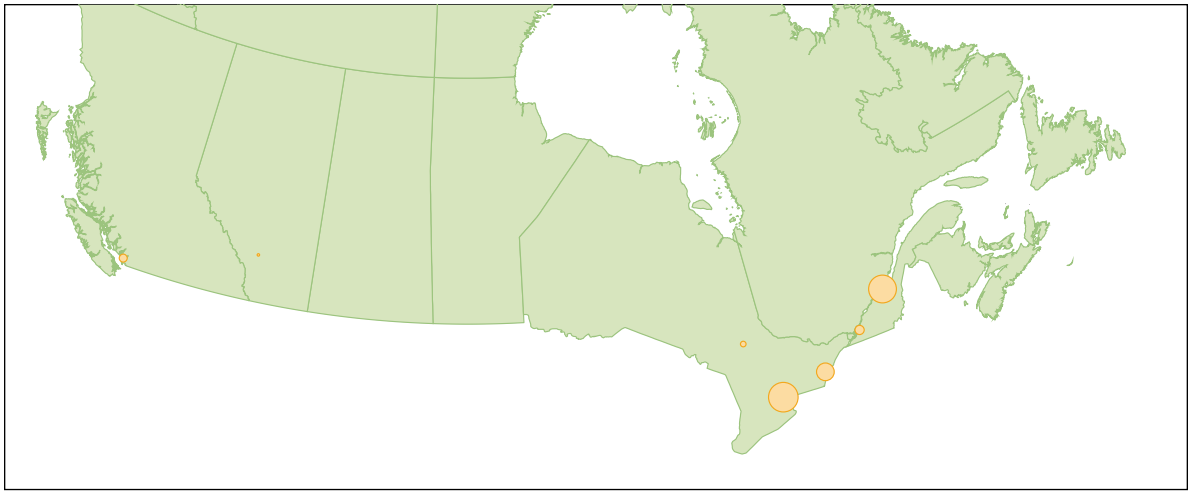
This change was largely due to a large CIHR Team Grant funded between 2009 and 2013 (accompanied by a decrease in overall funding for this priority between 2011 and 2013.)

FUNDING BY ORGANIZATION - 2007 VS 2013 (P6.4)



Between 2007 and 2013, CCS and CCO increased its funding for this priority. Over the same time interval, QBCF, CBCF and CIHR decreased its funding for this priority.

GEOGRAPHY OF FUNDING



Funding was allocated to recipients in Toronto, Quebec, Kingston and a number of other cities. There were substantial increases in funding to PIs in Quebec City from 2007-2013 and a decrease in funding to Kingston and Montreal over the same period.

Results: Priority #7 – Interventions to study the influence of lifestyle and environmental factors on the risk of developing breast cancer

DEFINITION

Specific factors continue to be identified as influencing the risk of developing breast cancer, particularly in some subpopulations. Research in this priority area will aim to develop new population-based interventions that could be introduced to reduce breast cancer incidence.

TYPE OF GRANTS INCLUDED

This priority includes grants which focus on:

- human trials of lifestyle interventions to reduce breast cancer risk (or biomarkers associated with risk)
- ancillary studies examining biological impacts of intervention trials

NATIONAL FRAMEWORK INVESTMENT REQUIREMENTS
(from Framework report, published in 2009, based on 2007 data)

This field was defined as needing more investment to encourage research (enable), since CIHR has a targeted initiative (not specific to breast cancer) as does CCS (Prevention Initiative). In addition, the CBCRA/CIHR TAGS grants will end in 2009.

Researchers indicate that this area of research requires approximately $20M in investment over the next five years to support primary prevention trials in collaboration with partners and international agencies. This research is unlikely to be exclusive to breast cancer.

Results

$5,554,453 of funding was allocated for this priority between 2007 and 2013. This represents approximately **1.3%** of overall breast cancer research funding over this period.

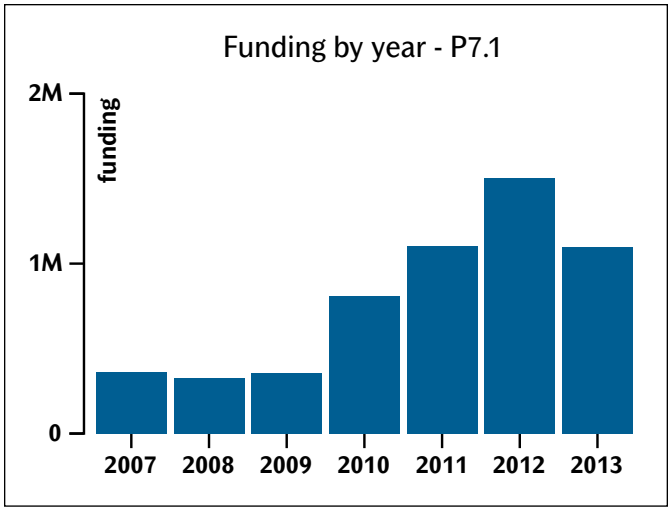
21.2 project equivalents were funded between 2007 and 2013.

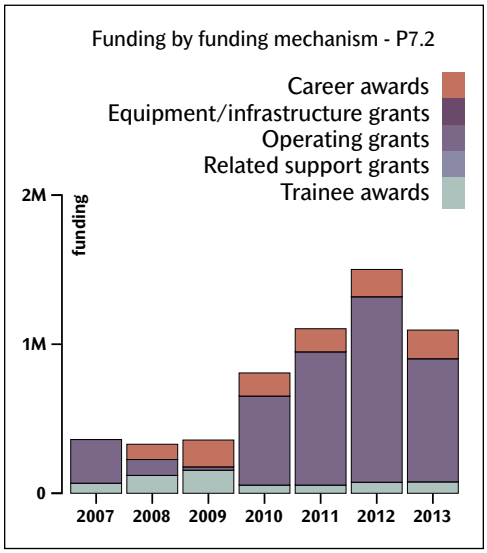
14 principal investigators had at least one operating or career grant coded or partially coded to this priority between 2007 and 2013.

FUNDING BY YEAR (P7.1)

Funding for this priority increased 203% between 2007 and 2013.

This represents a total of approximately $3.0M of additional funds between 2008-2013 over the 2007 level.





Comparison to National Framework investment requirements

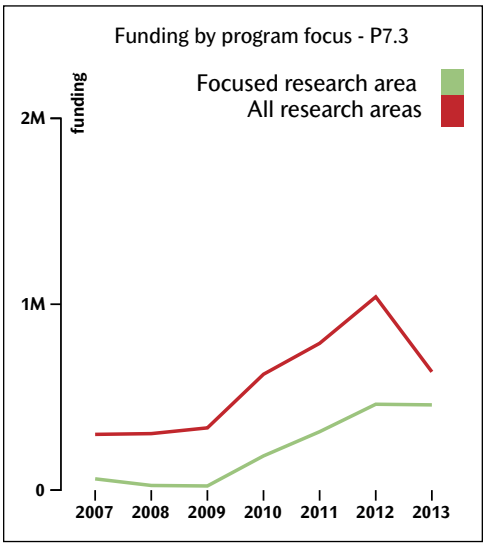
While there was an increase in funding, this increase was less than that proposed through the National Framework. However, this increase may be an underestimate of the relevant research. In this analysis we are only examining breast cancer research grants; in the original Framework document it was noted that relevant research for this prioirty was unlikely to be exclusive to breast cancer.

FUNDING BY FUNDING MECHANISM (P7.2)

The majority of funding in each year was allocated through operating grants, except in 2008 and 2009, where funding was mainly allocated through career and trainee awards.

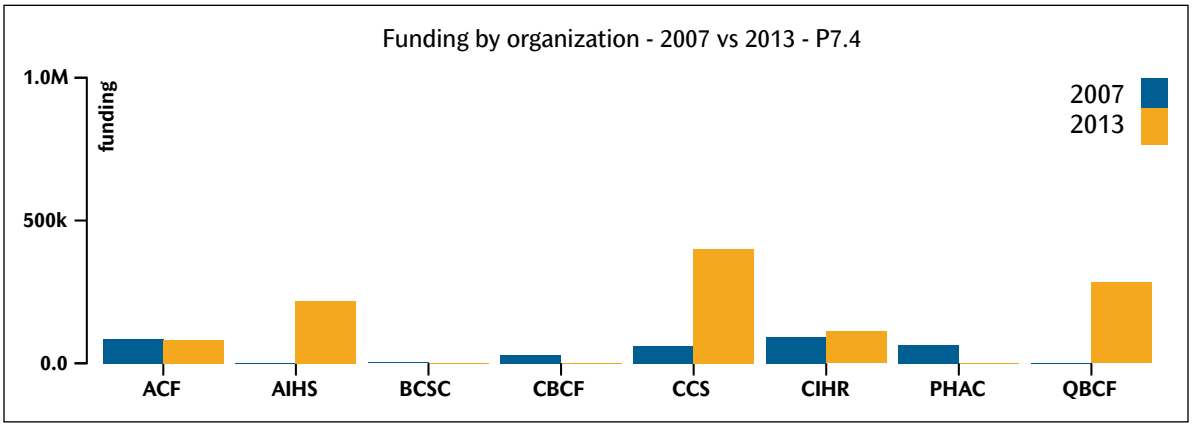
BREAKDOWN BY PROGRAM - FOCUSED ON A SPECIFIC RESEARCH AREA VS OPEN TO ALL RESEARCH AREAS (P7.3)

The majority of funding in each year was allocated through funding programs that were not focused on a specific research area. However relatively more funding was allocated through research area-specific programs from 2010 to 2013.



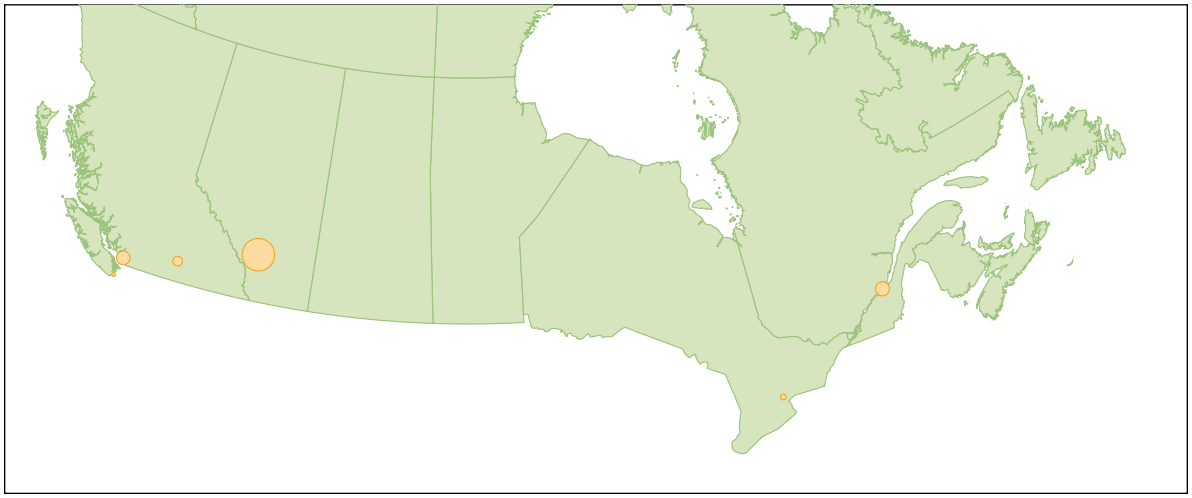
This was due to grants funded through CCS's "Prevention Initiative" and CBCRA's "Psychosocial Aspects of Breast Cancer" research program.

FUNDING BY ORGANIZATION - 2007 VS 2013 (P7.4)



Between 2007 and 2013, CCS, QBCF and AIHS substantially increased its funding for this priority.

GEOGRAPHY OF FUNDING



Funding for this priority was allocated to recipients in Calgary, and a number of other cities. There were substantial increases in funding to PIs in Calgary, Quebec City and Vancouver from 2007-2013.

Results: Priority #8 – Better approaches to early detection and diagnosis

DEFINITION

This research priority will focus on the development of new approaches to breast cancer screening and on the discovery of new tools leading to more accurate diagnoses and to more personalized treatment of the disease.

TYPE OF GRANTS INCLUDED

This priority includes grants which focus on:

- imaging methods for breast cancer screening, diagnosis or prognosis
- agent development for imaging
- image enhancement methods for breast cancer detection

NATIONAL FRAMEWORK INVESTMENT REQUIREMENTS
(from Framework report, published in 2009, based on 2007 data)

This area was identified as needing more funding to encourage research (enable) given the current level of investment. Researchers indicate that this area of research requires approximately $6M in investment using flexible funding mechanisms such as small pilot studies but avoiding too many small grants to multidisciplinary teams. Partnering across sectors and geographic regions will be key.

Results

$32,169,424 of funding was allocated for this priority between 2007 and 2013. This represents approximately **7.3%** of overall breast cancer research funding over this period.

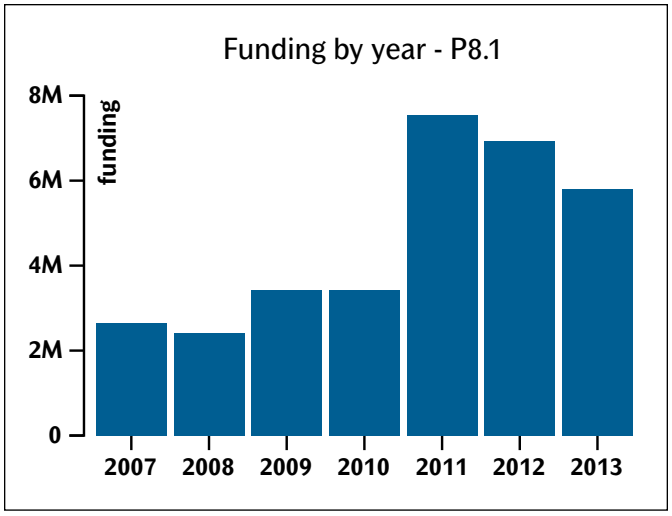
207.9 project equivalents were funded between 2007 and 2013.

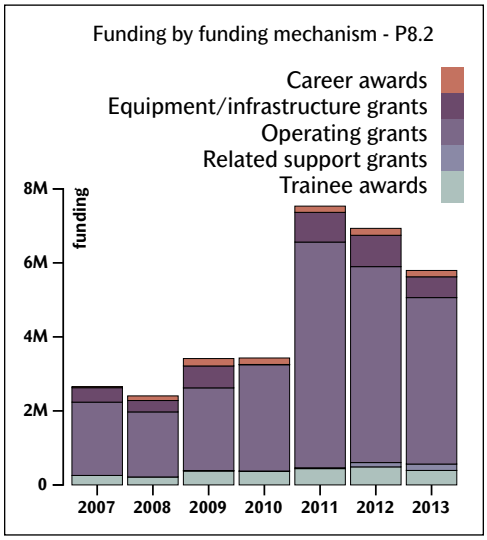
157 principal investigators had at least one operating or career grant coded or partially coded to this priority between 2007 and 2013.

FUNDING BY YEAR (P8.1)

Funding for this priority increased 118% between 2007 and 2013.

This represents a total of approximately $13.6M of additional funds between 2008-2013 over the 2007 level.





Comparison to National Framework investment requirements

There was an increase in funding that exceeded that proposed through the National Framework.

A wide variety of targeted initiatives focused on this priority.

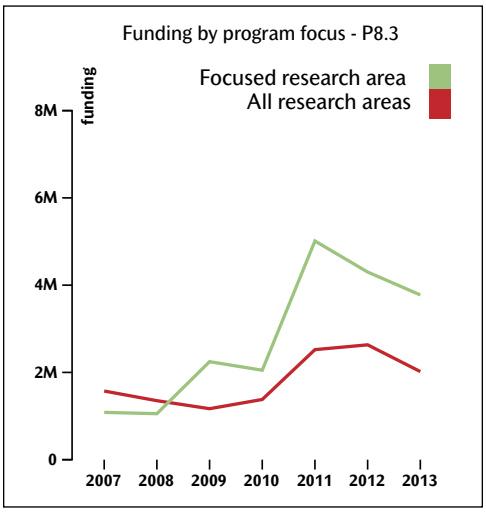
FUNDING BY FUNDING MECHANISM (P8.2)

The majority of funding in each year was allocated through operating grants. In 2009 and from 2011-13, equipment/infrastructure grants through CFI, OICR and NSERC were responsible for a significant fraction of funding.

BREAKDOWN BY PROGRAM - FOCUSED ON A SPECIFIC RESEARCH AREA VS OPEN TO ALL RESEARCH AREAS (P8.3)

The majority of funding from 2007-2008 was allocated through funding programs that were not focused on a specific research area. From 2009-2013 the majority of funding was allocated through targeted programs.

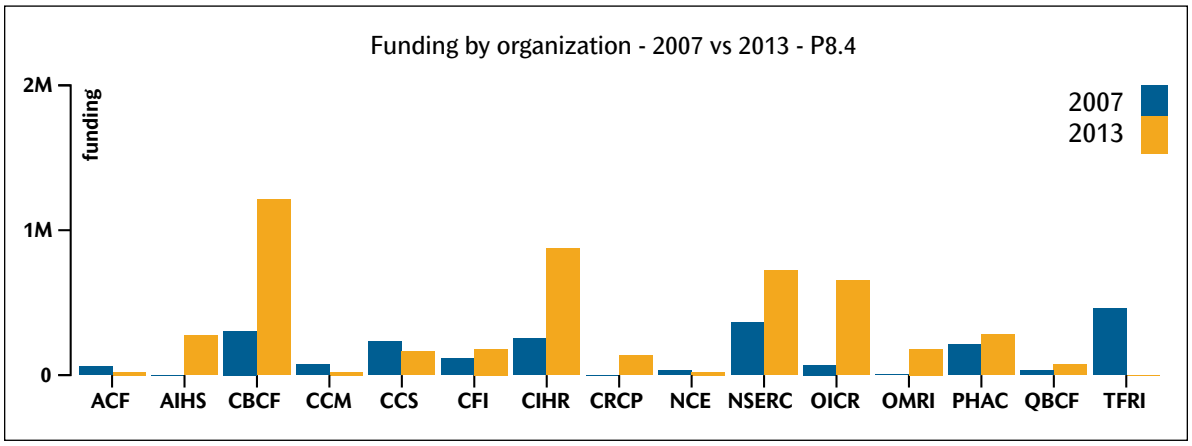
In part, this was due to grants funded through CIHR's "Medical Imaging Clinical Trials Network" and other focused research programs such as CIHR's "Alternative Radiopharmaceuticals for Medical Imaging program", NSERC's "Strategic Project Grant"



and “Idea to Innovation” grants, TFRI’s “Terry Fox New Frontiers Program”, OICR’s “Smarter Imaging Program” and CBCF’s “National Grants Competition on Earlier Detection.”

