Investment in Research on Childhood and Adolescent Cancers, 2005-2007

A special report from the Canadian Cancer Research Alliance's survey of government and voluntary sector investment in cancer research

CCRA ACRC
Canadian Cancer Research Alliance • Alliance canadienne pour la recherche sur le cancer

CANADIAN PARTNERSHIP AGAINST CANCER
PARTENARIAT CANADIEN CONTRE LE CANCER

OCTOBER 2009

For additional copies of this publication, please contact:

Canadian Cancer Research Alliance (CCRA)
1 University Avenue, Suite 300
Toronto, Ontario M5J 2P1 CANADA
Tel.: (416) 915-9222, ext. 5739
Fax: (416) 915-9224
Email: info@ccra-acrc.ca

This publication is also available at the following address http://www.ccra-acrc.ca. It is formatted for two-sided printing.

Suggested Citation:
Canadian Cancer Research Alliance (2009). *Investment in Research on Childhood and Adolescent Cancers, 2005-2007: A Special Report from the Canadian Cancer Research Alliance's Survey of Government and Voluntary Sector Investment in Cancer Research.* Toronto: CCRA.

ISBN 978-0-9784157-4-7 (PDF)

Aussi offert en français sous le titre : Investissement dans la recherche sur les cancers de l'enfant et de l'adolescent, 2005-2007: un rapport spécial de l'Alliance canadienne pour la recherche sur le cancer sur les investissements effectués dans la recherche sur le cancer par les organismes gouvernementaux et non gouvernementaux.

Investment in Research on Childhood and Adolescent Cancers, 2005-2007

A special report from the Canadian Cancer Research Alliance's survey of government and voluntary sector investment in cancer research

October 2009

ACKNOWLEDGEMENTS

Production of this report has been made possible through a financial contribution from Health Canada, through the Canadian Partnership Against Cancer. The views expressed herein represent the views of the Canadian Cancer Research Alliance.

The Canadian Cancer Research Survey relies on the participation of many organizations. In alphabetical order, we would like to thank Alberta Cancer Research Institute, Alberta Heritage Foundation for Medical Research, Brain Tumour Foundation of Canada, C^{17} Research Network, Canada Foundation for Innovation, Canada Research Chairs Program, Canadian Association of Radiation Oncology, Canadian Breast Cancer Foundation, Canadian Breast Cancer Research Alliance, Canadian Cancer Society, Canadian Institutes of Health Research, Canadian Prostate Cancer Research Initiative, Canadian Tobacco Control Research Initiative, Canary Foundation of Canada, CancerCare Manitoba, Cancer Care Nova Scotia, Cancer Care Ontario, Fonds de la recherche en santé du Québec, Genome Canada, Manitoba Health Research Council, Medical Research Fund of New Brunswick, Michael Smith Foundation for Health Research, National Research Council, Natural Sciences and Engineering Research Council, Networks of Centres of Excellence, Nova Scotia Health Research Foundation, Ontario Institute for Cancer Research, Ovarian Cancer Canada, Prostate Cancer Canada, Quebec Breast Cancer Foundation/Fondation du cancer du sein du Québec, Saskatchewan Cancer Agency, Saskatchewan Health Research Foundation, Social Sciences and Humanities Research Council, The Cancer Research Society, The Kidney Foundation of Canada, The Leukemia & Lymphoma Society of Canada, and The Terry Fox Foundation. The survey also includes information from the federal government's Indirect Costs Program and the Canadian Cancer Society-funded NCIC Clinical Trials Group.

This special report would not have been possible without the expertise, advice and hands-on data validation provided by Dr. Paul Grundy and Ms. Kathy Brodeur-Robb, both from the C^{17} Research Network. We would also like to acknowledge the contribution of our additional expert reviewers: Drs. Stuart Edmonds (Canadian Cancer Research Alliance), Elizabeth Eisenhauer (Canadian Cancer Research Alliance), Jim Hudson (on behalf of the Canadian Breast Cancer Foundation), Nancy Kreiger (Cancer Care Ontario), Morag Park (Canadian Institutes of Health Research), Mireille Vega (The Cancer Research Society), and Christine Williams (Canadian Cancer Society). Kim Badovinac, who manages the Canadian Cancer Research Survey, prepared this report. The report was designed by Magnesium Advertising & Design of Toronto.

Contents

List of Tables

List of Figures

1. Introduction

This report is devoted to quantifying the investment in research on childhood and adolescent cancers, using the Canadian Cancer Research Survey for years 2005 to 2007 as the data source. It is the first published effort of its kind.

The impetus for this report came from a need to understand the level and nature of research activity in this area. Although cancers among children and adolescents represent only a small proportion of the overall cancer cases and cancer deaths each year in Canada, these early-life cancers have formidable impacts on those affected, their families, and the health, economic and social welfare systems. In addition, the growing population of childhood/adolescent cancer survivors represents a significant burden of morbidity.

The report provides:

- background information about childhood/adolescent cancers and the general childhood/adolescent cancer research environment in Canada
- a description of the methodology employed
- findings in terms of overall investment, types of research, and cancer sites
- a brief summary of the results

While the report includes research investment by many of the major government and voluntary sector cancer research funders in Canada, it does not include funding that researchers at pediatric facilities may receive from their affiliated institutional foundations/charities nor monies that pediatric facilities may receive/invest in clinical trials research from industry sponsors or from cancer research funding organizations outside of Canada. Thus, the figures provided herein underestimate to some unknown degree the total research investment in this area.