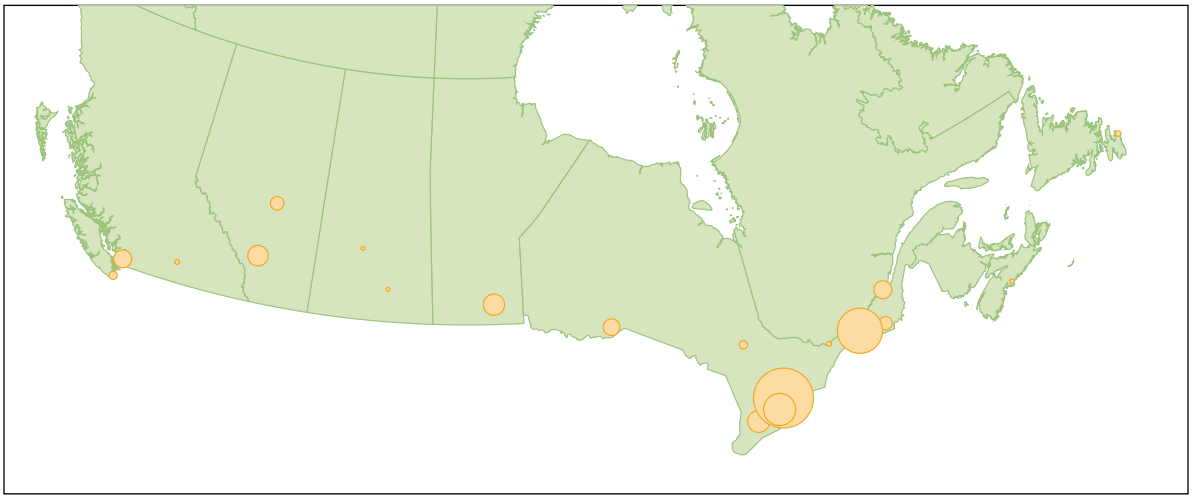
It is notable that the latter competition was specifically created in response to the National Framework.

FUNDING BY ORGANIZATION - 2007 VS 2013 (P8.4)



Between 2007 and 2013, CBCF, CIHR, OICR, NSERC, AIHS, GC, OMRI and others increased its funding for this priority. Over the same period, funding was decreased by TFRI and NRCC.

GEOGRAPHY OF FUNDING



Funding for this priority was allocated to recipients in Toronto, Montreal and Hamilton as well as a number of other cities. There were substantial increases in funding to PIs in Quebec, Toronto, Vancouver, Thunder Bay, Hamilton and other cities from 2007-2013.

Results: Priority #9 – Development and evaluation of new biomarkers (including biomarkers for diagnosis) and the optimization of treatments for individual patients

DEFINITION

Research in this priority will lead to the discovery and validation of new biomarkers. New diagnostic biomarkers will provide critical information for more accurate disease characterization. Predictive biomarkers will forecast patient response to therapy and could lead to the development of new treatment targets.

TYPE OF GRANTS INCLUDED

This priority includes grants which focus on:

- searches for biomarkers or biomarker signatures
- methods to detect biomarkers
- biomarker validation
- imaging agents to detect specific biomarkers

NATIONAL FRAMEWORK INVESTMENT REQUIREMENTS
(from Framework report, published in 2009, based on 2007 data)

This area was defined as needing new (evaluation of new biomarkers) as well as more (discovery of new biomarkers) investment to encourage research (initiate and enable). New funding is required to enable Canadian breast cancer researchers to validate targets or markers and initiate pre-clinical studies based on novel breast cancer targets.

Researchers indicate that this area of research requires approximately $12M in investment over the next five years through a portfolio of different funding mechanisms. These options include companion studies to clinical trials ($100-500K per study with duration of one to three years); RFAs in specific areas (possibility of multi-institutional and multidisciplinary projects at $5-10M per year); workshop support bringing experts from different disciplines together to propose a larger-scale effort ($100K per workshop); retrospective studies "ready to act" on results of clinical trials (included in RFA); and training support for methodology and statistical evaluation. Researchers emphasize the importance of flexibility in the funding streams, avoiding too many small multidisciplinary teams, as well as the need to link with pharma, Phase I clinical trials and other existing initiatives.

Results

$36,842,439 of funding was allocated for this priority between 2007 and 2013. This represents approximately **8.3%** of overall breast cancer research funding over this period.

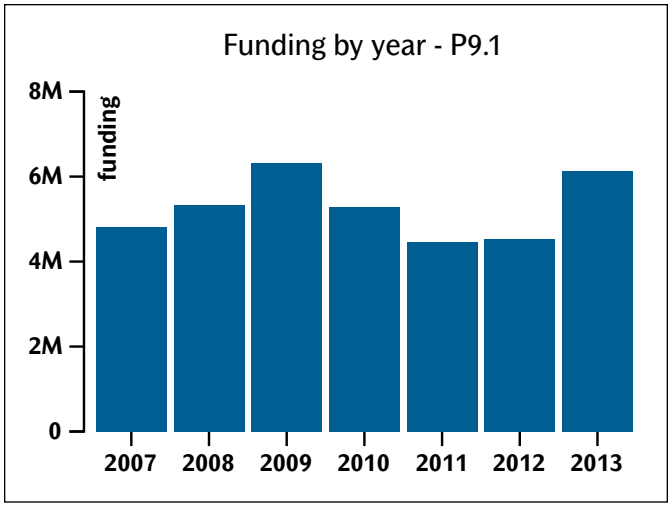
173.0 project equivalents were funded between 2007 and 2013.

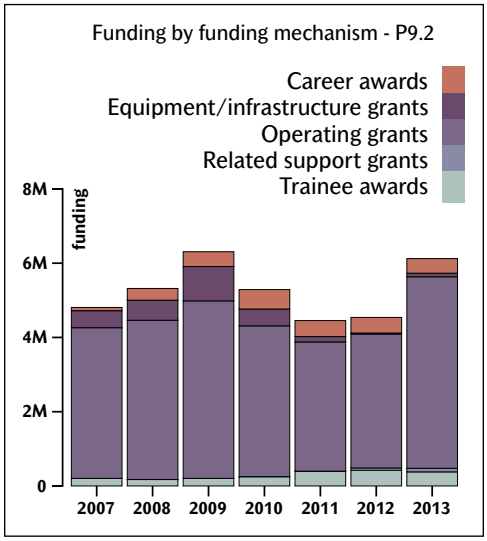
153 principal investigators had at least one operating or career grant coded or partially coded to this priority between 2007 and 2013.

FUNDING BY YEAR (P9.1)

Funding for this priority increased 27% between 2007 and 2013.

This represents a total of approximately $3.2M of additional funds between 2008-2013 over the 2007 level.





Comparison to National Framework investment requirements

There was an increase in funding, this increase was less than that proposed through the National Framework.

A variety of targeted initiatives focused on this priority.

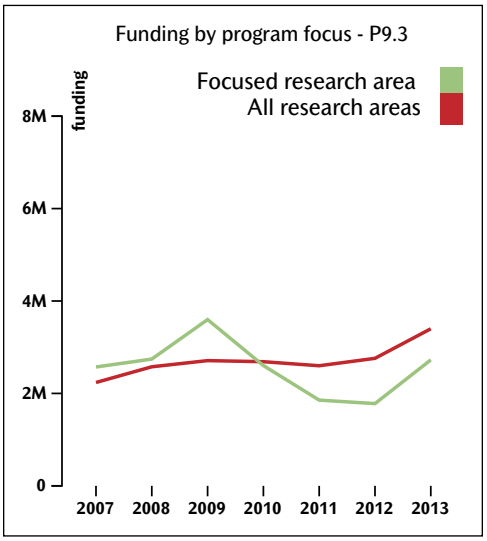
FUNDING BY FUNDING MECHANISM (P9.2)

The majority of funding in each year was allocated through operating grants. The amounts allocated through equipment/infrastructure grants decreased and through career awards and trainee grants increased from 2007-2013.

BREAKDOWN BY PROGRAM - FOCUSED ON A SPECIFIC RESEARCH AREA VS OPEN TO ALL RESEARCH AREAS (P9.3)

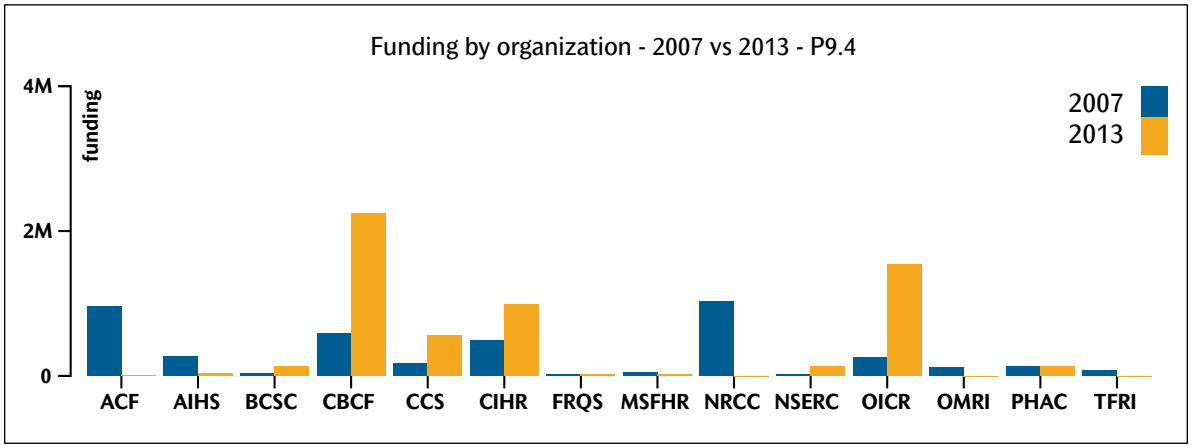
Roughly equal amounts of funding were allocated through funding programs that were focused on a specific research area and those that were not. From 2009-2013 the majority of funding was allocated through research area-specific programs.

Focused programs included NRCC's "Genomics and Health Initiative", ACF's "Breast Cancer Translational Research Group Grant", OICR's "Personalized Medicine Research Fund" and



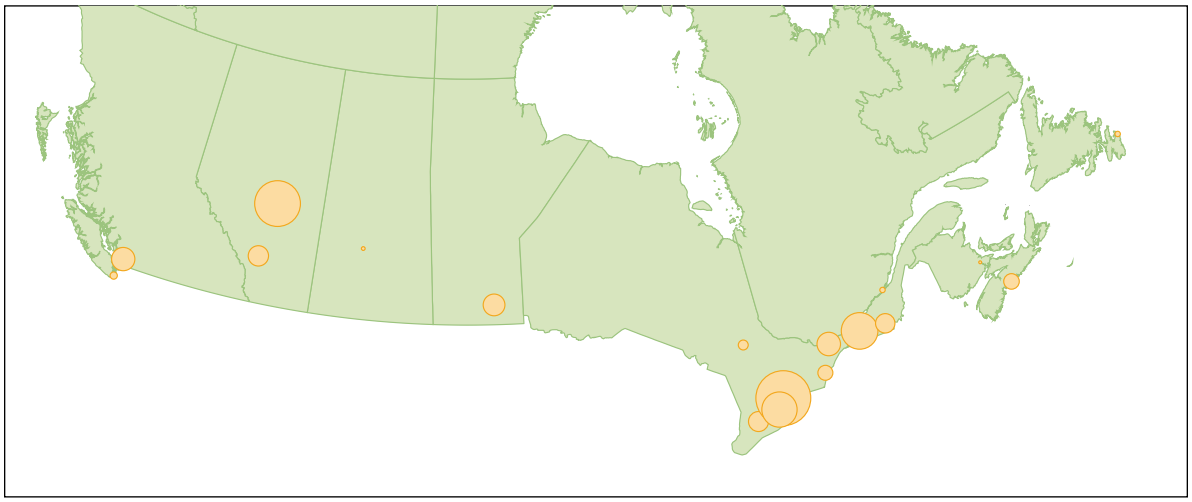
"Transformative Pathology Program" programs, CBCF's "National Grants Competition on Earlier Detection" and CBCRA's "Predictive Oncology" competition.

FUNDING BY ORGANIZATION - 2007 VS 2013 (P9.4)



Between 2007 and 2013, CBCF, OICR, CIHR and CCS substantially increased its funding for this priority. Over the same period, funding was decreased by NRCC and ACF.

GEOGRAPHY OF FUNDING



Funding for this priority was allocated to recipients in Toronto, Edmonton, Montreal and Hamilton as well as a number of other cities. There were substantial increases in funding to PIs in Hamilton, Toronto and other cities from 2007-2013, and a smaller decrease in funding to recipients in Ottawa, Edmonton and Montreal.

Results: Priority #10 – Clinical setting/clinical trials to assess clinical sensitivity and specificity of new biomarkers

DEFINITION

Following the discovery of new biomarkers, clinical trials will be required to assess their use in a clinical setting, particularly for some specific subtypes of breast cancer. The results of these trials will have an important impact on the development of new personalized therapeutic strategies by providing predictive information on response to therapy for specific groups of breast cancer patients.

TYPE OF GRANTS INCLUDED

This priority includes grants which focus on:

- testing biomarkers in a clinical trial
- testing biomarkers in companion studies of a clinical trial (for treatment)
- testing late stage/commercially available biomarkers

NATIONAL FRAMEWORK INVESTMENT REQUIREMENTS
(from Framework report, published in 2009, based on 2007 data)

It was determined that this field needs new funding to encourage further research (initiate) given the limited number of current projects specific to breast cancer that are testing new biomarkers.

Researchers indicate that this area of research requires approximately $15.5M over the next five years for two different funding mechanisms: investigator-initiated operating grants ($1-2M per year) and companion studies to existing clinical trials ($2-3M per year for clinical trials and $150K per year for three years for each study).

Results

$2,137,815 of funding was allocated for this priority between 2007 and 2013. This represents approximately **0.5%** of overall breast cancer research funding over this period.

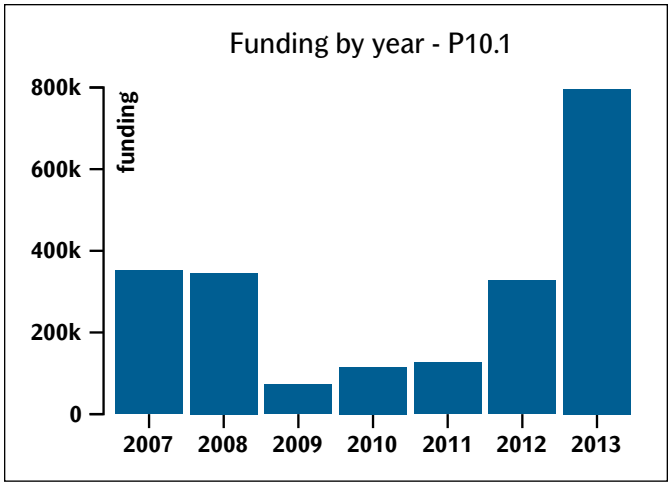
10.5 project equivalents were funded between 2007 and 2013.

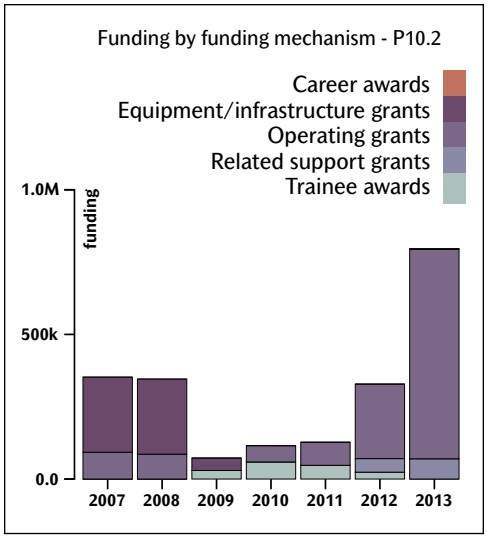
10 principal investigators had at least one operating or career grant coded or partially coded to this priority between 2007 and 2013.

FUNDING BY YEAR (P10.1)

Funding for this priority increased 126% between 2007 and 2013.

Since there was a substantial drop in funding between 2009-2011, this represents a total decrease of approximately $0.3M between 2008-2013 over the 2007 level.





Comparison to National Framework investment requirements

There was an overall decrease in funding; this is in contrast to the funding increase that was proposed through the National Framework.

Overall, funding levels were relatively low. However, grants funded through targeted programs increased substantially in 2013 and may indicate higher levels of funding for this priority in future.

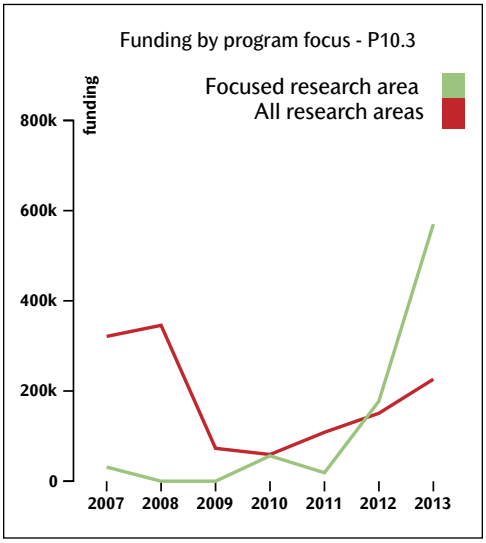
FUNDING BY FUNDING MECHANISM (P10.2)

From 2007-2009, the majority of funding in each year was allocated through equipment/infrastructure awards. From 2011-2013, the majority of funding in each year was allocated through operating grants.

The initial infrastructure investment was primarily through a single CFI grant.

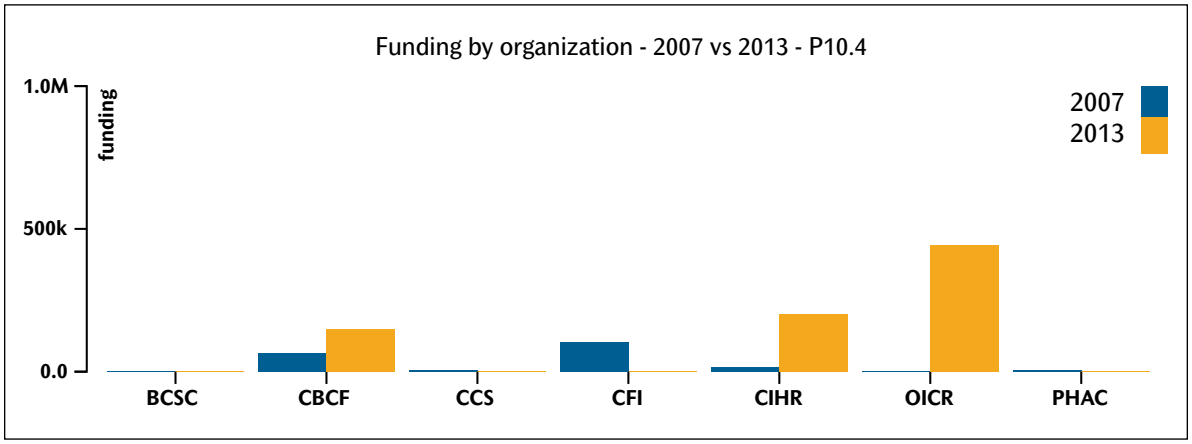
BREAKDOWN BY PROGRAM - FOCUSED ON A SPECIFIC RESEARCH AREA VS OPEN TO ALL RESEARCH AREAS (P10.3)

The majority of funding from 2007-2009 was allocated through funding programs that were not focused on a specific research area. In 2012 and 2013 the majority of funding was allocated through targeted programs.



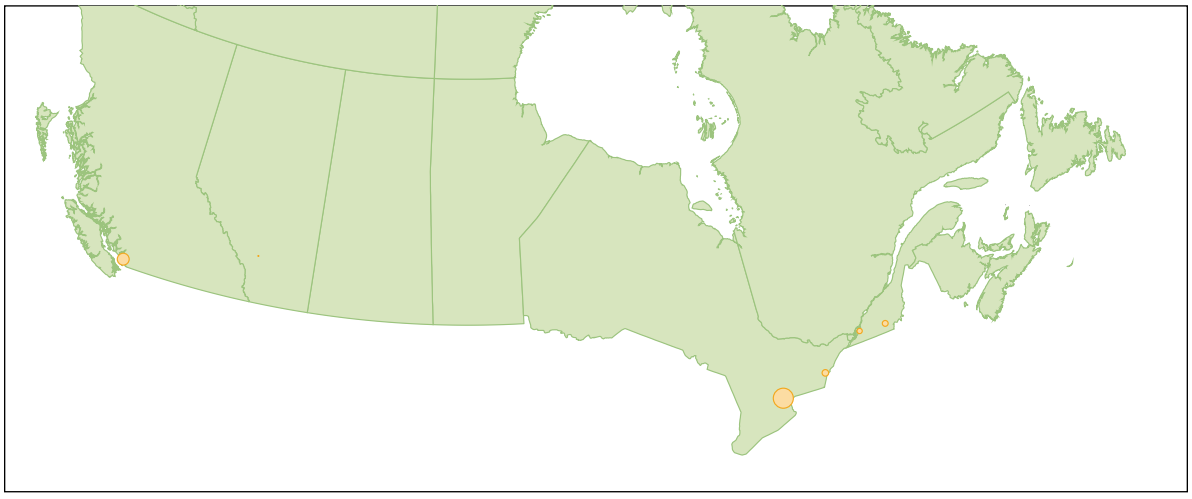
The latter included grants funded through OICR's "Transformative Pathology Program" and "Smarter Imaging Program" programs and CBCF's "National Grants Competition on Earlier Detection".