> "In countries where modern, experimental treatments are available, cancer in children has come from being an acute disease with a certain fatal outcome to a life-threatening disease with the possibility of cure. Unfortunately, such success is not without its costs. The presence of long-lasting uncertainty about a possible recurrence of the disease or second malignancy, together with recognition of some permanent cognitive and physical side-effects of treatment, have changed the disease in many cases to a chronic condition...The whole family has the difficult task of adjusting to a situation dominated by the stresses of long-lasting uncertainty and uncontrollability."
>
> From: Patenaude AF & Last B (2001). Cancer and children: Where are we coming from? Where are we going? *Psycho-Oncology*, 10:281-283.

2. BACKGROUND

Childhood cancers are a diverse group of diseases that vary widely in incidence, aggressiveness, age at diagnosis, type of treatment, survival, and, it is suggested, causes.[1] From 2001 to 2005, there were on average 1,271 new cases of cancers per year in Canada among the 0-19 age group,[2] which represents less than 1% of the total number of new cancer cases.[3] Cancers account, however, for 11% of all deaths in children and adolescents—the third largest cause of death in this age group.[4] The main cancers affecting the 0-19 year age group are leukemias and central nervous system cancers (see Figure 2.1.1). (Central nervous systems cancers include cancers of the brain and spinal cord.) This represents a very different spectrum of cancers than is found in adults.

CANADIAN CANCER STATISTICS

The 2008 and 2009 issues of the *Canadian Cancer Statistics* produced by the Canadian Cancer Society provide detailed cancer statistics for the 0-14 and 15-29 age groups, respectively. These reports are available electronically at

http://www.cancer.ca/canada-wide/about%20cancer/cancer%20statistics/canadian%20cancer%20statistics.aspx?sc_lang=en.

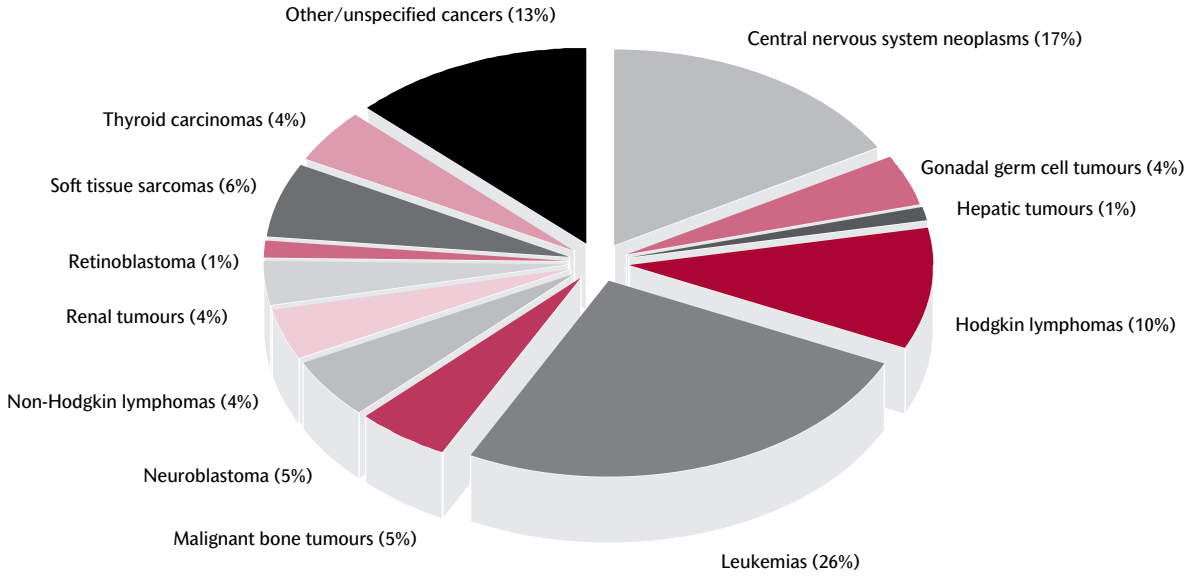
Given the comparatively lower number of childhood cancer cases to adult cancer cases, researchers are required to look beyond their own institutions and work with others so that a sufficient number of patients and/or tissue samples can be employed in their work. It is largely due to multi-centre and multidisciplinary collaboration in therapeutic research in childhood cancer that great improvements in survival have occurred over the past 30 years.[5]

While many children now have an opportunity for cure (see Figure 2.1.2 for the most recently published estimates of childhood and adolescent cancer survival in Canada for specific

1. Inskip PD, Ries LAG, Cohen RJ, Curtis RE. (2006). New malignancies following childhood cancer. In Curtis RE, Freedman DM, Ron E, Ries LAG, Hacker DG, Edwards BK, Tucker MA, Fraumeni JF Jr. (Eds), *New Malignancies Among Cancer Survivors: SEER Cancer Registries, 1973-2000*. National Cancer Institute, NIH Publ. No. 05-5302. Bethesda, MD, 2006. Available at http://seer.cancer.gov/publications/mpmono/Ch18_Childhood.pdf.
2. Computed from: Supplementary Table W2 to Canadian Cancer Society's Steering Committee. *Canadian Cancer Statistics 2009*. Toronto: Canadian Cancer Society, 2009. Available exclusively online at http://www.cancer.ca/canada-wide/about%20cancer/cancer%20statistics/~/media/CCS/Canada%20wide/Files%20List/English%20files%20heading/pdf%20not%20in%20publications%20section/stats%202009E%20Cancer%20in%20Children.ashx.
3. Data generated from Cancer Surveillance Online, Cancer Incidence Charts. Available at http://dsol-smed.phac-aspc.gc.ca/dsol-smed/cancer/c_dis_e.html.
4. Data from Statistics Canada, *Table 102-0561-Leading causes of death, total population, by age group and sex, Canada, annual, CANSIM (database)*.
5. Reaman GH. (2004). Pediatric cancer research from past successes through collaboration to future transdisciplinary research. *Journal of Pediatric Oncology Nursing*, 21(3):123-127.