FUNDING BY ORGANIZATION - 2007 VS 2013 (P10.4)



Between 2007 and 2013, OICR, CIHR and CBCF increased its funding for this priority. Over the same period, funding was decreased by CFI.

GEOGRAPHY OF FUNDING



Funding for this priority was allocated to recipients in Toronto, Vancouver as well as a few of other cities. There were increases in funding to PIs from Toronto and Sherbrooke between 2007-2013.

Results: Priority #11 – Discovery and development of new treatments for breast cancer

DEFINITION

More specific and effective therapies are required for breast cancer patients. This research priority area will focus on the development of better treatments, particularly for some specific subtypes of breast cancer.

TYPE OF GRANTS INCLUDED

This priority includes grants which focus on:

- drug screening, design and development
- drug delivery
- other treatment types, including therapeutic vaccines, immunotherapies, nanoparticles (for treatment), photodynamic therapy, radiotherapy, radiosensitizers, radioconjugates and dietary compounds (for treatment)
- mechanism of action of treatments
- non-curative (palliative) treatments
- treatment planning/dosing
- radiation/surgical guidance/tracking
- imaging of drug/therapy delivery
- methods for assessing treatment response

NATIONAL FRAMEWORK INVESTMENT REQUIREMENTS
(from Framework report, published in 2009, based on 2007 data)

This area was defined as requiring further investment to encourage research (enable). CBCRA's Predictive Oncology initiative, to be launched in 2009, will provide $5M of funding. A portfolio of mechanisms is proposed for approximately $12M of funding over the next five years. Examples include:

- Companion studies to clinical trials ($100-500K per study);
- Special operating grants envelopes ($100-500K per project);
- RFAs in specific areas ($5-10M per year);
- Strategic funding for workshops/larger-scale meetings to bring experts from different disciplines together to propose larger-scale efforts ($1M for three to five years), retrospective studies, "ready to act" on the results of clinical trials.

Results

$74,887,992 of funding was allocated for this priority between 2007 and 2013. This represents approximately **17.0%** of overall breast cancer research funding over this period.

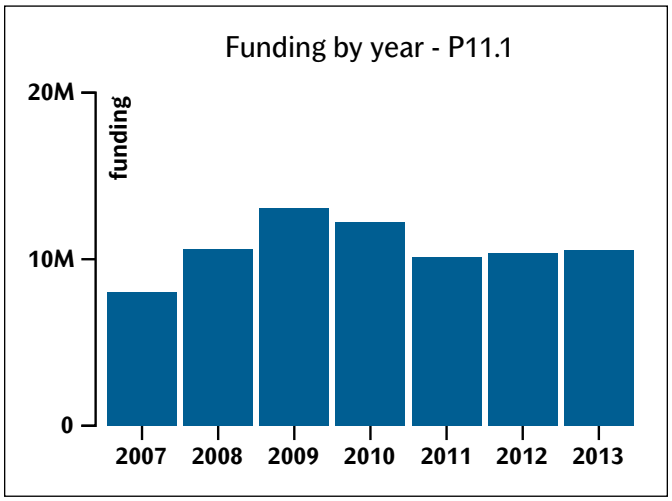
481.4 project equivalents were funded between 2007 and 2013.

385 principal investigators had at least one operating or career grant coded or partially coded to this priority between 2007 and 2013.

FUNDING BY YEAR (P11.1)

Funding for this priority increased 32% between 2007 and 2013.

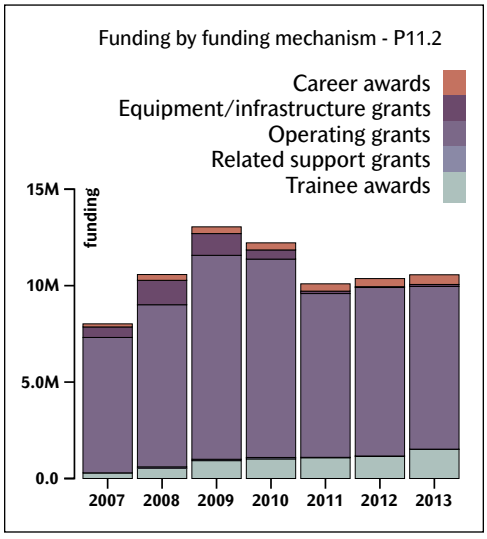
This represented a total increase of approximately $18.8M between 2008-2013 over the 2007 level.



Comparison to National Framework investment requirements

There was an increase in funding that was greater than that proposed through the National Framework.

The increase was a result of additional funding through open, operating grants and, between 2008-2010, targeted programs.



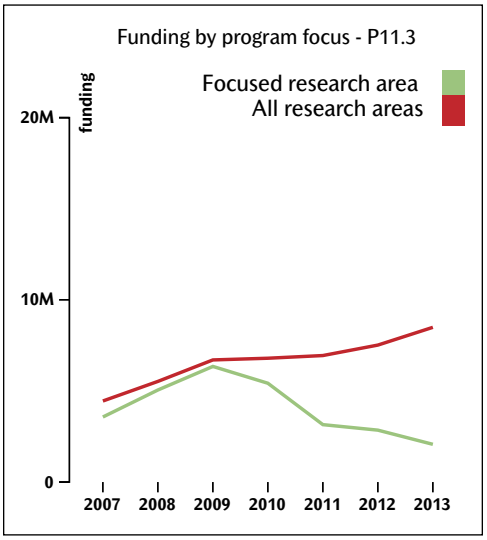
FUNDING BY FUNDING MECHANISM (P11.2)

The majority of funding in each year was allocated through operating grants. Funding for career grants peaked in 2008 and 2009, while funding for trainee grants increased from 2009.

BREAKDOWN BY PROGRAM - FOCUSED ON A SPECIFIC RESEARCH AREA VS OPEN TO ALL RESEARCH AREAS (P11.3)

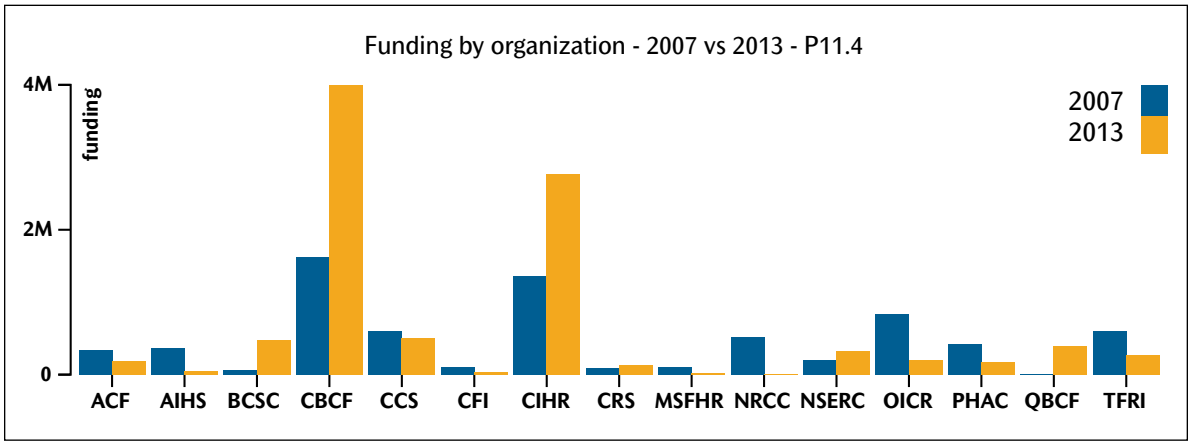
From 2007-2009, roughly equal amounts of funding were allocated through funding programs that were focused on a specific research area and those that were not. Starting in 2010, the relative proportion of grants funded through targeted programs decreased.

Focused programs included NRCC's "Genomics and Health Initiative", TFRI's "Terry Fox New Frontiers Program ", ACF's "Breast Cancer Translational Research Group", CIHR's "Collaborative Health Research Projects" and "Proof of Principle Program - Phase I", OICR's "Cancer Research Fund -



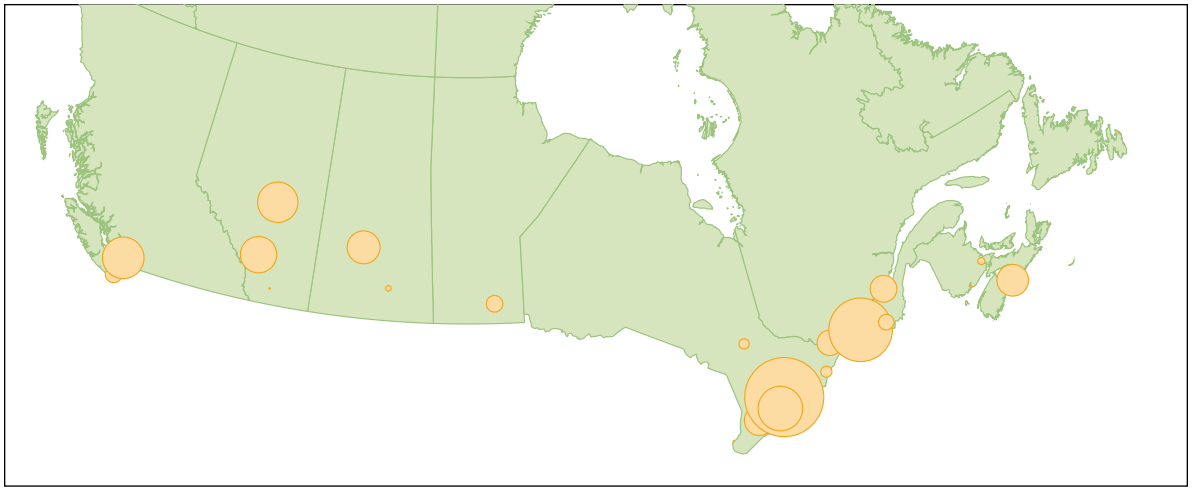
Translational Research", CBCF Atlantic Region's "Endowed Chair in Breast Cancer Research" and CBCRA's "Translation Acceleration Grant Program".

FUNDING BY ORGANIZATION - 2007 VS 2013 (P11.4)



Between 2007 and 2013, CBCF, CIHR, BCSC, QBCF and SCA, among others increased its funding for this priority. Over the same period, funding was decreased by OICR, NRCC, AIHS and TFRI.

GEOGRAPHY OF FUNDING



Funding for this priority was allocated to recipients in Toronto, Montreal, Hamilton, Vancouver and as well as a few other cities. There were increases in funding to PIs in Saskatoon, Montreal, Toronto and Halifax between 2007-2013 and smaller decreases to PIs in Calgary, Sudbury and London over the same period.

Results: Priority #12 – Clinical trials of new promising therapies

DEFINITION

Following the discovery of new promising therapies, clinical trials and related companion studies test these new agents on breast cancer patients. Clinical testing and applications of new breast cancer therapies and the assessment of side effects, toxicity and pharmacodynamics is a critical step in the implementation of these therapies.

TYPE OF GRANTS INCLUDED

This priority includes grants which focus on:

- clinical trials focused on new treatments
- clinical trials focused on treatment guidance
- clinical trials testing palliative treatments
- clinical trials testing new protocols/combinations of older treatments

NATIONAL FRAMEWORK INVESTMENT REQUIREMENTS
(from Framework report, published in 2009, based on 2007 data)

Given the significant number of large clinical trials already in place, this area needs new and increased funding to encourage (initiate and enable) the launch of companion studies. This research would focus on existing clinical trials as well as investigator-initiated operating grants. Specifically, a portfolio of mechanisms is proposed for approximately $5M over the next five years.

Examples include:

- Companion studies to clinical trials ($100-500K per study);
- Host meetings assembling clinicians and scientists to hear about pending trials and explore opportunities ($250K per year for two to three meetings);
- Investigator-led clinical trials (non-randomized), rapid trials (early stage Phase 0-Phase 2) ($150-500K per project);
- Funding for trials ($250K per trial for Phase II, several million for Phase III);
- Funding of core infrastructure (e.g., research nurses) for non-industry-sponsored trials ($500K per trial).

Results

$14,638,436 of funding was allocated for this priority between 2007 and 2013. This represents approximately **3.3%** of overall breast cancer research funding over this period.

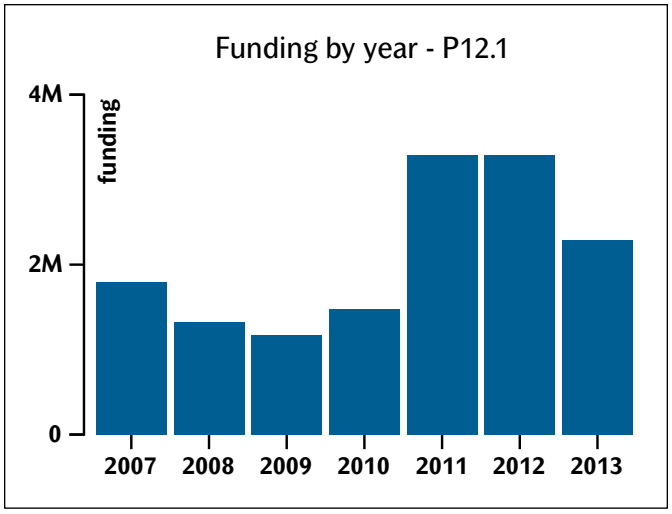
121.1 project equivalents were funded between 2007 and 2013.

109 principal investigators had at least one operating or career grant coded or partially coded to this priority between 2007 and 2013.

FUNDING BY YEAR (P12.1)

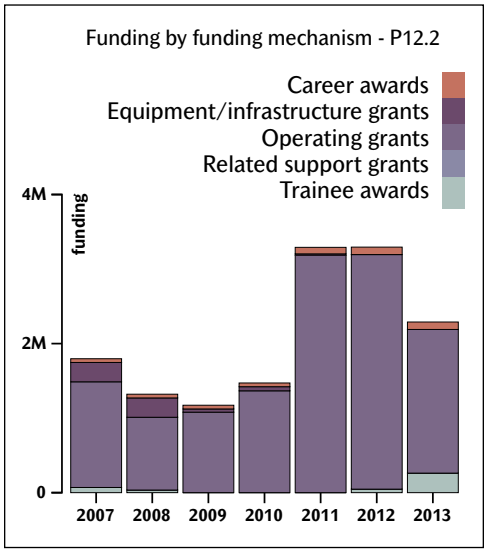
Funding for this priority increased 27% between 2007 and 2013.

This represents a total increase of approximately $2.1M between 2008-2013 over the 2007 level.



Comparison to National Framework investment requirements

There was an increase in funding, this increase was less than that proposed through the National Framework.



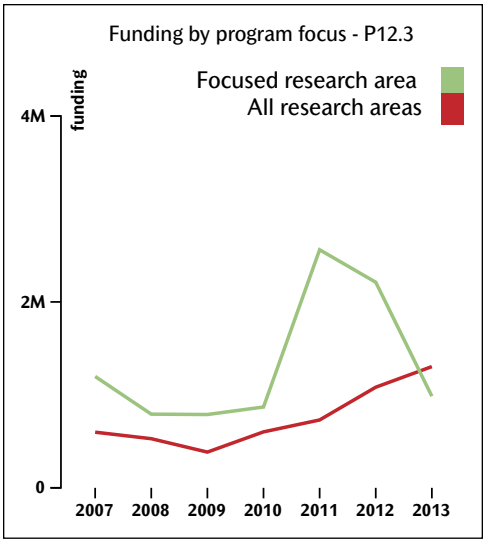
Funding for this priority was primarily for Phase I-III clinical trials testing new treatments.

FUNDING BY FUNDING MECHANISM (P12.2)

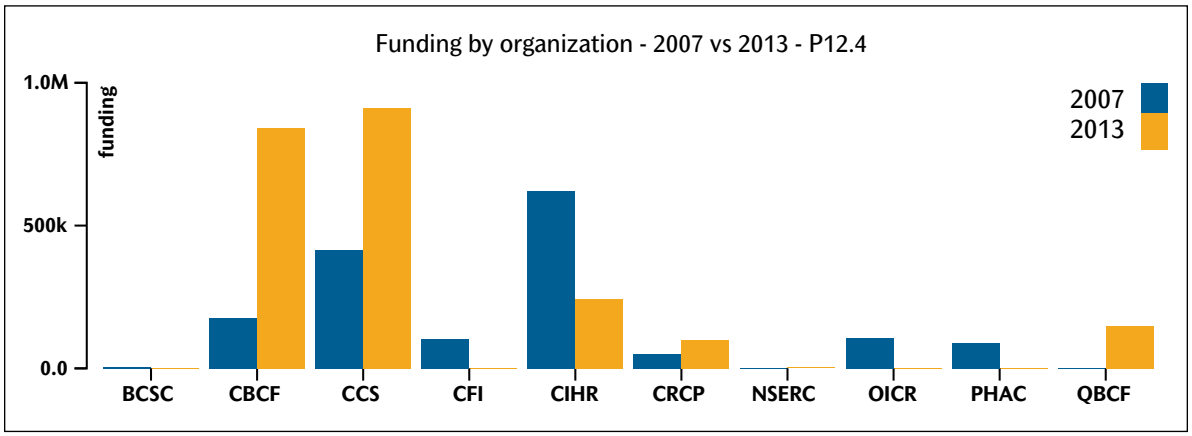
The majority of funding in each year was allocated through operating grants. Funding for equipment/ infrastructure grants was higher from 2007-2009, largely due to a single large CFI grant. Career awards increased from 2011 onwards (primarily due to a single Canada Research Chair award), and trainee grants increased slightly in 2012 and 2013.

BREAKDOWN BY PROGRAM - FOCUSED ON A SPECIFIC RESEARCH AREA VS OPEN TO ALL RESEARCH AREAS (P12.3)

In all years but 2013, the majority of funding was allocated through funding programs that were focused on a specific research area. Many clinical trials were funded through dedicated programs by CCS and CIHR.