FIGURE 2.1.1

DISTRIBUTION OF NEW CANCER CASES BY CANCER SITE FOR AGE GROUP 0-19 YEARS, 2001-2005



[1] Supplementary Table W2 to Canadian Cancer Society's Steering Committee. *Canadian Cancer Statistics 2009*. Toronto: Canadian Cancer Society, 2009. Available exclusively online at http://www.cancer.ca/canada-wide/about%20cancer/cancer%20statistics/~/media/CCS/Canada%20wide/Files%20List/English%20files%20heading/pdf%20not%20in%20publications%20section/stats%202009E%20Cancer%20in%20Children.ashx

age groups), a significant proportion of survivors experience life-long adverse effects that result from either the cancer itself or the treatment received. Long-term complications include impairment in growth and development, neurocognitive problems, compromised cardio-pulmonary function, endocrine dysfunction, renal impairment, gastrointestinal dysfunction, musculoskeletal disorders, and subsequent cancers.[6] The Childhood Cancer Survivor Study, a US-based retrospective cohort study that tracked the health status of more than 10,000 adults who were treated for childhood cancer between 1970 and 1986, found that the risk of chronic health conditions among survivors was not

CHILDHOOD CANCER SURVIVOR STUDY

A recent *Journal of Clinical Oncology* Review Series issue (Vol. 27, No. 14, May 10, 2009) is devoted to the Childhood Cancer Survivor Study. Featuring 10 articles, the objective of this journal issue is to provide one-stop shopping for researchers and clinicians by synthesizing research published in a number of different journals over the past few years. In addition to an overview of this landmark study and its methodology, key findings are provided on the following topics:

- Late mortality
- Subsequent cancers
- Health behaviours, medical care and interventions to promote healthy living
- Ovarian failure and reproductive outcomes
- Physical performance limitations
- Social outcomes
- Psychological status
- High-risk populations

6. Landier W & Bhatia S. (2008). Cancer survivorship: a pediatric perspective. *The Oncologist*, 13:1181-1192.

only high, but that these conditions increased over time with no apparent plateau.[7]

In Canada, a concerted effort to improve the environment for clinical research on childhood cancers occurred about a decade ago. In 2001, leaders in pediatric oncology and hematology from the 16 academic pediatric oncology/hematology programs in 17 centres across Canada formed a non-profit organization called the C[17] Council with support from the Childhood Cancer Foundation-Candlelighters Canada (see sidebar on the next page for a list of pediatric centres). The Council set up the C[17] Research Network in 2004 to encourage and develop collaborative, multidisciplinary, multi-site, Canadian research in pediatric hematology, oncology and hematological stem cell transplantation and further the Council's mission to improve health outcomes and quality of life for children and adolescents with cancer and blood disorders.[8] Member organizations of the C[17] Council are all involved in conducting clinical trials and testing treatment protocols as part of the Children's Oncology Group (COG). In addition, discussions are underway between C[17] and the Canadian Cancer Society's funded NCIC Clinical Trials Group to plan a series of early trials involving children/adolescents.

PEDIATRIC CANCER CENTRES IN CANADA

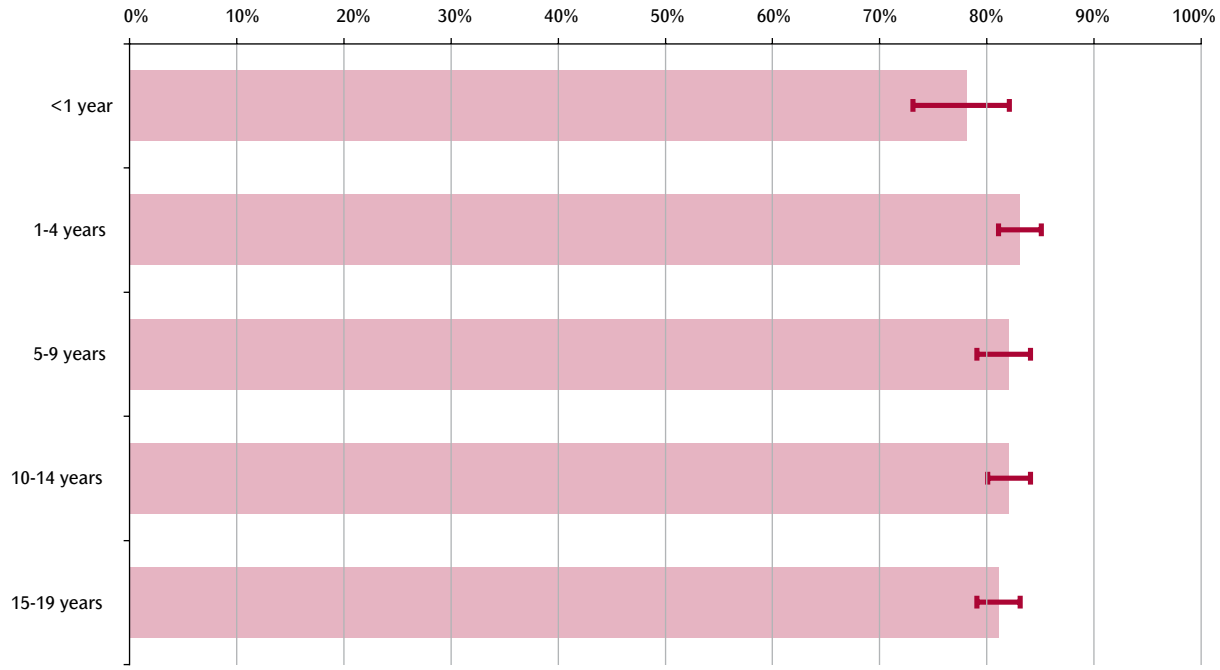
- Alberta Children's Hospital (Calgary)
- Allan Blair Cancer Centre (Regina)
- BC Children's Hospital (Vancouver)
- CancerCare Manitoba (Winnipeg)
- Children's Hospital of Eastern Ontario (Ottawa)
- Children's Hospital at London Health Sciences Centre (London)
- Centre hospitalier Universitaire de Québec (Quebec)
- Centre hospitalier Universitaire de Sherbrooke (Sherbrooke)
- Hôpital Sainte-Justine (Montréal)
- IWK Health Centre (Halifax)
- Janeway Children's Health and Rehabilitation Centre (St. John's)
- Kingston General Hospital (Kingston)
- McMaster Children's Hospital (Hamilton)
- The Hospital for Sick Children (Toronto)
- The Montreal Children's Hospital (Montréal)
- Saskatoon Cancer Centre (Saskatoon)
- Stollery Children's Hospital (Edmonton)

The COG is one of 12 groups supported by the US National Cancer Institute's Clinical Trials Cooperative Group Program, a program established in the mid-1950s in order to accelerate the study of new drugs and other treatments for cancer.[9] Formed in 2000 with the merger of four independent cooperative groups, the COG involves over 200 institutions and 5,000 cancer researchers from Australia, Canada, the US, and several European countries and is the largest and most recognized pediatric research group worldwide.[10] Dr. Paul Grundy of the Stollery Children's

7. Oeffinger KC et al. (2006). Chronic health conditions in adult survivors of childhood cancer. *The New England Journal of Medicine*, 355(15):1572-1582.
8. See http://c17.ca/about.php.
9. See http://www.cancer.gov/cancertopics/factsheet/NCI/clinical-trials-cooperative-group.
10. See http://www.teenslivingwithcancer.org/about/cog.asp. For a recent review of the progress made by the COG and its predecessor groups, see O'Leary M et al. (2008). Progress in childhood cancer: 50 years of research collaboration, a report from the Children's Oncology Group. *Seminars in Oncology*, 35(5):484-493.

FIGURE 2.1.2

FIVE-YEAR OBSERVED SURVIVAL PROPORTIONS (%) BY AGE GROUP AT DIAGNOSIS, ALL CANCERS, CANADA [1,2]



[1] 95% confidence intervals are indicated by solid lines at the end of the bars.

[2] Period analysis estimates for 1999-2003 (excludes Quebec). Source: Ellison LF, Pogany L & Mery LS. (2007). Childhood and adolescent cancer survival: A period analysis of data from the Canadian Cancer Registry. *European Journal of Cancer*, 43: 1967-1975.

Hospital in Edmonton was appointed the Senior Medical Officer for COG Canadian Affairs and, in conjunction with the C17 Council of pediatric hematology and oncology directors, he works to streamline regulatory approval for clinical trials in Canada. Canadian centres are currently participating in 76 of the 82 open clinical trials led by the COG.[11]

Since a number of pediatric cancers have a single mutation as the primary oncogenic driver, the molecular pathways that cause these cancers can be studied in a simpler genetic background.[12] Research focused on understanding the cellular and molecular biology of pediatric cancers has and will likely continue to advance not only the study of pediatric cancers but cancers in general by providing new insights into normal and stem cell biology, growth and cell cycle control, and normal and abnormal development.[13] In addition to basic and clinical

11. Data provided by email from Kathy Brodeur-Robb, Executive Director, C17 Council on April 29, 2009.

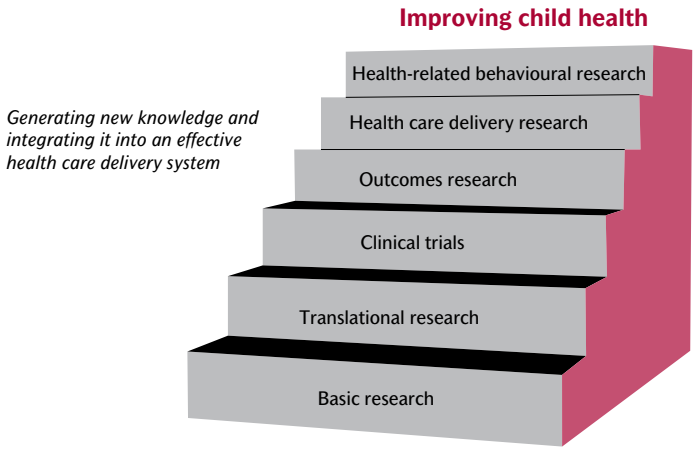
12. Braun BS & Lessnick SL. (2009). Pediatric malignancies: update on sarcomas and leukemia development in children. *Current Opinions in Genetics & Development*, 19:92-96.

13. Ibid.

research, increased focus on behavioural and psychosocial research on childhood/adolescent cancer survivors[14] as well as health services research[15] have been suggested as important components of a continuum of research designed to improve child health (see Figure 2.1.3). Of note, survivorship research focused on children, adolescents and young adults is one of the current strategic priorities of the Institute of Cancer Research of the Canadian Institutes of Health Research.