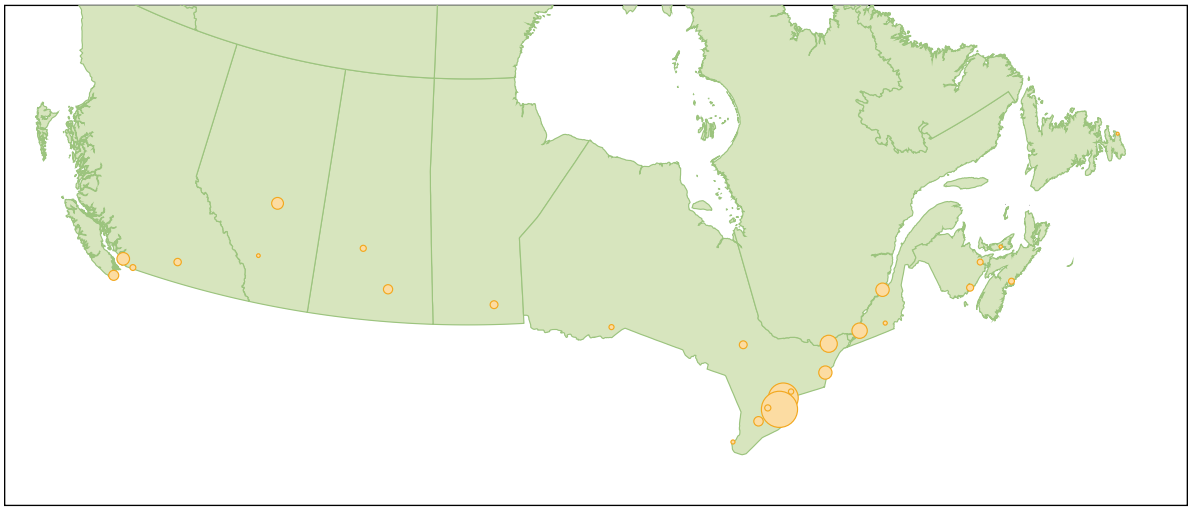


FUNDING BY ORGANIZATION - 2007 VS 2013 (P12.4)



Between 2007 and 2013, CBCF, CCS and QBCF increased its funding for this priority. Over the same period, funding was decreased by CIHR, OICR and CFI.

GEOGRAPHY OF FUNDING



Funding for this priority was allocated to recipients in Hamilton, Toronto, Ottawa Montreal, Quebec, Vancouver and as well as a number of other cities. There were increases in funding to PIs in Ottawa, Quebec City, Kingston and Victoria, plus a number of other cities between 2007-2013, and decreases to recipients in Hamilton, Toronto and Montreal over the same period.

Results: Priority #13 – Psychosocial and survivorship interventions

DEFINITION

Research in cancer survivorship covers the range of research domains from basic biomedical (e.g., to understand the underlying mechanisms leading to late effects of treatment modalities); clinical (e.g., to test interventions to ameliorate late effects; health service interventions to improve the quality of survivorship care; randomized trials to improve the evidentiary basis for elements of follow-up care during survivorship); and population studies (e.g., to understand the impact of public health interventions to improve lifestyle factors on the outcomes for cancer survivors).

Research in quality of life could lead to the development of new interventions for improving the quality of life of breast cancer patients across the course of the disease, and promoting psychological adjustment to the diagnosis of breast cancer and to treatment effects.

TYPE OF GRANTS INCLUDED

This priority includes grants which focus on:

- psychological interventions
- support interventions
- physical activity interventions
- interventions to prevent or treat side effects of breast cancer treatments
- prediction of response to survivorship interventions

NATIONAL FRAMEWORK INVESTMENT REQUIREMENTS
(from Framework report, published in 2009, based on 2007 data)

This area was identified as needing more investment to encourage research (enable). Currently underway is the CBCRA/CBCF Special Research Competition on Psychosocial Aspects of Breast Cancer for $2.4M (2009-2014). In addition, CPAC, CCS and CIHR are planning other initiatives targeting this area. A range of research options is proposed such as pilot grants, career awards, program project grants, team grants and operating grants.

A collective funding envelope of $18M is suggested to devote to all research defined in this category of cancer control, survivorship and outcomes research.

Results

$15,398,868 of funding was allocated for this priority between 2007 and 2013. This represents approximately **3.5%** of overall breast cancer research funding over this period.

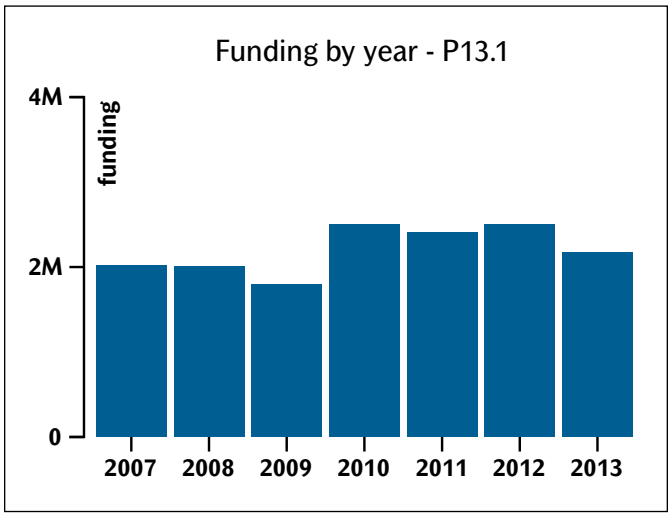
88.6 project equivalents were funded between 2007 and 2013.

68 principal investigators had at least one operating or career grant coded or partially coded to this priority between 2007 and 2013.

FUNDING BY YEAR (P13.1)

Funding for this priority increased 8% between 2007 and 2013.

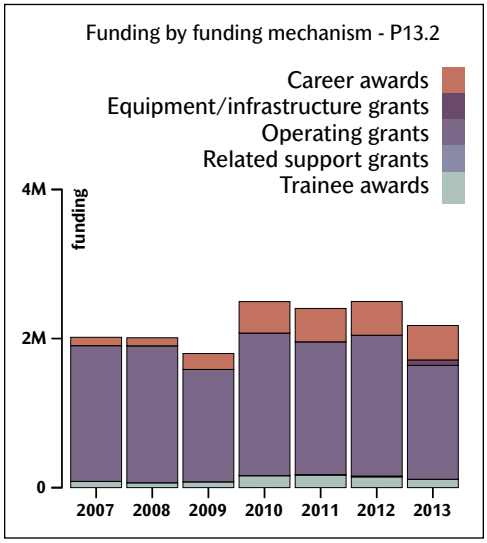
This represents a total increase of approximately $1.3M between 2008-2013 over the 2007 level.



Comparison to National Framework investment requirements

There was an increase in funding for this Priority. The Framework recommended an overall increase of $18M to be devoted to research focusing on cancer control, survivorship and outcomes and noted that Priorities 13 through 16 were relevant to these areas of research. The total increase in funding for Priorities 13 through 16 was approximately $6.3M, less than the $18M recommended.

Grants focusing on this priority were funded primarily through open operating grants and targeted initiatives.



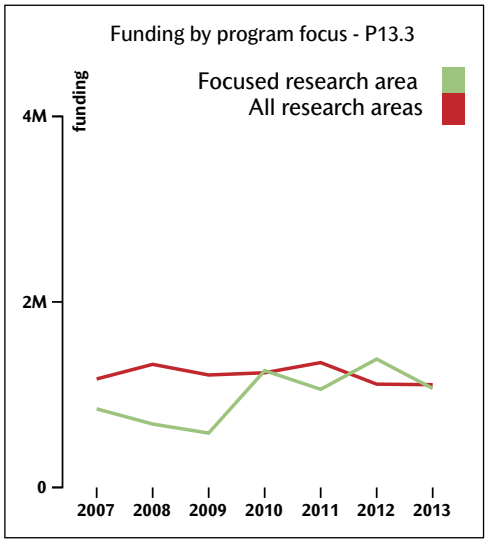
FUNDING BY FUNDING MECHANISM (P13.2)

The majority of funding in each year was allocated through operating grants.

Funding for career grants was higher from 2009-2013, largely due to career awards from CBCF, AIHS and CIHR.

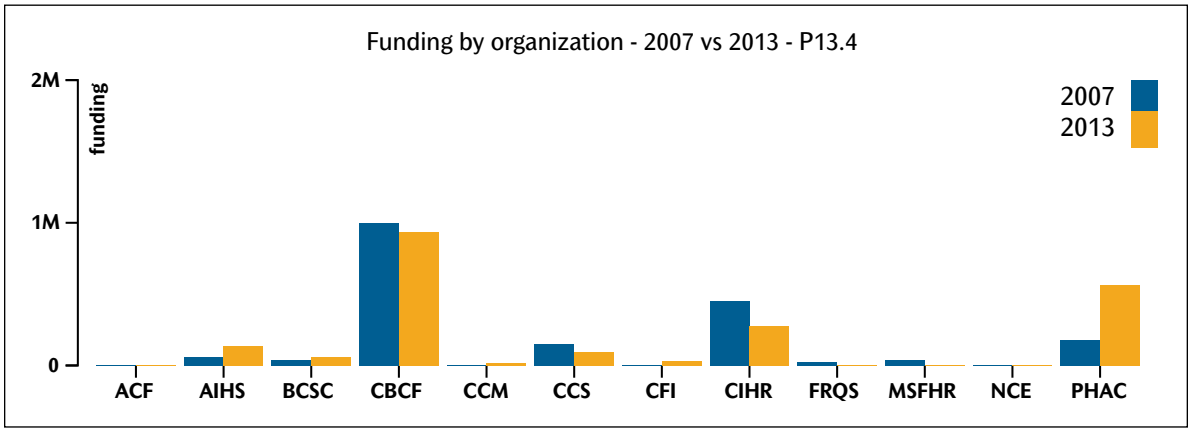
BREAKDOWN BY PROGRAM - FOCUSED ON A SPECIFIC RESEARCH AREA VS OPEN TO ALL RESEARCH AREAS (P13.3)

From 2007-2013, roughly equal amounts of funding were allocated through funding programs that were focused on a specific research area and those that were not, though the former increased slightly in later years.



Focused programs included CBCRA's "Quality-of-Life/Survivorship Research Grant" and "Psychosocial Aspects of Breast Cancer" programs, CBCF Ontario Region's "Endowed Chair in Breast Cancer Research" a CIHR "Team Grant: Physical Activity, Mobility and Health" and a career award from AIHS.

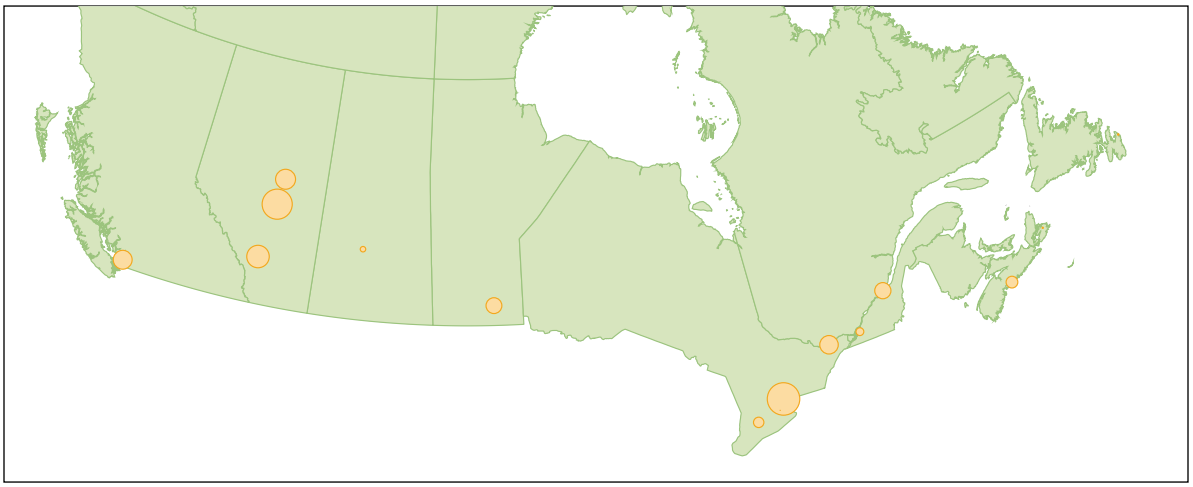
FUNDING BY ORGANIZATION - 2007 VS 2013 (P13.4)



Between 2007 and 2013, PHAC (through programs administered by CIHR, AIHS, CFI and BCSC) increased its funding for this priority.

It is notable that CBCF, for example, funded similar amounts in 2007 and 2013. However, in 2007 this was partially done through CBCRA, while in 2013 funding was allocated solely through its own programs.

GEOGRAPHY OF FUNDING



Funding for this priority was allocated to recipients in Toronto, Edmonton, Calgary and Athabasca as well as a number of other cities. There were increases in funding to PIs in a Edmonton, Athabasca, Vancouver and Toronto between 2007-2013 and a decrease in funding to PIs in Calgary, Quebec City, Ottawa and a few other cities over the same period.

Results: Priority #14 – Analysis of the financial and health-care delivery issues facing breast cancer patients across the cancer continuum

DEFINITION

This area of research examines quality of care, access to care (including timeliness and equity), and factors associated with variations in quality and access. Studies examine the health system requirements to provide optimum quality of care throughout the cancer continuum (from health system requirements to improved screening, reduced wait times for diagnosis, and improved end-of-life care). This research also studies patients' preferences and needs through the cancer continuum.

In addition, individuals affected by breast cancer and their family/caregivers face economic challenges. Research in this area could focus on the financial implications of a breast cancer diagnosis; it could include an evaluation of the long-term economic and employment implications for breast cancer patients and their families. The results of this research could have an important impact on the development of new health services and care delivery policies.

TYPE OF GRANTS INCLUDED

This priority includes grants which focus on:

- financial impacts of breast cancer on survivors and families
- health care access and quality
- new health care delivery methods for improving care
- effectiveness of health care delivery methods
- communication with health care practitioners
- cost-effectiveness analyses of specific interventions
- attitudes/perceptions of health care workers

NATIONAL FRAMEWORK INVESTMENT REQUIREMENTS
(from Framework report, published in 2009, based on 2007 data)

Although resources exist for research on all cancers in this area, no studies specifically for breast cancer are underway. Therefore, more funding to encourage research is recommended (enable). The preferred funding mechanism is operating grants.

A collective funding envelope of $18M is proposed to devote to all work defined in this category of cancer control, survivorship and outcomes research.

Results

$10,677,507 of funding was allocated for this priority between 2007 and 2013. This represents approximately **2.4%** of overall breast cancer research funding over this period.

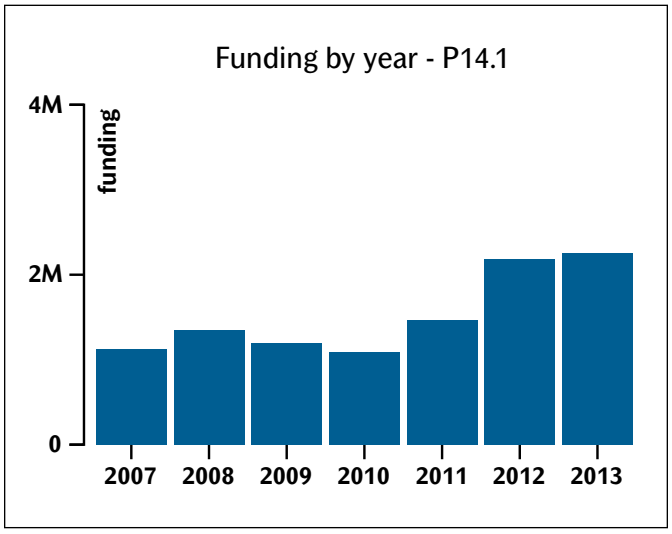
94.3 project equivalents were funded between 2007 and 2013.

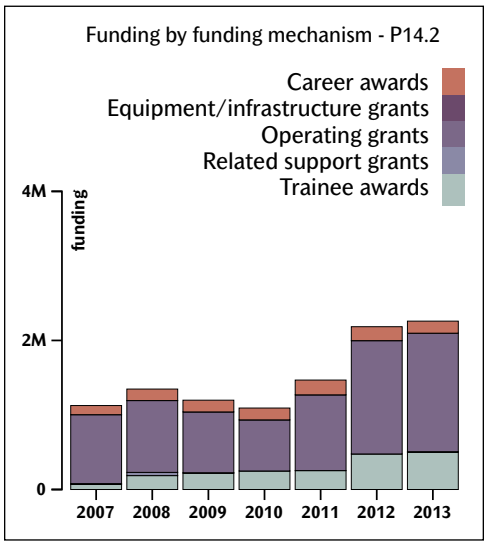
85 principal investigators had at least one operating or career grant coded or partially coded to this priority between 2007 and 2013.

FUNDING BY YEAR (P14.1)

Funding for this priority increased 101% between 2007 and 2013.

This represents a total increase of approximately $2.8M between 2008-2013 over the 2007 level.





Comparison to National Framework investment requirements

There was an increase in funding for this Priority. The Framework recommended an overall increase of $18M to be devoted to research focusing on cancer control, survivorship and outcomes and noted that Priorities 13 through 16 were relevant to these areas of research.

The total increase in funding for Priorities 13 through 16 was approximately $6.3M, less than the $18M recommended.

As recommended, the majority of funding for this priority was allocated through operating grants.

FUNDING BY FUNDING MECHANISM (P14.2)

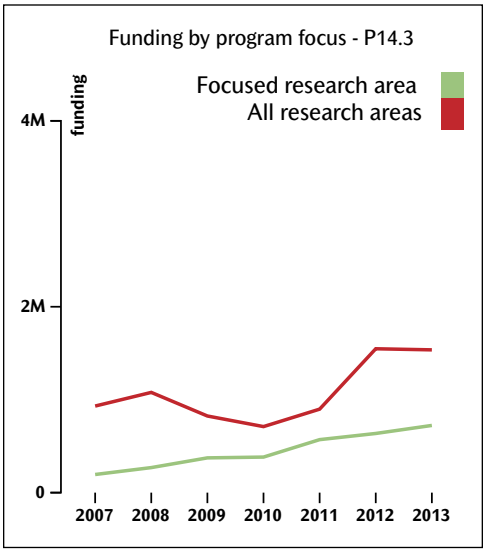
The majority of funding in each year was allocated through operating grants.

Funding for trainee grants generally increased over the time frame of the study.

BREAKDOWN BY PROGRAM - FOCUSED ON A SPECIFIC RESEARCH AREA VS OPEN TO ALL RESEARCH AREAS (P14.3)

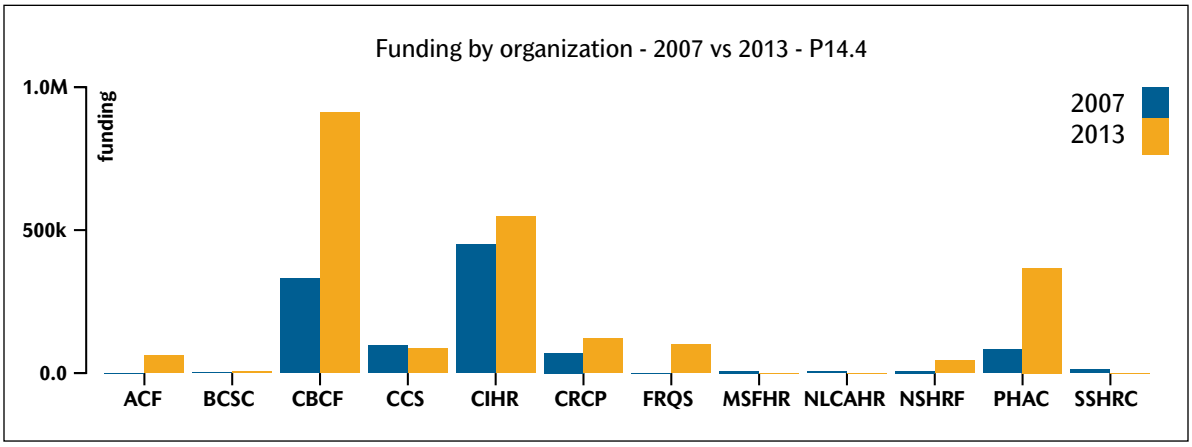
From 2007-2013, the majority of funding was allocated through funding programs that did not focus on a specific research area.

Focused programs included CBCF Ontario Region's "Community Health Promotion Grant Program"



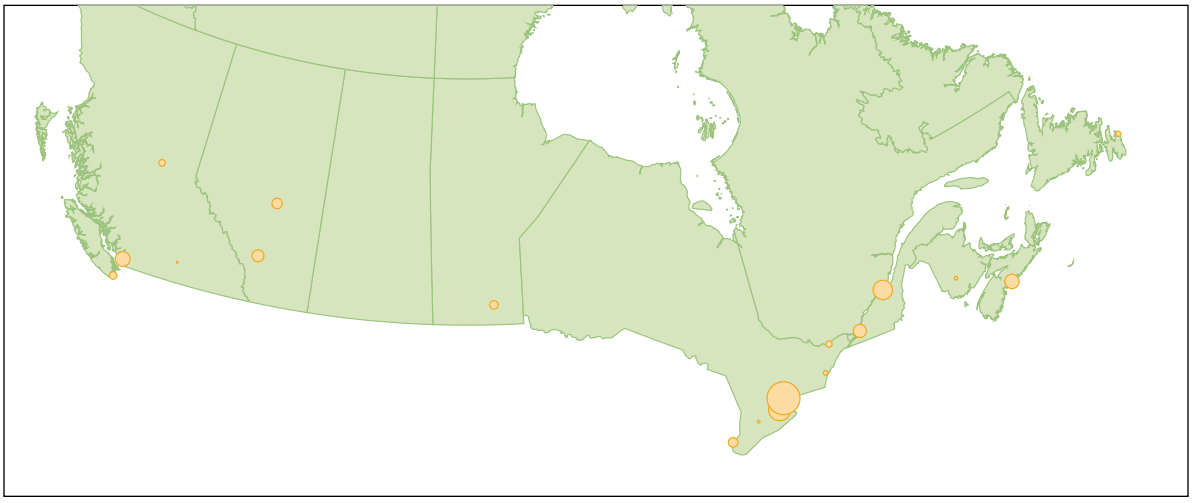
and “Community Based Research (CBR) Implementation Program”, CIHR’s “Team Grant: Community-Based Primary Healthcare” and “Operating Grant: Health Services for Genetic Diseases” programs, a fellowship through its “Priority Announcement: Evidence Informed Healthcare Renewal” program as well as an operating grant allocated through CIHR’s Institute of Health Services and Policy Research.

FUNDING BY ORGANIZATION - 2007 VS 2013 (P14.4)



Between 2007 and 2013, funding for this priority was increased through grants from CBCF, PHAC (administered through CBCRA and CIHR), FRQS and CIHR.

GEOGRAPHY OF FUNDING



Funding for this priority was allocated to recipients in Toronto, Hamilton, Quebec, Vancouver and Halifax as well as a number of other cities. There were increases in funding to PIs in a Toronto, Vancouver and Edmonton between 2007-2013.

Results: Priority #15 – Interventions to improve knowledge translation and disseminate best practices in breast cancer across the cancer continuum

DEFINITION

New initiatives in this area will aim to improve the application of research findings into policy and practice and identify which KT interventions are most effective for breast cancer. An understanding of the barriers to and supports for the successful application of research results to breast cancer is needed. Research will also identify the most effective strategies to implement best practices in breast cancer care. This could include the development of new communication approaches, tools and methods to facilitate, for example, communicating therapeutic options to patients. This research could also have an important impact on breast cancer patients through significant improvement in the translation of research findings into new policies.

TYPE OF GRANTS INCLUDED

This priority includes grants which focus on:

- knowledge translation research
- development and evaluation of new tools for evidence-based health communication
- assessment of information needs

NATIONAL FRAMEWORK INVESTMENT REQUIREMENTS
(from Framework report, published in 2009, based on 2007 data)

This area was identified as needing more investment to encourage research (enable). Currently underway is the CBCRA/ CBCF Special Research Competition on Psychosocial Aspects of Breast Cancer for $2.4M (2009-2014). In addition, CPAC, CCS and CIHR are planning other initiatives targeting this area. Grants for multidisciplinary teams including policy-makers and other stakeholders are the preferred funding mechanism.

A collective funding envelope of $18M is suggested to devote to all research defined in this category of cancer control, survivorship and outcomes research.

Results

$4,354,225 of funding was allocated for this priority between 2007 and 2013. This represents approximately **1.0%** of overall breast cancer research funding over this period.

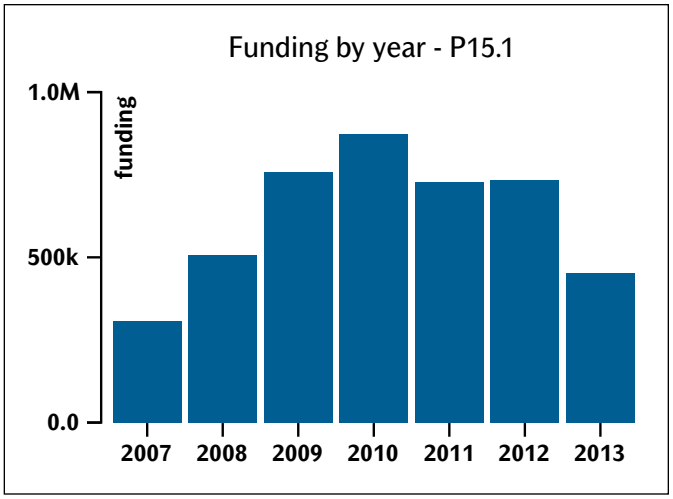
34.3 project equivalents were funded between 2007 and 2013.

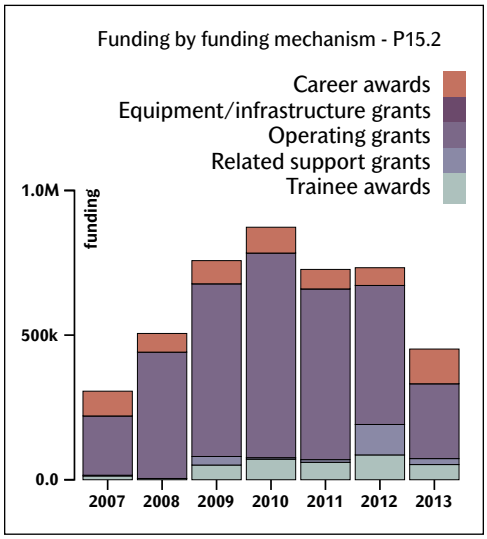
31 principal investigators had at least one operating or career grant coded or partially coded to this priority between 2007 and 2013.

FUNDING BY YEAR (P15.1)

Funding for this priority increased 48% between 2007 and 2013.

This represents a total increase of approximately $2.2M between 2008-2013 over the 2007 level.





Comparison to National Framework investment requirements

There was an increase in funding for this Priority. The Framework recommended an overall increase of $18M to be devoted to research focusing on cancer control, survivorship and outcomes and noted that Priorities 13 through 16 were relevant to these areas of research. The total increase in funding for Priorities 13 through 16 was approximately $6.3M, less than the $18M recommended.

One grant was funded through the CBCRA/CBCF Special Research Competition on Psychosocial Aspects of Breast Cancer and other grants were funded through targeted competitions of other organizations.

It is possible that some knowledge translation projects were not captured in the CCRA data, which contains only research projects funded by CCRA members.

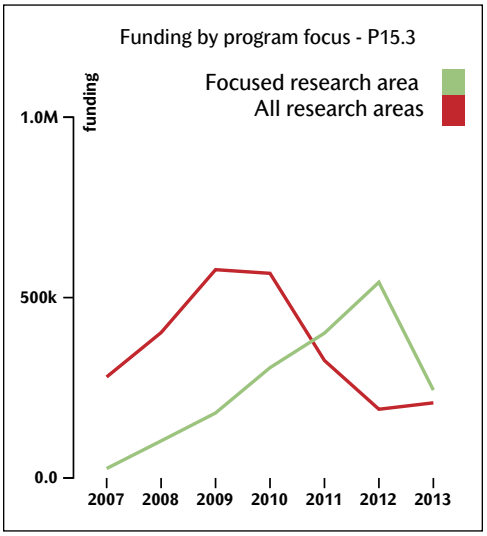
FUNDING BY FUNDING MECHANISM (P15.2)

The majority of funding in each year was allocated through operating grants.

Additional investments were made through career awards and trainee grants.

BREAKDOWN BY PROGRAM - FOCUSED ON A SPECIFIC RESEARCH AREA VS OPEN TO ALL RESEARCH AREAS (P15.3)

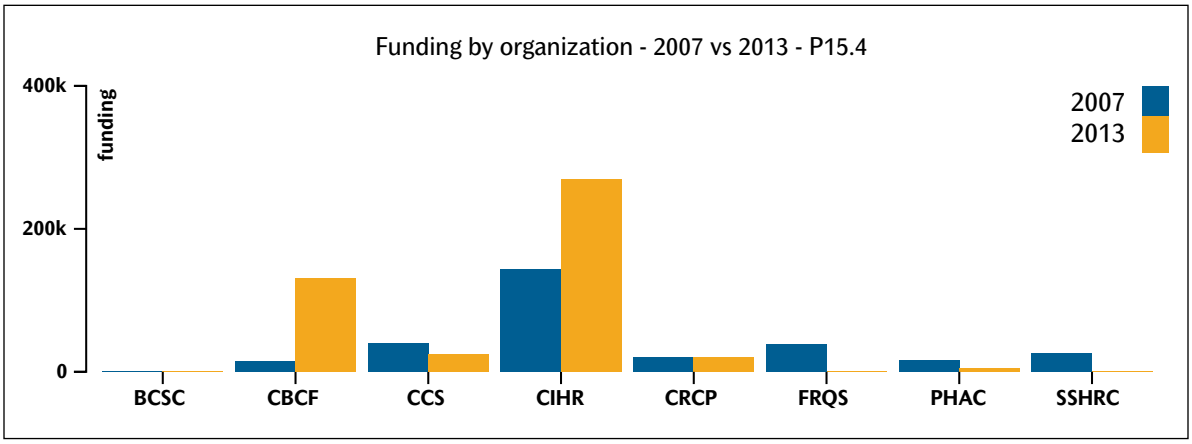
From 2007-2010, the majority of funding was allocated through funding programs that did not focus on a specific research area. However, from



2011-2013, the majority of funding was allocated through programs focused on a particular research area.

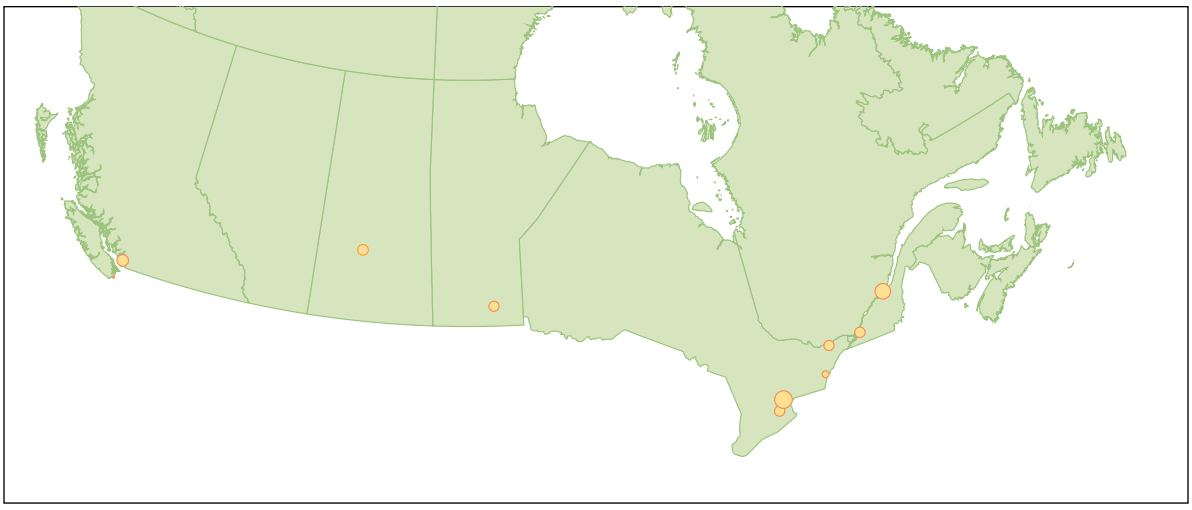
Focused programs included OICR/CCO's "KT-Net", CBCRA's "Psychosocial Aspects of Breast Cancer", CIHR's "Knowledge to Action Operating grants" and operating grants through the "Priority Announcement: Knowledge Translation" and "Meetings, Planning and Dissemination Grant: Knowledge Translation Supplement".

FUNDING BY ORGANIZATION - 2007 VS 2013 (P15.4)



Between 2007 and 2013, funding for this priority was increased through grants from CIHR and CBCF. Over the same period, funding for this priority by FRQS and SSHRC decreased.

GEOGRAPHY OF FUNDING



Funding for this priority was allocated to recipients in Toronto, Quebec City and as well as a number of other cities. There were small increases in funding to PIs in a Winnipeg, Toronto, and Quebec between 2007-2013 and a small decrease in funding to PIs in Ottawa and Montreal over the same period.

Results: Priority #16 – Developing mechanisms to link clinical trial data with administrative health databases for studies on long-term outcomes and late effects

DEFINITION

Linking data collected during clinical trials with administrative health databases enables long-term studies on survivorship and quality of life issues related to breast cancer treatment. This form of linkage is potentially powerful because data from clinical trials (where patients have been randomly assigned to treatments and where the precise treatment regimens are known) may be linked with administrative health databases providing information about long-term outcomes. For example, a clinical trial conducted in 1990, if linked with administrative health databases running to 2005, could provide 15-year, patient-specific information on outcomes compared to population controls. Research in this area will provide critical information for the development of future therapeutic strategies and better understanding of late effects of treatments.

TYPE OF GRANTS INCLUDED

This priority includes grants which focus on:

- Research into mechanisms to link clinical trial data with administrative databases

NATIONAL FRAMEWORK INVESTMENT REQUIREMENTS
(from Framework report, published in 2009, based on 2007 data)

Although resources exist in this area on all cancers, none is specific to breast cancer. Therefore, this area was defined as needing research funding to encourage breast cancer studies (enable). The preferred support mechanisms are operating grants combined with contract funding to support the development of position papers related to, for example, privacy and logistical issues.

A collective funding envelope of $18M is suggested, directed to all research in this category of cancer control, survivorship and outcomes research.

Results

$0 of funding was allocated for this priority between 2007 and 2013. This represents approximately **0.0%** of overall breast cancer research funding over this period.

0 project equivalents were funded between 2007 and 2013.

0 principal investigators had at least one operating or career grant coded or partially coded to this priority between 2007 and 2013.

FUNDING BY YEAR

No projects could be identified in the CCRA database for this priority.

Comparison to National Framework investment requirements

There was no funding for this priority.

Results: Priority #17 – Developing new animal and cellular models to study response to therapeutics and mimic human breast cancer development

DEFINITION

New animal and cellular models are required to study specific subtypes of breast cancer and their response to treatment as well as breast cancer development and invasion.

TYPE OF GRANTS INCLUDED

This priority includes grants which focus on:

- Development of new animal models for understanding cancer development
- Development of new animal models for testing therapies
- Development of new in vitro models

NATIONAL FRAMEWORK INVESTMENT REQUIREMENTS
(from Framework report, published in 2009, based on 2007 data)

This area was recognized as needing new and additional funding to encourage research (initiate and enable) through programs such as the creation of a breast cancer model network/consortium (similar to the mouse model consortium in the U.S.), an RFA on model systems for breast cancer, and seed funding for research on other animal models. In addition, IDEA or catalyst grants could support further research on the integration of several animal model systems and humans.

In recognition of the expense associated with mouse modelling a proposed $7.5M would be required over a five-year period (approximately $1.5M per team per year). If single investigator operating grants were awarded they would need to be larger than those currently available: approximately $250K per year per grant. Suggested seed funding is approximately $200K per project.

Results

$3,253,799 of funding was allocated for this priority between 2007 and 2013. This represents approximately **0.7%** of overall breast cancer research funding over this period.

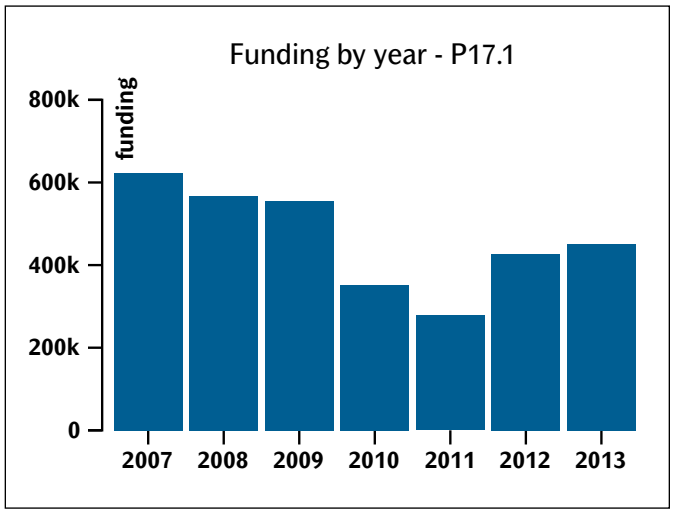
10.25 project equivalents were funded between 2007 and 2013.

18 principal investigators had at least one operating or career grant coded or partially coded to this priority between 2007 and 2013.

FUNDING BY YEAR (P17.1)

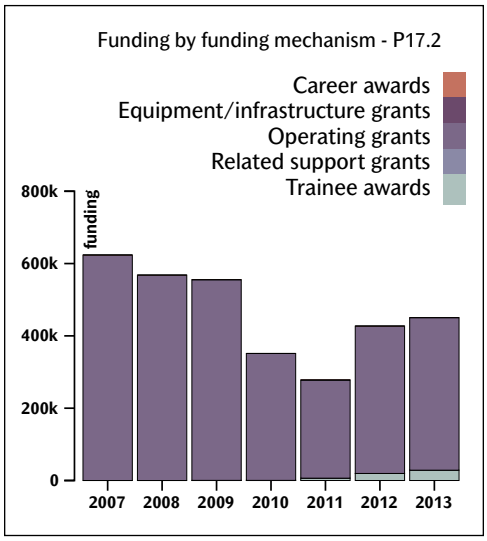
Funding for this priority decreased 28% between 2007 and 2013.

This represents a total decrease of approximately $1.1M between 2008-2013 over the 2007 level.



Comparison to National Framework investment requirements

There was an decrease in funding, which was less than the amount proposed by the Framework. However, it should be noted that projects that involved model systems were usually coded to the appropriate biology or treatment-related priority instead.

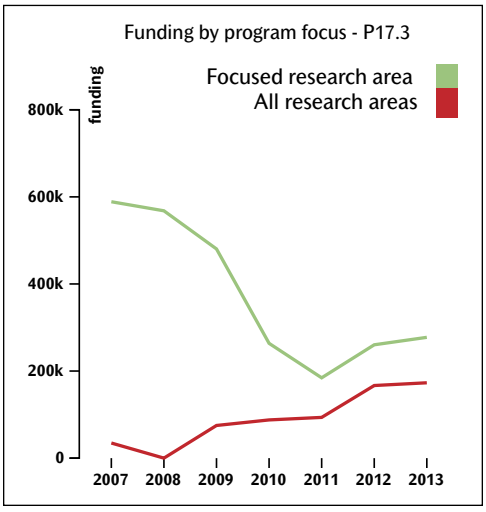


FUNDING BY FUNDING MECHANISM (P17.2)

The majority of funding in each year was allocated through operating grants.