FIGURE 2.1.3

CONTINUUM OF RESEARCH TO IMPROVE CHILD HEALTH [1]



[1] From: Boat TF. (2007). The future of pediatric research. *Journal of Pediatrics*, 151:S21-S27.

14. Last BF, Grootenhuis MA & Eiser C. (2005). International comparison of contributions to psychosocial research on survivors of childhood cancer: past and future considerations. *Journal of Pediatric Psychology*, 30(1):99-113.
15. Boat TF. (2007). The future of pediatric research. *Journal of Pediatrics*, 151:S21-S27.

3. Methodology

This section describes the methodological issues of importance to the calculation of the research investment for childhood/adolescent cancers as well as the classification and reporting conventions relevant to interpretation of the results. For a detailed description of the methodology for the Canadian Cancer Research survey, the reader should consult *Cancer Research Investment in Canada, 2005: The Canadian Cancer Research Alliance's Survey of Government and Voluntary Sector Investment in Cancer Research in 2005* (available at http://www.ccra-acrc.ca/aboutus_publications_en.htm).

3.1 PROJECT IDENTIFICATION

Identifying relevant projects employed a number of steps:

(1) All research projects being conducted at pediatric facilities were identified. Note that this is an imperfect criterion because universities are most typically identified as host institutions, and not all institutions involved in child health research can be readily identified by their name.

(2) All projects with one or more of the following 14 keywords in the title and/or descriptions were identified: child, infant, pediatric/paediatric, youth, adolescent, Wilm, retinoblastoma, neuroblastoma, rhabdomyosarcoma, hepatoblastoma, Ewing, osteosarcoma, medulloblastoma, and acute lymphoblastic leukemia/leukaemia.[1] (Wildcard search strategies were used.) The list of keywords was determined on the basis of external expert input.

(3) The combined list of projects from steps (1) and (2) were reviewed by CCRA staff and then by external experts. Excluded were:

- projects involving child/adolescent subjects but focused on risk factors/health determinants of cancers with an adult onset (e.g. tobacco prevention research). Of note, all the prevention intervention research projects within the database were excluded because they focused on adult onset cancers, and not on cancers in children or adolescents. (The lack of research on primary prevention interventions reflects the state of knowledge of modifiable risk factors for childhood/adolescent cancers.)
- projects focused on basic biological mechanisms, which could be potentially applicable to many cancers and age groups
- projects focused on adult cancers (e.g. breast, pancreas).

1. The wildcard search term "child*" tended to be the best individual keyword for identifying relevant projects, although there was some over-selection.

Projects included were:

- discovery research which had at least a partial focus on the biological and molecular mechanisms of childhood/adolescent cancers
- clinical, translational, behavioural/psychosocial studies which focused on treatment, survivorship, familial issues, and palliation of children/adolescents with cancer as well as adult survivors of childhood/adolescent cancers
- grants for equipment/infrastructure used to conduct research which focused in whole or in part on childhood cancers (75% of such grants went to Principal Investigators (PIs) working at pediatric facilities).

Of note, not all projects at pediatric facilities were included (i.e. 129/264 were included).

(4) During step (3), weightings were assigned to those projects not entirely focused on childhood/adolescent cancers but deemed to be relevant enough to include some portion of their project budgets within the analysis (67 projects were weighted).

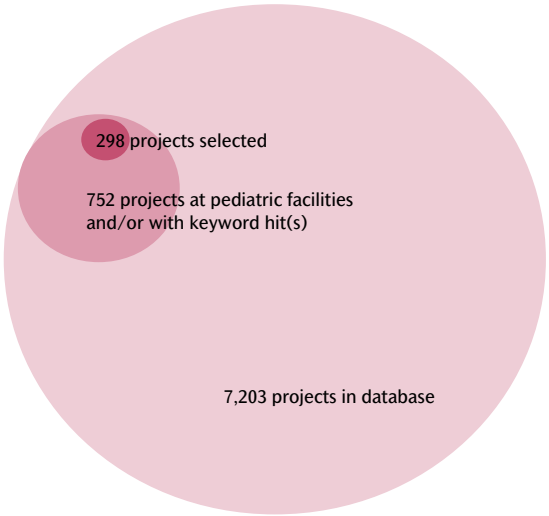
The final list of 298 projects represented 4.1% of all projects in the CCRA database for years 2005-2007 inclusive (see Figure 3.1.1).

3.2 PROJECT CLASSIFICATION

The data source used was the CCRA database, which includes research projects funded by 37 government and voluntary sector organizations from January 1, 2005 to December 31, 2007.

FIGURE 3.1.1

PROJECTS SELECTED FOR INCLUSION IN THE CALCULATION OF RESEARCH INVESTMENT IN CHILDHOOD/ADOLESCENT CANCERS



This database is populated with information captured as part of the annual Canadian Cancer Research Survey.

All research projects within the database are classified in terms of area of research and cancer site on the basis of descriptions provided by the participating funder organizations. The Common Scientific Outline (CSO), a classification system specific to cancer research, is used as the tool to classify the projects into seven broad categories of scientific interest (see sidebar for a description of these categories). The CSO is the principal classification framework used by the International Cancer Research Partners (ICRP), a partnership comprised of a number of key cancer research funders from the US, UK and Canada.

For this report, the International Classification of Childhood Cancer, Third Edition (ICCC-3)[2] was used to group cancers. (In the main survey, site classification is done of the basis of the International Statistical Classification of Diseases and Related Health Programs, 10th Revision, Version for 2007 (ICD-10)). The ICCC-3 is based on tumour morphology (structure) and was developed to reflect the differences in childhood cancers from cancers in adults in terms of histology, site of origin, and tumour behaviour. It classifies childhood cancers into 12 diagnostic groups, with additional subgroups for further refinement. For details on the way in which the ICCC-3 was applied to the analyses, please refer to Appendix A.

CATEGORIES OF THE COMMON SCIENTIFIC OUTLINE (CSO)

BIOLOGY: Research included in this category looks at the biology of how cancer starts and progresses as well as normal biology relevant to these processes.

ETIOLOGY: Research included in this category aims to identify the causes or origins of cancer-genetic, environmental and lifestyle, and the interactions between these factors.

PREVENTION: Research included in this category looks at identifying interventions which reduce cancer risk by reducing exposure to cancer risks and increasing protective factors. Interventions may target lifestyle or may involve drugs or vaccines.

EARLY DETECTION, DIAGNOSIS & PROGNOSIS: Research included in this category focuses on identifying and testing cancer markers and imaging methods that are helpful in detecting and/or diagnosing cancer as well as predicting the outcome or chance of recurrence.

TREATMENT: Research included in this category focuses on identifying and testing treatments administered locally and systemically as well as non-traditional (complementary/alternative) treatments.

CANCER CONTROL, SURVIVORSHIP & OUTCOMES: Research included in this category includes a broad range of areas: patient care and pain management; tracking cancer cases in the population; beliefs and attitudes that affect behaviour regarding cancer control; education and communication approaches for patients and health care professionals; supportive and end-of-life care; health care delivery in terms of quality and cost-effectiveness; and research ethics.

SCIENTIFIC MODEL SYSTEMS: Research included in this category looks at development of new animal models, cell cultures and computer simulations and their application to other studies across the spectrum of cancer research.

2. Steliarova-Foucher E, Stiller C, Lacour B & Kaatsch P. (2005). International Classification of Childhood Cancer, Third Edition. *Cancer*, 103(7):1457-1467.

DEFINITIONS OF FUNDING MECHANISMS

Career awards: Competitive awards which provide protected time for research on either a long-or short-term basis to outstanding researchers who have demonstrated high levels of productivity and research accomplishments. These awards are given to only a small percentage of all researchers. (May also be called salary awards.) Research chairs and establishment grants, grants designed to facilitate the recruitment of outstanding researchers, are also included under this funding mechanism.

Equipment/infrastructure grants: Competitive grants which cover in part or in full the costs of construction or major remodelling of new research facilities, and/or the purchase, housing and installation of equipment, scientific collections, computer software, information databases, and communication linkages used primarily for conducting research.

Operating grants: Competitive grants which support all the direct costs involved in conducting specific research projects performed by identified researchers. Operating grants typically cover salaries for laboratory staff and research assistants/associates/trainees, costs of research equipment and supplies, and other specific research-related expenses. Multi-component projects (program projects), feasibility grants, proof-of-principle grants, regional development grants, innovation grants and knowledge translation grants are all included in this category.

Related support grants: Competitive grants which support travel, workshops/symposia as well as researcher time for proposal development/ letters of intent. These grants generally involve relatively small levels of funding.

Trainee awards: Competitive awards which recognize outstanding trainees and support them during their undergraduate, graduate or post-graduate training. Trainees from Canada who are studying at institutions outside of Canada may also be eligible for some types of trainee awards. Block training grants given to institutions that in turn distribute the monies to trainees through a competitive process are also included under this funding mechanism.

Projects are also grouped according to type of funding mechanism. Definitions of the funding mechanisms are provided in the sidebar.

3.3 REPORTING CONVENTIONS

The term "cancer research investment" represents the direct funding of cancer research projects that received some form of peer review and that were administered by the organizations participating in the survey.

This chapter uses two approaches to calculating the investment for calendar year periods 2005, 2006 and 2007:

(1) **Annual investments:** These are prorated calculations which assume that project dollars were paid out in equal monthly instalments based on project start and end dates. This approach provides a fairly accurate picture of the dollars being invested by funder organizations in a given year, and standardizes the calculation across organizations with disparate funding cycles.

(2) **New commitments:** This approach allocates the full project amounts to the year in which the projects started. It is a useful way to identify emerging strategic priorities or shifts in funding patterns, particularly when time series are being examined. It is, however, subject to fluctuations especially when the number of projects included in the analysis is not large.

To illustrate the differences in the two approaches, consider the example of a two-year project awarded $160,000 that had a start date of July 1, 2005 and an end date of June 30, 2007.

	2005	2006	2007
Annual investments	$40,000	$80,000	$40,000
New commitments	$160,000	$0	$0

3.4 CAVEATS

Project selection criteria as well as classification are only as good as the available information. In particular, use of text-based selection criteria is based on the assumption that researchers state their intentions regarding disease focus and age group relevance within their project descriptions. This may not always be the case.

While this report provides an estimate of the investment in research by the major government and voluntary sector cancer research funders in Canada, it does not include funding that researchers at pediatric facilities may receive from their affiliated institutional foundations/charities nor monies that pediatric facilities may receive/invest in clinical trials research from industry sponsors or from cancer research funding organizations outside of Canada. In 2007, the pediatric cancer centres in Canada received $1,589,673 in COG funding.[3] A smaller number of centres are involved in trials through the Pediatric Blood and Marrow Transplant Consortium (PBMTC). We are also aware that the four pediatric cancer centres in Quebec receive monies for clinical research from Leucan Inc., a Quebec-based charity focused on pediatric oncology. The amount awarded averaged $959,311 annually for the period April 1, 2005 to March 31, 2008.[4]

---

3. Data provided by email from Kathy Brodeur-Robb, Executive Director, C[17] Council on May 1, 2009.
4. Data on registered charity information returns for years 2006, 2007, and 2008, line 4910, "Research grants and scholarships as part of charitable programs" retrieved from the Canada Revenue Agency's Charities and Giving website (http://www.cra-arc.gc.ca/tx/chrts/menu-eng.html) on May 1, 2009.