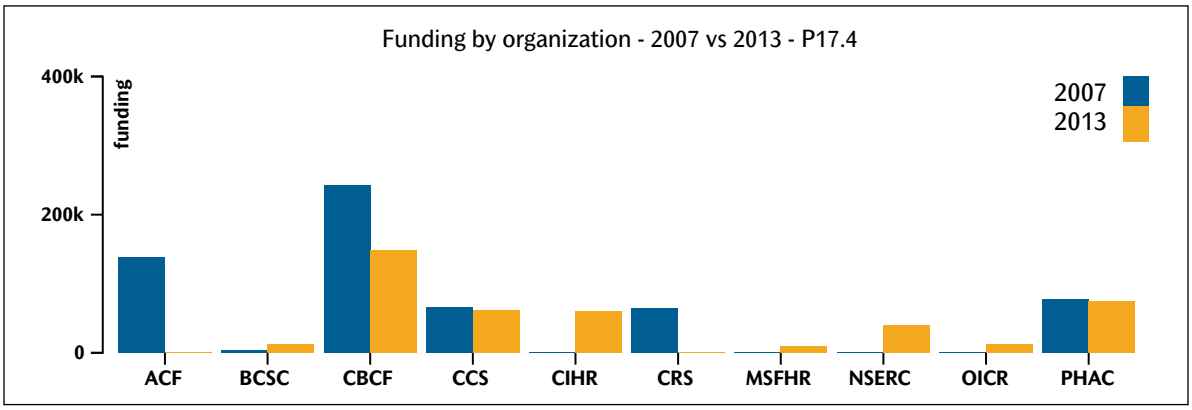
BREAKDOWN BY PROGRAM - FOCUSED ON A SPECIFIC RESEARCH AREA VS OPEN TO ALL RESEARCH AREAS (P17.3)

The majority of funding for this priority was allocated through competitions specifically focused on a particular area of research.



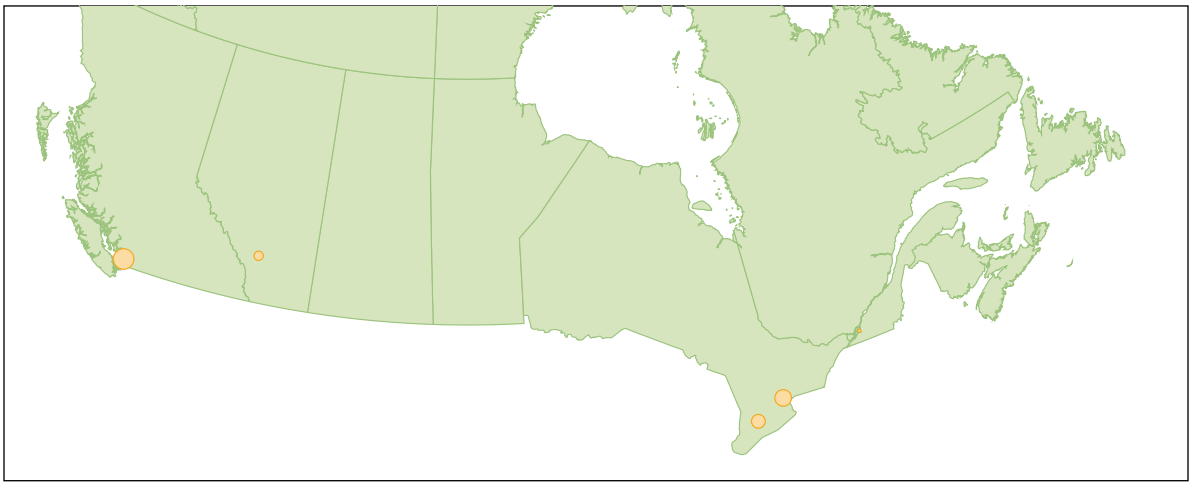
This included CBCRA's "New Approaches to Metastatic Disease (METS) Grant" and "Predictive Oncology" competitions, CIHR's "Collaborative Health Research Projects (CHRP)" and OICR's "Cancer Research Fund - Translational Research".

FUNDING BY ORGANIZATION - 2007 VS 2013 (P17.4)



Between 2007 and 2013, funding for this priority was increased slightly for a number of funders, including CIHR, NSERC and OICR. Funding by ACF, CBCF and CRS was decreased over the same period.

GEOGRAPHY OF FUNDING



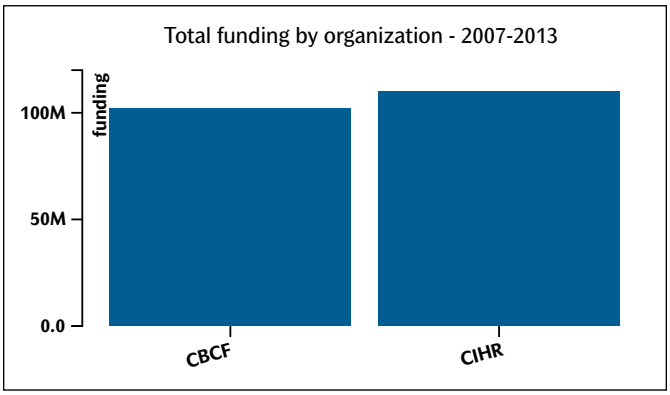
Funding for this priority was allocated to recipients in Vancouver, Toronto and London and a few other cities. There were small increases in funding to PIs in a Toronto and Vancouver between 2007-2013 and a small decrease in funding to PIs in London, Calgary and Montreal over the same period.

7 Topics of Interest

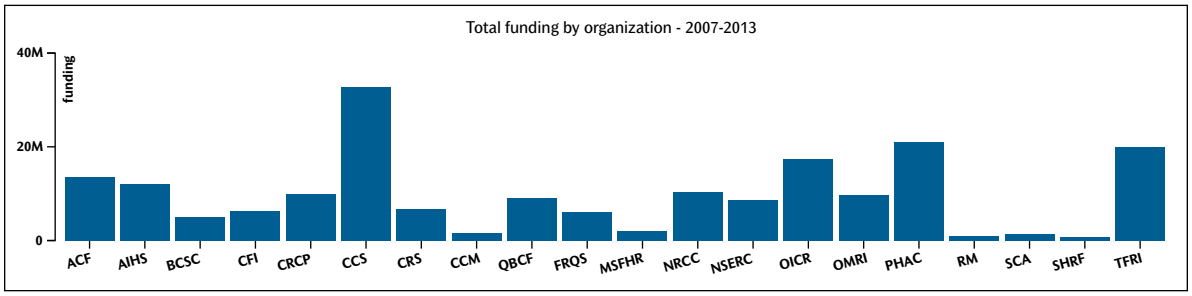
Breast cancer research funding by organization

FUNDING 2007-2013

Breast cancer research is funded by a number of organizations in Canada. Between 2007 and 2013, the largest funders were CIHR and CBCF.



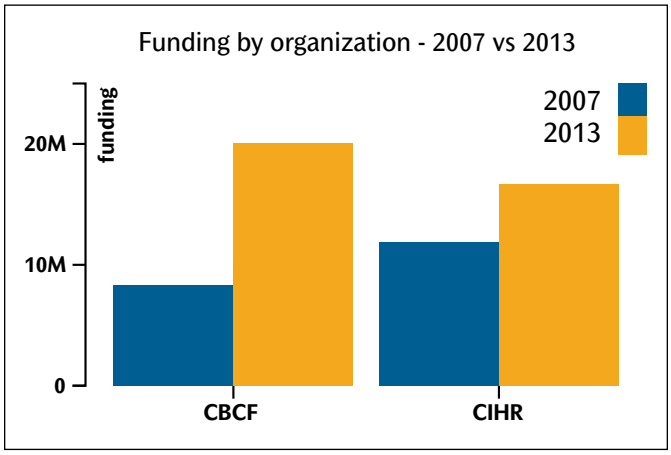
The next largest funder was CCS, followed a range of governmental and voluntary sector funders (the next 20 top funders are shown below).



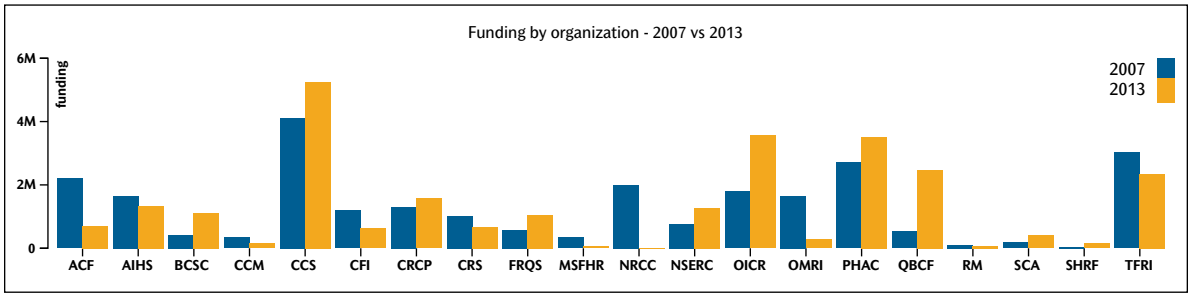
FUNDING 2007 VS 2013

As shown previously, breast cancer research funding increase substantially from 2007 to 2013.

The two largest funders showed substantial increases in funding over the same period.



Indeed, many of the other funders showed an increase in breast cancer research funding between 2007 and 2013 as well (the next 20 top funders are shown below).

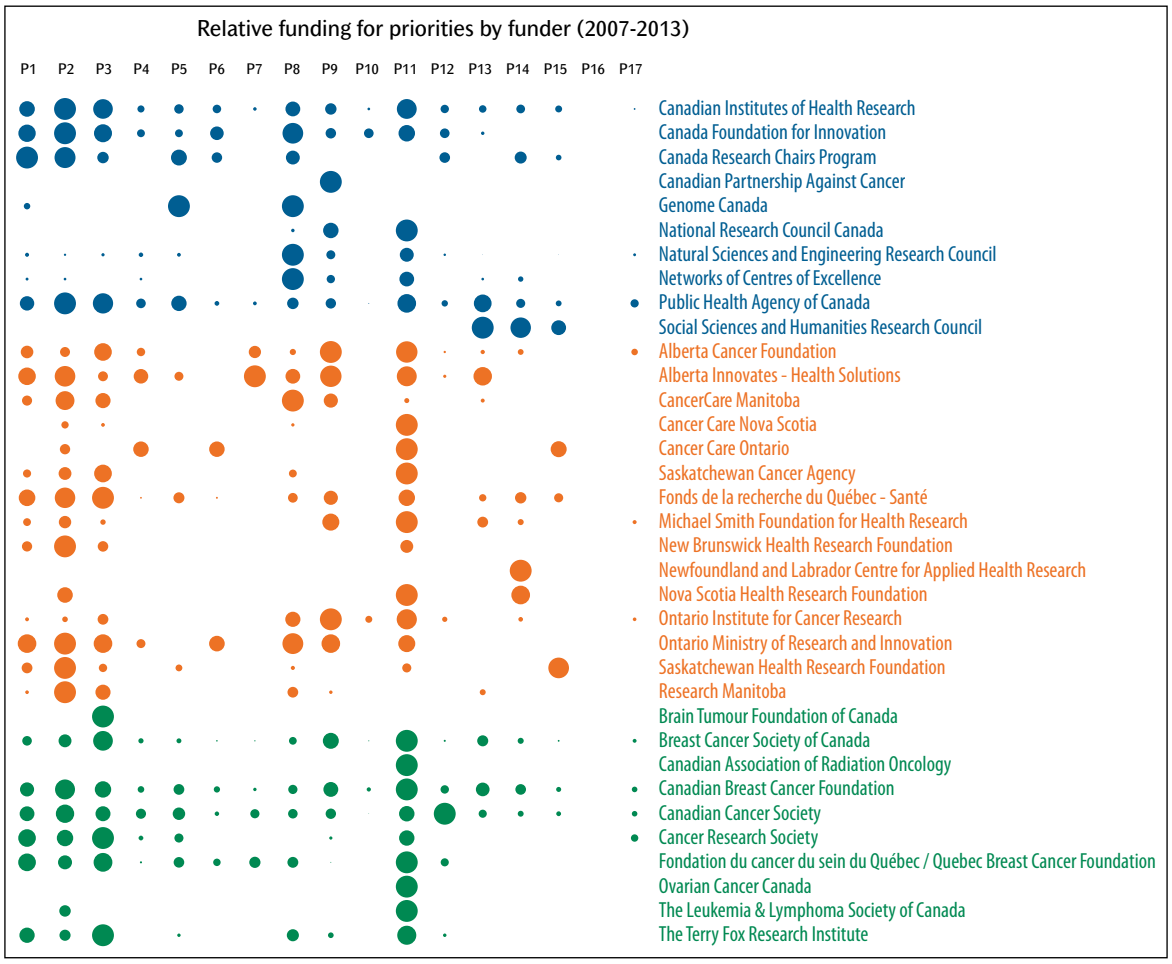


Priority funding by funder

RELATIVE LEVELS OF FUNDING

To gain insight into the funding portfolios of different organizations, we examined the relative funding for priorities for 35 organizations. In the figure below, funding is proportional to the area of each circle. In this case, each circle has been normalized to the total funding for each organization (ie. normalized across rows).

Organizations are grouped by type, federal government organizations are shown in blue, provincial government organizations shown in orange and voluntary sector organizations shown in green.

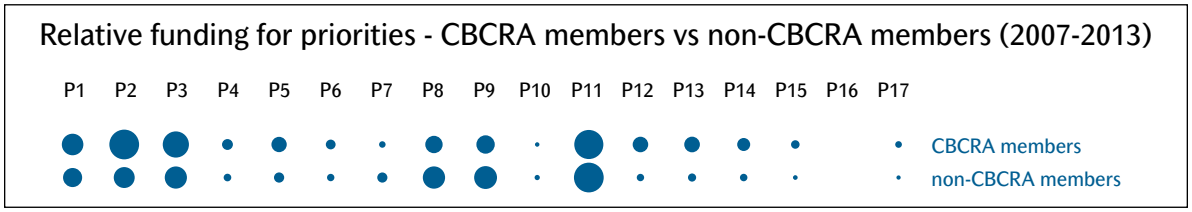


While many organization have similar funding distributions to the two largest funders, CIHR and CBCF, many do not. For example, Genome Canada primarily funds research focused on P5 - The genetics and hormonal causes of breast cancer and P8 - Better approaches to early detection and diagnosis. The Social Sciences and Humanities Research Council primarily funds research focused on P13 - Psychosocial and survivorship interventions, P14 - Analysis of the financial and health-care delivery issues facing breast cancer patients across the cancer continuum and P15 - Interventions to improve knowledge translation and disseminate best practices in breast cancer across the cancer continuum.

Other organizations showed distinct areas of focus. For example, OICR allocated funding mainly for P8 - Better approaches to early detection and diagnosis, P9 - Development and evaluation of new biomarkers (including biomarkers for diagnosis) and the optimization of treatments for individual patients and P11 - Discovery and development of new treatments for breast cancer, while the Canadian Cancer Society had a distinct focus on P12 - Clinical trials of new promising therapies.

CHANGES IN RELATIVE FUNDING FOR PRIORITIES CBCRA VS NON-CBCRA MEMBERS

Given the assumption that CBCRA member organizations had greater awareness about the National Framework than non-members we wondered whether there might be differences in funding patterns between CBCRA members and non-members.

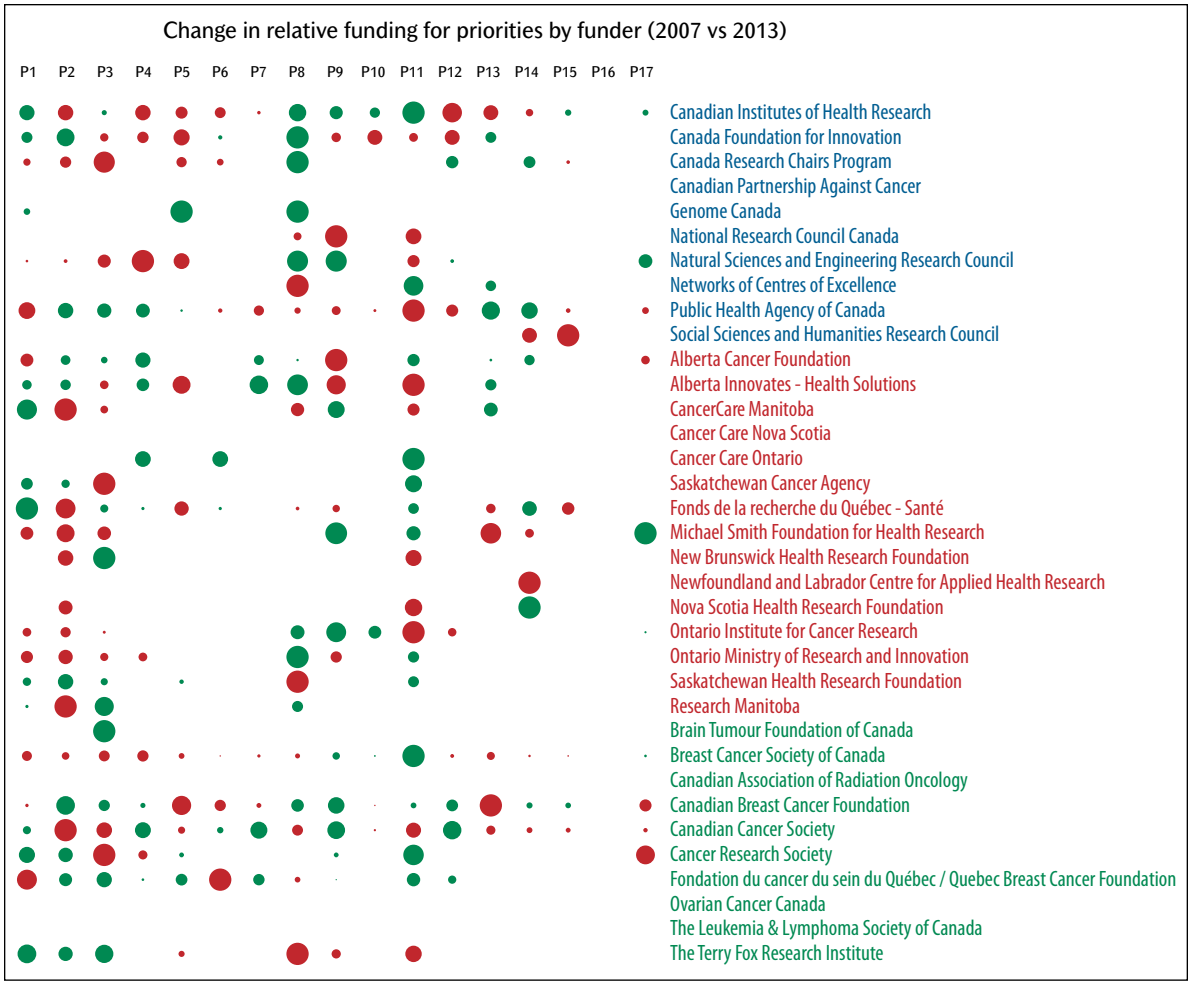


When examined as two groups in the figure above, there were only minor differences in funding pattern by former CBCRA members and friends vs non-CBCRA members. Similarly,As well, the overall proportion of funding that was allocated to priorities vs non-priorities was slightly higher for former CBCRA members and friends vs non-CBCRA organizations (data not shown).

CHANGES IN RELATIVE FUNDING FOR PRIORITIES BY FUNDER

For many organizations, the distribution of funding was not constant between 2007 and 2013.

The figure below shows the difference in 2007 vs 2013 levels of funding for each priority for 35 organizations. Changes in funding are proportional to the area of each circle - green represents an increase of funding while red represents a decrease of funding from 2007 to 2013. In this case, each circle was normalized to the total funding for each organization.



Some general trends are apparent. For example, many organizations show an increase in funding for research focusing on P8 - Better approaches to early detection and diagnosis.

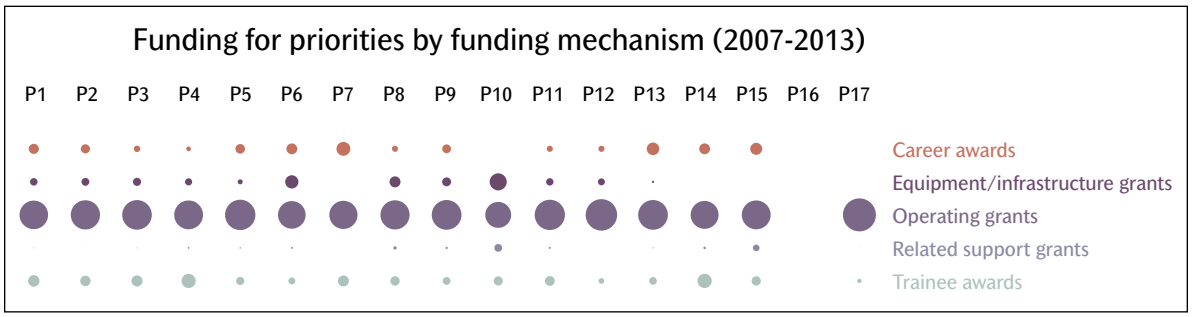
Changes may represent strategic intentions of an organization. For example, CCS show increased funding for priorities related to lifestyle risk factors, P4 - The influence of lifestyle and environmental factors on the risk of developing breast cancer and P7 - Interventions to study the influence of lifestyle and environmental factors on the risk of developing breast cancer, which represented a recent strategic focus of the organization.

Other changes, especially for organizations that primarily fund through competitions that are open to all areas of research, may not be indicative of changes in strategic direction. Instead, these but may simply be representative of the focus of research grants that happened to be funded in each period.

Funding mechanisms

As noted in the detailed section for each priority, funding was allocated through five general funding mechanisms. To get an overview across priorities, we examined the relative levels of funding by funding mechanism for each priority from 2007-2013.

In the figure below, funding is proportional to the area of each circle for each priority.



For every priority, the majority of funding was allocated through operating grants.

This was true for most individual years of funding for each priority. The only exceptions were 2008 and 2009 for P7 - Interventions to study the influence of lifestyle and environmental factors on the risk of developing breast cancer, in which the majority of funding was through career and trainee awards and from 2007-2009 for P10 - Clinical setting/clinical trials to assess clinical sensitivity and specificity of new biomarkers in which the majority of funding in each year was through equipment/infrastructure awards (primarily though a single CFI grant).

Within the broader CCRA cancer research portfolio, operating grants normally account for about half of overall funding, while equipment/infrastructure grants account for approximately one third of overall funding. In this report, the proportion of operating grants was higher and the proportion of equipment/infrastructure grants for National Framework priorities much lower.

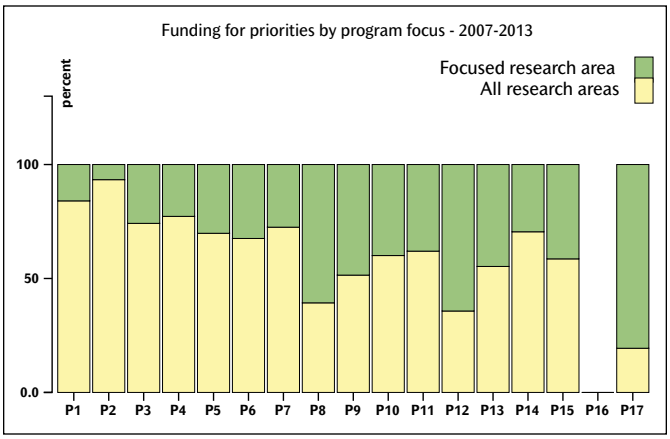
This difference may be due to the focus on breast cancer research; in this study, we examined projects which were classified as being at least 50% breast cancer. Infrastructure/equipment grants tend to be awarded for non-site specific research or research that is relevant to a wider variety of cancer sites.

Research area-specific funding programs

Research area-specific funding programs may be used to

- provide funding for grants in a particular priority area, or
- stimulate new research in an underfunded area

As noted in the detailed section for each priority, there was a large number of targeted grant programs. To get an overview across priorities, we examined the proportion of funding that was allocated through targeted programs for each priority.



As seen in the figure above, there were a considerable range in the proportion of funding through targeted programs across priorities.

PRIORITIES FOCUSED ON CANCER BIOLOGY

The first three priorities, P1 - The genetic and epigenetic basis of breast cancer development, P2 - Deciphering the molecular pathways implicated in breast cancer initiation and P3 - Understanding the cause of metastatic breast cancer and identifying new avenues for interventions, all focus on basic cancer biology. For each of these, the majority of funding was allocated through non-targeted programs. Usually, this was through open operating grant funding programs.

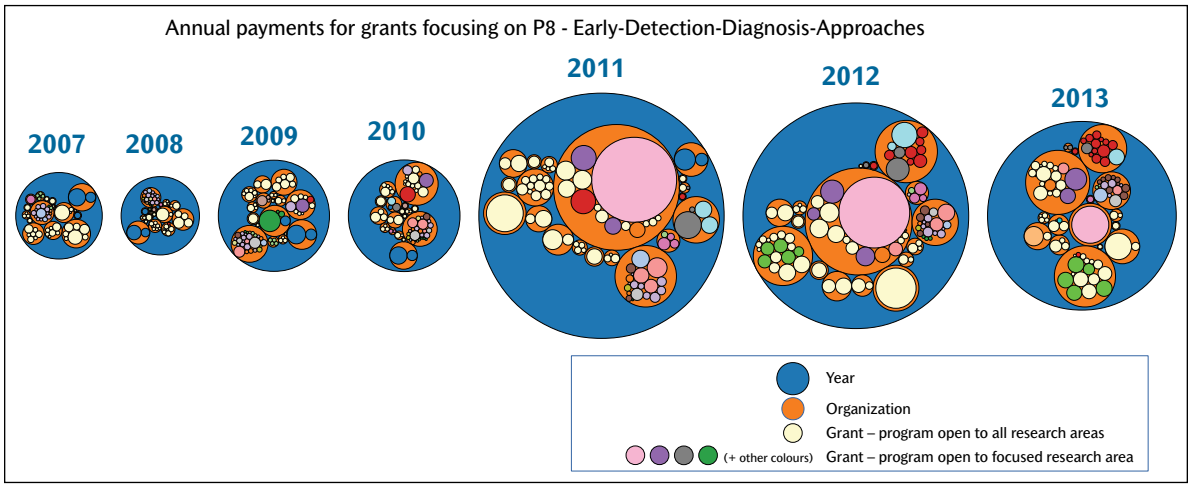
Of the priorities focused on basic biology, breast cancer metastasis was the most common focus of research area-specific programs.

PRIORITIES FOCUSED ON BREAST CANCER RISK

The next 4 priorities, P4 - The influence of lifestyle and environmental factors on the risk of developing breast cancer, P5 - The genetics and hormonal causes of breast cancer, P6 - Understanding the interplay of multicausal factors - genetics and environment and P7 - Interventions to study the influence of lifestyle and environmental factors on the risk of developing breast cancer focus on breast cancer risk and lifestyle/environmental interventions. These also show a pattern in which the majority of funding was allocated through non-targeted programs.

PRIORITIES FOCUSED ON EARLY DETECTION DIAGNOSIS AND PROGNOSIS

The next 3 priorities, P8 - Better approaches to early detection and diagnosis, P9 - Development and evaluation of new biomarkers (including biomarkers for diagnosis) and the optimization of treatments for individual patients and P10 - Clinical setting/clinical trials to assess clinical sensitivity and specificity of new biomarkers focused on early detection, diagnosis and prognosis. For these priorities, relatively more funding was allocated through targeted programs. In the case of P8 - Better approaches to early detection and diagnosis, the majority of funding was allocated through such programs.



It appeared that P8 - Better approaches to early detection and diagnosis was a major strategic focus for a number of organizations during the period under study, as seen by the large number of targeted funding programs in the figure above.

At least in part, this was driven the National Framework. For example, the "CBCF National Grants Competition on Earlier Detection" was created in response to the Framework, and a number of relevant grants were funded (represented by dark red circles in the lower right hand orange circle in 2012, 2013 in the figure above).

PRIORITIES FOCUSED ON TREATMENT

The next 2 priorities, P11 - Discovery and development of new treatments for breast cancer and P12 - Clinical trials of new promising therapies focus on breast cancer treatment. While non-research area specific programs are responsible for the majority of funding for P11 - Discovery and development of new treatments for breast cancer, a substantial portion was delivered through focused programs. For P12 - Clinical trials of new promising therapies, most research was funded through clinical trial specific programs.

PRIORITIES FOCUSED ON SURVIVORSHIP, HEALTH CARE AND KNOWLEDGE TRANSLATION

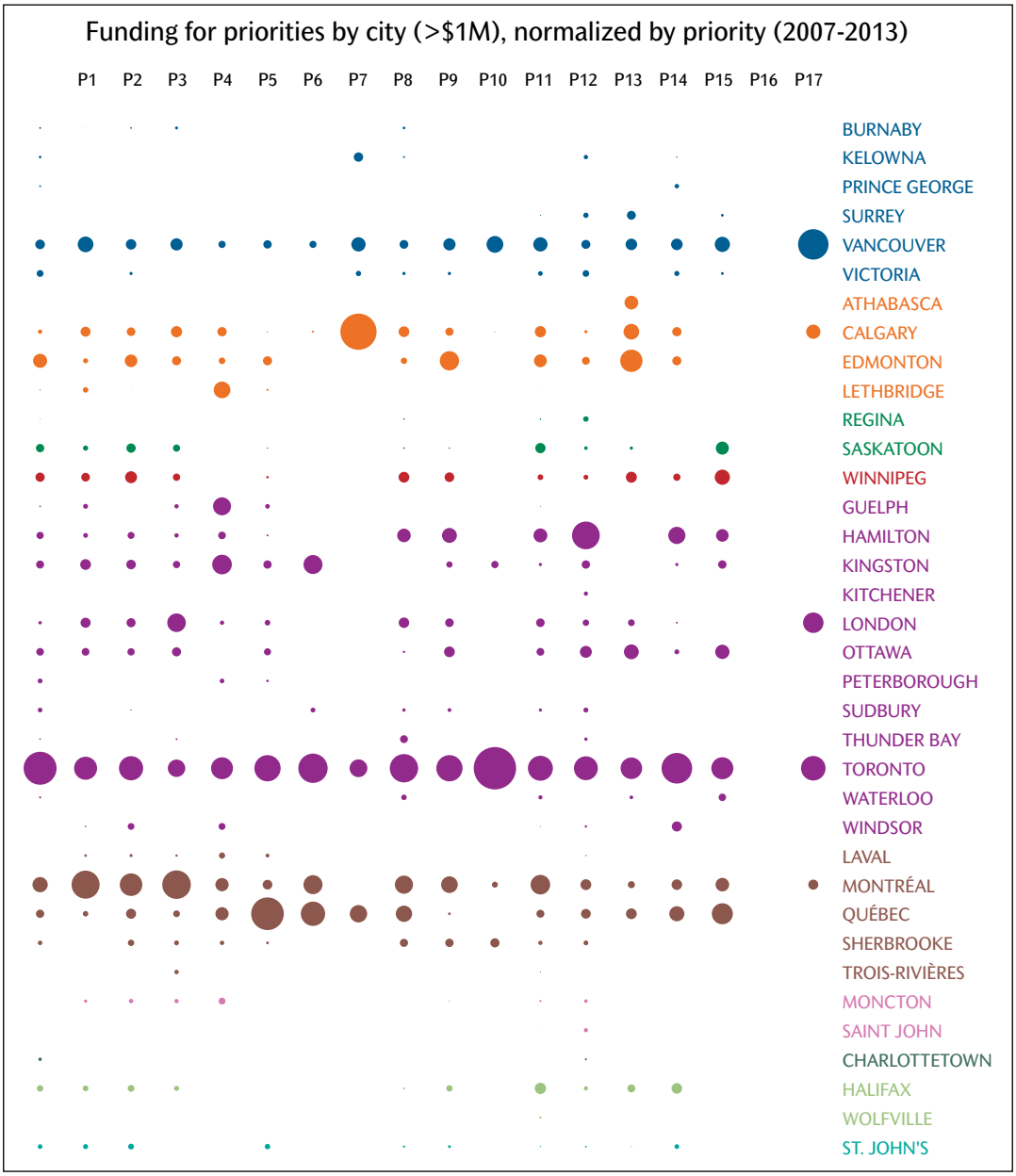
Funding for the next 3 priorities, P13 - Psychosocial and survivorship interventions, P14 - Analysis of the financial and health-care delivery issues facing breast cancer patients across the cancer continuum and P15 - Interventions to improve knowledge translation and disseminate best practices in breast cancer across the cancer continuum was primarily delivered through non-research area specific programs. Of these, P13 - Psychosocial and survivorship interventions had the highest level of targeted funding, primarily through 2 CBCRA special competitions.

Geography of funding

In the detailed section for each priority, we've shown the geographic distribution of funding for priorities by city. This section provides an overview of funding of funding for all the priorities by city.

FUNDING FOR PRIORITIES BY CITY - NORMALIZED BY PRIORITY

The figure below shows levels of funding for each priority from 2007-2013 for Canadian cities grouped by province; funding is proportional to the area of each circle and normalized for each priority. In other words, the figure is normalized by column.



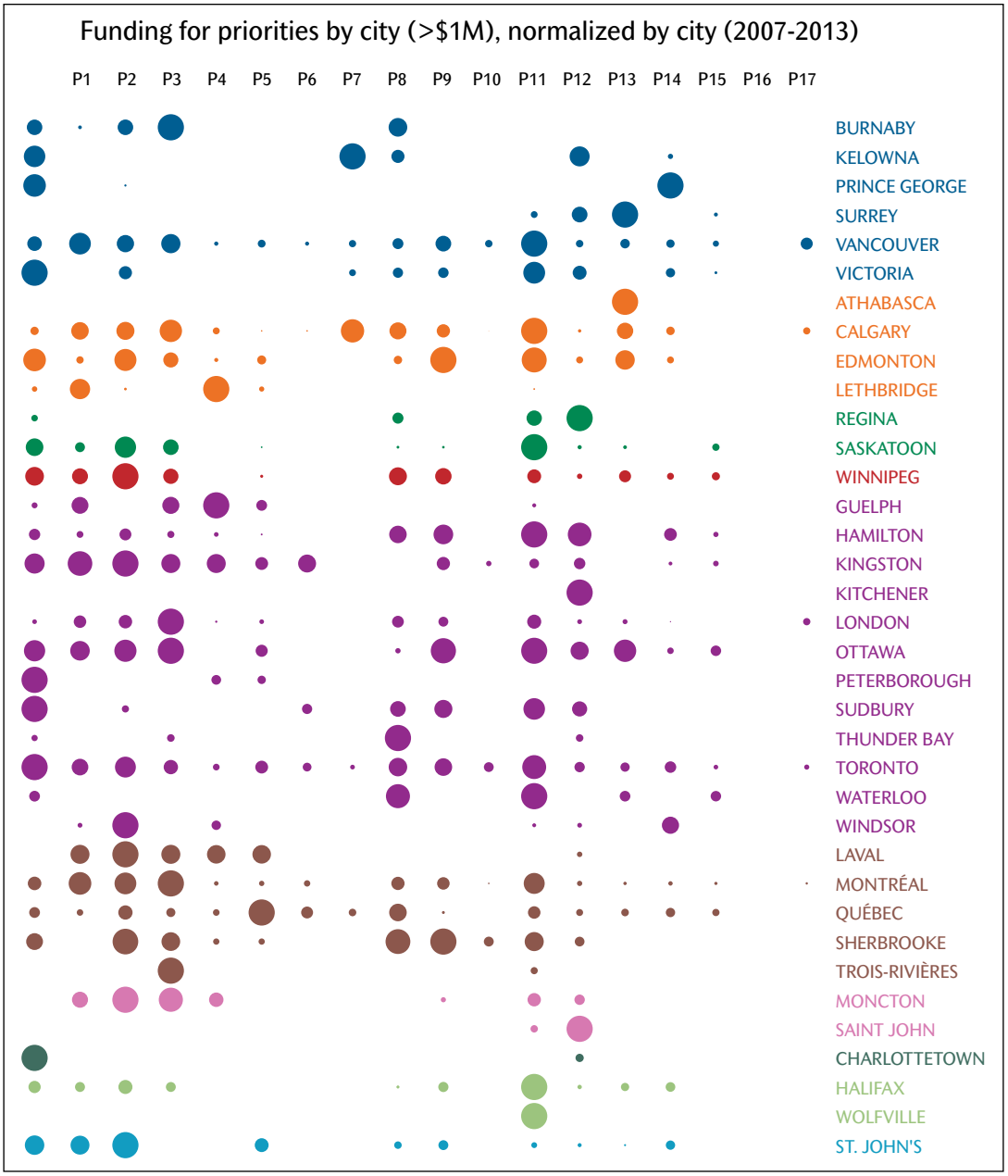
For many priorities, the largest amount of funding was allocated to researchers in Toronto, Canada's largest city. However, this was not true for all priorities.

For example, the greatest amount of funding for P3 - Understanding the cause of metastatic breast cancer and identifying new avenues for interventions was allocated to recipients in Montreal and London, indicating that metastasis researchers may be concentrated in these cities.

Similarly, funding for P7 - Interventions to study the influence of lifestyle and environmental factors on the risk of developing breast cancer was primarily allocated to researchers in Calgary.

FUNDING FOR PRIORITIES BY CITY - NORMALIZED BY CITY

To assess the breast cancer research focus of researchers in various Canadian cities, we looked at the distribution of funding for priorities for 36 cities. The figure below shows levels of funding for each priority from 2007-2013 for Canadian cities grouped by province; funding is proportional to the area of each circle and normalized for each city. In other words, the figure is normalized by row.



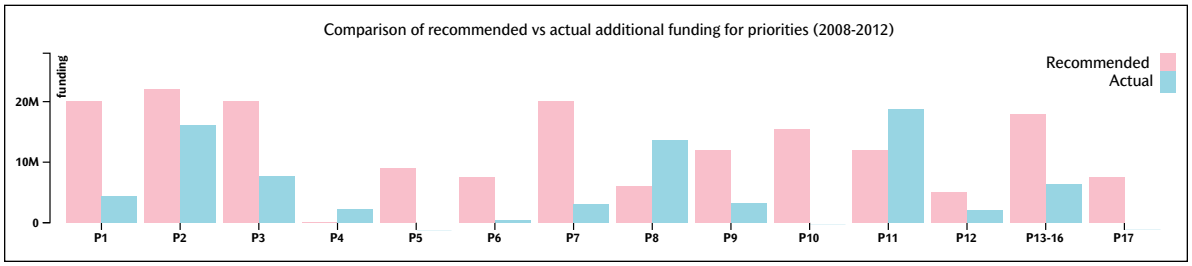
This figure shows the relative level of funding for priorities allocated to each city. There is a wide range of apparent strengths among different cities.

National Framework funding recommendations

As part of the development of the National Framework, the National Framework Working Group made recommendations about funding for priorities over the subsequent 5 years; additional funding was recommended for the majority of the priorities.