4. FINDINGS

4.1 INVESTMENT

An overview of the investment in childhood and adolescent cancer research for years 2005 to 2007 is provided in Table 4.1.1. Overall, this investment represented about 3% of all cancer research investment and 4% of all cancer research projects within the CCRA database. This is comparable to the ~3.7% reported by the National Cancer Institute in the US for fiscal years 2005 to 2007.[1]

TABLE 4.1.1

NUMBER OF PROJECTS AND RESEARCH INVESTMENT IN CHILDHOOD/ ADOLESCENT CANCERS, ANNUAL INVESTMENTS AND NEW COMMITMENTS, 2005-2007

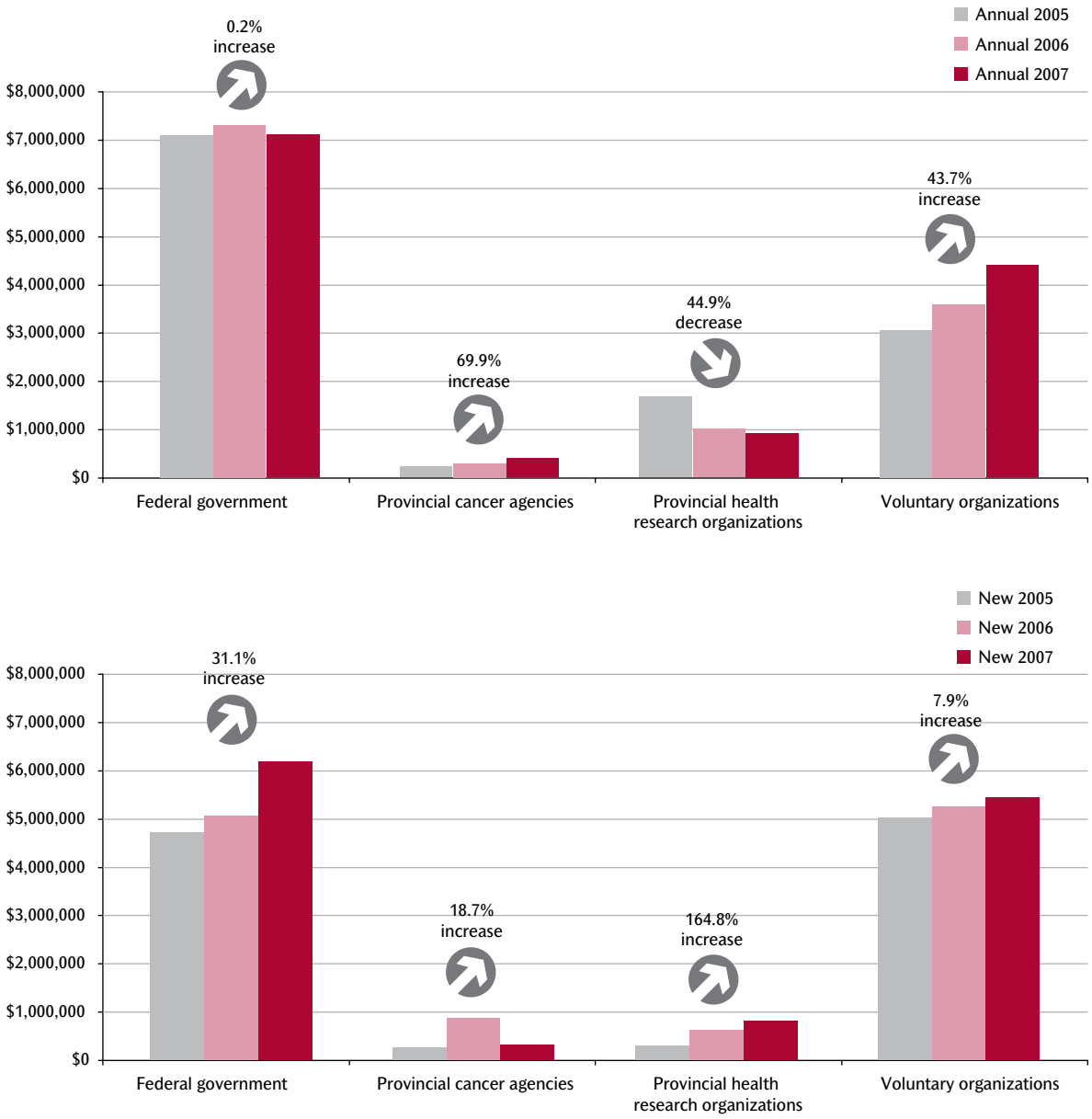
		Research in childhood/adolescent cancers				All cancer research	
		Investment	Number of projects	% of total investment	% of total projects	Investment	Number of projects
Annual investment	2005	$12,390,361	176	3.40	4.28	$364,337,256	4,114
	2006	$12,538,938	185	3.33	4.05	$376,442,053	4,570
	2007	$13,169,621	198	3.27	4.07	$402,448,190	4,868
New commitments	2005	$9,998,723	62	2.83	4.01	$352,898,714	1,514
	2006	$11,449,472	52	2.92	3.45	$391,718,096	1,509
	2007	$12,344,800	66	3.80	4.03	$324,727,835	1,637

The federal sector, largely due to the Canadian Institutes of Health Research (CIHR), accounted for 58.0% of the annual investment in childhood/adolescent cancers for years 2005 to 2007 (see Figure 4.1.1), and this represented 3.1% of the total annual cancer research investment by the federal sector over this period. The voluntary sector, largely due to the Canadian Cancer Society (CCS), accounted for 29.8% of the investment in childhood/adolescent cancers for years 2005 to 2007. This represented 5% of the sector's total annual cancer research investment. Annualized investment decreased from 2005 to 2007 for provincial health research organizations, although new commitments rose. For all other sectors, increased levels of annualized investment and new commitments occurred between 2005 and 2007.