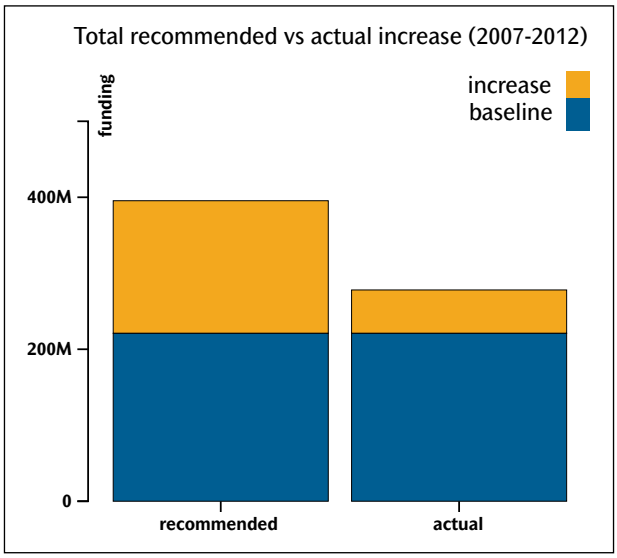
The figure below shows the level of recommended funding for each priority vs the actual additional funding from 2008-2012. Note that, here, we are comparing recommendations over 5 years to actual funding over 5 years (vs 6 years of actual funding in the detailed section for each priority).

RECOMMENDED VS ACTUAL FUNDING INCREASES FOR EACH PRIORITY



As seen above, most increases in funding did not meet the recommended levels. However, funding for 2 priorities: P8 - Better approaches to early detection and diagnosis and P11 - Discovery and development of new treatments for breast cancer exceeded recommended increases (as well as P4 - The influence of lifestyle and environmental factors on the risk of developing breast cancer, for which additional funding was not recommended).

TOTAL RECOMMENDED VS ACTUAL FUNDING INCREASE



In total, more than $174M of increased funding was recommended. Using 2007 as the base year, overall breast cancer research funding would have had to increase by approximately 79% over the next 5 years. This represents an average annual 15.8% increase over 2007 levels.

The actual increase in funding over baseline levels from 2008-2012 was approximately $57M. This represents an average annual increase of 5.2% over 2007 levels.

Prioritizing the priorities

The National Breast Cancer Research Framework focused on funding through two main groups: the CBCRA and individual funders. The CBCRA had planned to take a leadership role to ensure the implementation of the Framework by promoting mechanisms to maintain the interaction between funders, monitoring progress, and brokering collaborations. Individual funders were challenged to become familiar with the framework, to mobilize support for the Framework priorities, and to jointly tackle projects that could not be achieved alone, including through different collaborative approaches.

Given this call to action, the response of the breast cancer community is a key question to answer in monitoring progress against the Framework. This response can be seen in at least three overlapping actions: 1) collaborative funding efforts by breast cancer funders 2) targeted funding in priority areas of the Framework, and 3) changes in application demand according to the framework priorities. While much of this report focuses on how funding in open, scientific merit-based competitions has responded to application demand, the boxed examples in this section show how CBCRC members and funders have taken action on the Framework with collaborative and targeted funding initiatives.

As well as working together to collaborate on funding research, CBCRC members have made efforts to engage the community in the Framework and raise awareness. At the 2011 CCRA-Canadian Cancer Research Conference, CBCRC sponsored a satellite symposium featuring research presentations in the 6 theme areas, and administered a survey of the breast cancer research community to "prioritize the priorities" of the National Breast Cancer Research Framework. The priorities selected most often by respondents were:

- P11 - Discovery and development of new treatments for breast cancer
- P3 - Understanding the cause of metastatic breast cancer and identifying new avenues for interventions
- P7 - Interventions to study the influence of lifestyle and environmental factors on the risk of developing breast cancer and P8 - Better approaches to early detection and diagnosis

More recently, and as part of setting the new priority for the 2015 National Grants Competition, CBCF conducted an online survey of its stakeholders (survivors, donors, volunteers, public, etc) in 2014 to gauge the most pressing research questions in breast cancer research. More than 2500 surveys were completed.

The priorities selected most often by respondents were:

- P11 - Discovery and development of new treatments for breast cancer
- P8 - Better approaches to early detection and diagnosis and P9 - Development and evaluation of new biomarkers (including biomarkers for diagnosis) and the optimization of treatments for individual patients and
- P1 - The genetic and epigenetic basis of breast cancer development and P2 - Deciphering the molecular pathways implicated in breast cancer initiation

The strong interest in the priority for developing new treatments, together with the opportunity to partner with other cancer funders (EIF Canada, the Ontario Institute for Cancer Research, CIHR-ICR and Genome Canada among others) lead to the development of a priority call in breast cancer as part of the first Stand Up to Cancer Canada competition.

Using the Framework

From 2010, the CIHR-Institute of Cancer Research (ICR) managed funds provided by PHAC for breast cancer research under the Canadian Breast Cancer Initiative, and was an early adopter of the Framework, incorporating its six overarching research themes into funding programs and attracting funding partners from outside breast cancer. Specifically, in 2010 CIHR-ICR partnered with the CIHR Institute for Musculoskeletal Health and Arthritis (IMHA) in the Physical Activity, Mobility and Health Initiative, resulting in a $2.5M investment in studying physical activity and health-related fitness to improve breast cancer survivorship. ICR also targeted breast cancer funds within the roadmap Signature Initiatives, partnering with Genome Canada on co-launching the 2012 Large-Scale Applied Research

Project Competition in Genomics and Personalized Health and with a number of other CIHR institutes in the launch of the Transformative Community-based Primary Healthcare Initiative. These resulted in an $11.4M project focused on Personalized Risk Stratification for the Prevention and Early Detection of Breast Cancer (with co-funding from the Quebec Breast Cancer Foundation) and $2.5M in team grant investments focused on risk reduction and the application of personalized medicine for vulnerable populations.

CIHR-ICR also partnered with other breast cancer funders on particular Framework research priorities. With the Avon Foundation, ICR partnered to fund a highly ranked application from targeting Framework priorities, with a specific interest in breast cancer prevention, and partnered with the Breast Cancer Society of Canada in supporting the Eileen Iwanicki Fellowships in Breast Cancer Research focused on breast cancer imaging and knowledge translation. And in 2012, CIHR joined with the Canadian Breast Cancer Foundation (CBCF) on a workshop and subsequent research program competition focused on Breast Cancer in Young Women, and targeting Framework priorities related to under-served priorities in psychosocial and survivorship interventions and interventions to improve KT and best practice dissemination.

In addition to the Breast Cancer in Young Women competition, CBCF has made regular reference to the Framework in developing the priorities for its National Grants Program and investments under the National Research Strategy. The first CBCF National Grants Competition, launched in 2011, focused on Framework priorities 8, 9, and 10, investing $3.2M in research focused on earlier detection of breast cancer. The 2011 CBCF National Research Strategy called for strategic investments not only in priority research areas of the Framework, but also in the approach for funding research: cooperatively with other funders, building capacity and platforms, and engaging stakeholders in the Framework priorities. In response, CBCF has partnered with the Canadian Cancer Society in funding Capacity Development Awards in breast cancer Prevention, and has contributed to supporting the Canadian Cancer Clinical Trials Network.

8 Conclusion

The wealth of data contained in this monitoring report and its interpretation lead to some conclusions to inform the partnerships work going forward.

1. It is encouraging that the data shows funding for breast cancer research increased strongly during the period analysed. Funding increased for most priorities identified by the community through the National Framework.
2. Investigator-led funding mechanisms continued to dominate the funding landscape. Funding through targeted competitions varied widely across priorities, representing the majority of funding for a few priorities. To increase the impact of efforts like the National Framework it is critically important to consider the funding mechanism and engage the appropriate actors to realize strategic change.
3. It is not clear how directly the Framework impacted funding programs. For some priorities, such as P8 - Better approaches to early detection and diagnosis, there were large increases in funding through targeted programs after publication of the Framework. For others, there seemed to be little direct effect. There may be a benefit of further tracking over time to fully understand the impact of the Framework on launch of competitions focused on priority areas. There is some evidence, however, that the Framework helped to shape the conversation around partnering initiatives to fund in priority areas and themes.
4. In the original Framework report, relatively large funding increases were recommended for many of the priorities. The later discrepancy between recommended and actual funding levels raises important questions about the challenges of connecting such a Framework to engaging new funding support and may reflect changes in the funding landscape and the availability of funds. Ambitious funding increases are unlikely to materialize without a strong and specific plan for engaging investment sources (donors and decision makers). Evaluating the impact of the Framework in terms of industry engagement and recruitment of new funders was beyond the scope of this report.
5. Analysing funding patterns by geography may be helpful in understanding opportunities for multi-Regional / pan-Canadian collaborations.
6. In the original Framework report, funding levels for priorities were estimated using subcategories of the Common Scientific Outline. However, CSO subcategories did not correlate well with the articulated priorities, necessitating the development of a dedicated classification system for this report. Future priority setting exercises need to consider measurement during development.

Appendix A

FUNDING ORGANIZATIONS

AC	Alberta Cancer
ACF	Alberta Cancer Foundation
AIHS	Alberta Innovates - Health Solutions
BHRCI	Beatrice Hunter Cancer Research Institute
BTFC	Brain Tumour Foundation of Canada
BCSC	Breast Cancer Society of Canada
CFI	Canada Foundation for Innovation
CRCP	Canada Research Chairs Program
CARO	Canadian Association of Radiation Oncology
CBCF	Canadian Breast Cancer Foundation
CBCRA	Canadian Breast Cancer Research Alliance
CCS	Canadian Cancer Society
CIHR	Canadian Institutes of Health Research
CPAC	Canadian Partnership Against Cancer
CCNS	Cancer Care Nova Scotia
CCO	Cancer Care Ontario
CRS	Cancer Research Society
CCM	CancerCare Manitoba
QBCF	Fondation du cancer du sein du Québec / Quebec Breast Cancer Foundation
FRQS	Fonds de la recherche du Québec - Santé
GC	Genome Canada
MHRC	Manitoba Health Research Council
MSFHR	Michael Smith Foundation for Health Research
NRC	National Research Council
NRCC	National Research Council Canada
NSERC	Natural Sciences and Engineering Research Council
NCE	Networks of Centres of Excellence
NBHRF	New Brunswick Health Research Foundation
NLCAHR	Newfoundland and Labrador Centre for Applied Health Research
NSHRF	Nova Scotia Health Research Foundation
OICR	Ontario Institute for Cancer Research
OMRI	Ontario Ministry of Research and Innovation
OCC	Ovarian Cancer Canada
POGO	Pediatric Oncology Group of Ontario
PHAC	Public Health Agency of Canada
RM	Research Manitoba
SCA	Saskatchewan Cancer Agency
SHRF	Saskatchewan Health Research Foundation
SSHRC	Social Sciences and Humanities Research Council
LLSC	The Leukemia & Lymphoma Society of Canada
TFRI	The Terry Fox Foundation

Appendix B

TABLE OF FUNDING FOR EACH PRIORITY BY YEAR

	2007	2008	2009	2010	2011	2012	2013	Total
P1: Genetic-Epigenetic-Basis	4,757,022	4,756,870	5,284,572	5,385,455	5,582,594	5,628,985	6,263,097	37,658,594
P2: Molecular-Pathways-Initiation	6,429,344	7,502,625	8,002,527	9,084,166	9,923,974	10,451,228	9,648,172	61,042,035
P3: Cause-of-Metastasis	6,579,241	6,961,381	7,499,010	7,319,265	7,205,624	8,841,717	9,274,070	53,680,307
P4: Lifestyle-Environmental-Risks	852,217	904,570	1,386,761	1,275,666	1,190,697	1,222,028	1,304,517	8,136,456
P5: Genetic-Hormonal-Causes	2,556,947	2,298,052	2,323,853	2,455,298	2,260,282	2,003,767	2,752,432	16,650,631
P6: Multicausal-Genetic-Environment-Causes	948,970	761,657	1,174,611	1,138,955	1,329,353	1,023,253	681,011	7,057,810
P7: Lifestyle-Environmental-Interventions	360,599	328,956	357,203	807,285	1,103,913	1,501,526	1,094,972	5,554,453
P8: Early-Detection-Diagnosis-Approaches	2,657,025	2,405,686	3,414,712	3,429,953	7,533,862	6,932,849	5,795,339	32,169,424
P9: Biomarkers-Development	4,808,281	5,319,813	6,307,824	5,289,272	4,453,808	4,538,877	6,124,565	36,842,440
P10: Biomarkers-Clinical	352,382	345,657	72,852	115,417	127,177	328,070	796,262	2,137,815
P11: New-Treatments-Development	8,019,034	10,575,995	13,048,798	12,219,050	10,094,637	10,366,827	10,563,652	74,887,993
P12: New-Treatments-Clinical	1,796,955	1,321,074	1,173,139	1,471,654	3,291,450	3,294,508	2,289,658	14,638,437
P13: Psychosocial-Survivorship-Interventions	2,016,851	2,010,668	1,798,710	2,495,741	2,404,163	2,497,594	2,175,143	15,398,869
P14: Financial-Health-Care-Delivery-Issues	1,126,553	1,347,657	1,198,476	1,093,012	1,468,416	2,184,342	2,259,052	10,677,508
P15: Knowledge-Translation-Best-Practices	306,180	505,715	757,509	872,936	727,099	732,977	451,808	4,354,225
P16: Outcomes-Late-Effects-Trial-Admindb-Linkage	0	0	0	0	0	0	0	0
P17: Animal-Models-Development-Therapeutics	623,550	568,001	555,384	351,365	278,002	427,043	450,454	3,253,800

TABLE OF FUNDING FOR EACH ORGANIZATION BY PRIORITY

	P1	P2	P3	P4	P5	P6	P7	P8	P9	P10	P11	P12	P13	P14	P15	P16	P17	Total
Alberta Cancer Foundation	1,058,035	663,477	2,075,537	471,686	0	0	1,002,216	254,730	3,195,712	0	3,056,528	36,710	122,526	223,125	0	0	283,681	**12,443,961**
Alberta Innovates - Health Solutions	1,119,990	1,542,818	356,407	771,312	293,124	0	1,741,591	789,132	1,662,910	0	1,441,793	36,710	1,242,631	0	0	0	0	**10,998,417**
Brain Tumour Foundation of Canada	0	0	23,500	0	0	0	0	0	0	0	0	0	0	0	0	0	0	**23,500**
Breast Cancer Society of Canada	256,544	466,324	1,081,909	74,959	67,552	6,554	4,174	166,937	712,397	2,721	1,337,826	11,878	339,947	101,812	9,127	0	42,339	**4,682,999**
Canada Foundation for Innovation	730,587	1,160,442	785,789	150,067	149,330	447,304	0	1,036,424	265,672	225,000	659,818	225,000	28,863	0	0	0	0	**5,864,295**
Canada Research Chairs Program	2,074,500	1,905,625	567,667	0	1,093,334	476,000	0	833,333	0	0	0	487,500	0	624,167	136,667	0	0	**8,198,792**
Canadian Association of Radiation Oncology	0	0	0	0	0	0	0	0	0	0	69,449	0	0	0	0	0	0	**69,449**
Canadian Breast Cancer Foundation	7,662,178	15,327,684	10,347,135	1,669,241	4,445,571	1,509,463	444,387	3,275,144	8,502,752	691,742	18,447,524	2,729,590	7,207,013	4,356,219	970,741	0	1,200,356	**88,786,739**
Canadian Cancer Society	2,942,104	4,526,336	3,015,972	1,374,950	2,089,295	269,638	1,125,007	1,223,586	1,448,005	4,424	3,206,838	6,435,187	889,194	467,511	313,080	0	412,619	**29,743,746**
Canadian Institutes of Health Research	10,299,599	20,269,956	16,276,154	2,129,936	3,769,306	3,074,415	523,827	9,296,090	5,510,236	310,348	16,639,257	2,962,255	2,378,421	3,232,321	2,029,471	0	133,599	**98,835,191**
Canadian Partnership Against Cancer	0	0	0	0	0	0	0	0	349,722	0	0	0	0	0	0	0	0	**349,722**
CancerCare Manitoba	96,315	336,707	216,919	0	0	0	0	452,728	189,188	0	23,500	0	14,968	0	0	0	0	**1,330,325**
Cancer Care Nova Scotia	0	24,350	6,500	0	0	0	0	5,000	0	0	219,250	0	0	0	0	0	0	**255,100**
Cancer Care Ontario	0	50,000	0	112,500	0	112,500	0	0	0	0	225,000	0	0	0	120,237	0	0	**620,237**
Cancer Research Society	1,278,570	1,110,684	1,974,456	93,335	338,592	0	0	0	43,000	0	976,100	0	0	0	0	0	225,816	**6,040,553**
Fondation du cancer du sein du Québec / Quebec Breast Cancer Foundation	1,405,931	879,516	1,586,580	20,000	504,975	250,000	565,596	531,490	3,400	0	2,152,890	295,334	0	0	0	0	0	**8,195,710**
Fonds de la recherche du Québec - Santé	664,448	1,010,684	1,153,526	7,500	292,430	8,967	0	227,994	481,529	0	650,940	0	128,361	311,868	198,654	0	0	**5,136,901**
Genome Canada	19,165	0	0	0	220,639	0	0	220,639	0	0	0	0	0	0	0	0	0	**460,443**

	P1	P2	P3	P4	P5	P6	P7	P8	P9	P10	P11	P12	P13	P14	P15	P16	P17	Total
Michael Smith Foundation for Health Research	86,191	216,499	40,878	0	0	0	0	0	409,188	0	675,527	0	164,938	51,001	0	0	22,750	**1,666,970**
National Research Council Canada	0	0	0	0	0	0	0	166,395	3,249,852	0	6,524,863	0	0	0	0	0	0	**9,941,110**
Natural Sciences and Engineering Research Council	159,466	51,000	103,050	196,891	142,141	0	0	4,687,184	784,365	0	1,901,295	60,000	2,250	0	2,250	0	81,602	**8,171,492**
Networks of Centres of Excellence	4,500	3,750	0	3,750	0	0	0	251,375	36,250	0	113,750	0	3,750	15,000	0	0	0	**432,125**
New Brunswick Health Research Foundation	29,375	133,975	31,034	0	0	0	0	0	0	0	46,667	0	0	0	0	0	0	**241,051**
Newfoundland and Labrador Centre for Applied Health Research	0	0	0	0	0	0	0	0	0	0	0	0	0	24,063	0	0	0	**24,063**
Nova Scotia Health Research Foundation	0	100,150	0	0	0	0	0	0	0	0	198,020	0	0	144,177	0	0	0	**442,347**
Ontario Institute for Cancer Research	175,047	360,676	1,329,291	0	0	0	0	2,648,619	5,510,787	558,576	4,677,134	312,068	0	249,202	0	0	152,101	**15,973,500**
Ontario Ministry of Research and Innovation	627,806	868,112	628,463	145,228	0	442,951	0	786,349	626,858	0	524,972	0	0	0	0	0	0	**4,650,739**
Ovarian Cancer Canada	0	0	0	0	0	0	0	0	0	0	50,000	0	0	0	0	0	0	**50,000**
Public Health Agency of Canada	1,515,599	3,499,221	3,000,942	674,337	1,722,317	164,171	104,487	962,815	787,368	5,310	2,534,249	297,407	2,296,879	601,583	247,143	0	494,037	**18,907,865**
Research Manitoba	13,493	481,894	230,330	0	0	0	0	115,615	12,038	0	0	0	35,700	0	0	0	0	**889,070**
Saskatchewan Cancer Agency	87,500	218,338	416,437	0	0	0	0	82,000	0	0	635,026	0	0	0	0	0	0	**1,439,300**
Saskatchewan Health Research Foundation	50,000	206,221	30,000	0	20,000	0	0	7,333	0	0	35,417	0	0	0	183,767	0	0	**532,738**
Social Sciences and Humanities Research Council	0	0	0	0	0	0	0	0	0	0	0	0	105,000	91,667	48,058	0	0	**244,725**
The Leukemia & Lymphoma Society of Canada	0	1,375	0	0	0	0	0	0	0	0	5,000	0	0	0	0	0	0	**6,375**
The Terry Fox Research Institute	3,300,484	1,747,963	6,758,499	0	165,749	0	0	2,062,974	450,629	0	5,121,987	171,700	0	0	0	0	0	**19,779,985**