1. National Cancer Institute. *A Snapshot of Pediatric Cancers.* September 2008. Available at http://planning.cancer.gov/disease/Pediatric-Snapshot.pdf.

FIGURE 4.1.1

RESEARCH INVESTMENT IN CHILDHOOD/ADOLESCENT CANCERS BY FUNDER SECTOR [1], ANNUAL INVESTMENTS AND NEW COMMITMENTS, 2005-2007



[1] Refers to the sector of the organization that administered the funding program.

Table 4.1.2 provides a detailed snapshot of the 2007 annual investment and new commitment estimates by funder organization. Combined CIHR and CCS represented 56.6% ($7.5M) of the annual investment and 66.4% ($8.2M) of the new commitments in 2007. Substantial new commitments were also reflected for the Canada Research Chairs Program.

TABLE 4.1.2

RESEARCH INVESTMENT IN CHILDHOOD/ADOLESCENT CANCERS BY PARTICIPATING ORGANIZATIONS, ANNUAL INVESTMENT AND NEW COMMITMENTS, 2007

		Annual Investment 2007		New Commitments 2007	
SECTOR [1]	ORGANIZATION	$	%	$	%
Federal government	Canada Foundation for Innovation	$2,751,235	20.89	$136,785	1.11
	Canada Research Chairs Program	$165,833	1.26	$1,600,000	12.96
	Canadian Institutes of Health Research	$4,365,737	33.15	$4,247,982	34.41
	Social Sciences and Humanities Research Council	$11,206	0.09	$0	0.00
Provincial cancer agencies	Alberta Cancer Board	$372,628	2.83	$235,148	1.90
	CancerCare Manitoba	$38,925	0.30	$77,850	0.63
Provincial health research organizations	Alberta Heritage Foundation for Medical Research	$38,000	0.29	$0	0.00
	Fonds de la recherche en santé du Québec	$454,933	3.45	$367,748	2.98
	Manitoba Health Research Council	$3,825	0.03	$15,300	0.12
	Michael Smith Foundation for Health Research	$45,563	0.35	$9,000	0.07
	Nova Scotia Health Research Foundation	$21,218	0.16	$7,130	0.06
	Ontario Institute for Cancer Research	$385,701	2.93	$391,068	3.17
Voluntary organizations	Brain Tumour Foundation of Canada	$11,442	0.09	$62,373	0.51
	C[17] Research Network	$185,731	1.41	$419,455	3.40
	Canadian Cancer Society	$3,088,098	23.45	$3,947,772	31.98
	The Cancer Research Society	$279,300	2.12	$0	0.00
	The Leukemia & Lymphoma Society of Canada	$62,500	0.47	$200,000	1.62
	The Terry Fox Foundation	$887,745	6.74	$627,189	5.08
TOTAL		**$13,169,621**	**100**	**$12,344,800**	**100**

[1] Refers to the sector of the organization that administered the funding program.

The geographic breakdown of the investment is provided in Table 4.1.3. In this table, projects were grouped under the province/jurisdiction where the Principal Investigator (PI) was located. The vast majority of projects were conducted by PIs working in Ontario. Half of the annual investments and just over one-third of the new commitments for the 2005-2007 period were for research conducted at The Hospital for Sick Children in Toronto. A detailed breakdown of the cumulative annual investments for 2005 to 2007 by institution of PI is provided in Table 4.1.4.

TABLE 4.1.3

RESEARCH INVESTMENT IN CHILDHOOD/ADOLESCENT CANCERS BY PROVINCE OF PI, ANNUAL INVESTMENTS AND NEW COMMITMENTS, 2005-2007

		Province [1]								
		Alta.	B.C.	Man.	N.L.	N.S.	Ont.	Que.	Sask.	Outside Canada [2]
Annual investment	2005	$575,805	$1,382,811	$262,143	$24,998	$55,960	$8,364,471	$1,594,672	$22,000	$107,500
	2006	$602,407	$1,591,174	$384,029	$0	$55,094	$8,174,194	$1,514,884	$27,157	$190,000
	2007	$726,287	$1,442,065	$449,357	$3,333	$56,437	$8,618,205	$1,712,306	$21,629	$140,000
New commitments	2005	$423,323	$1,875,891	$960,946	$0	$0	$4,663,373	$1,630,190	$0	$445,000
	2006	$921,532	$967,835	$531,552	$0	$45,060	$7,991,729	$895,905	$20,859	$75,000
	2007	$1,064,252	$499,243	$163,150	$50,000	$292,400	$8,081,168	$2,194,587	$0	$0

[1] There were no projects in New Brunswick or Prince Edward Island.
[2] Includes trainees who were studying at institutions outside Canada.

TABLE 4.1.4

ANNUAL RESEARCH INVESTMENT IN CHILDHOOD/ADOLESCENT CANCERS BY INSTITUTION OF PI, 2005-2007 [1]

Province [2]	Institution of PI	Annual investment 2005-2007	% of total investment
Alta. $1,904,499 (5.06%)	Alberta Children's Hospital	$2,083	0.01
	Cross Cancer Institute/Alberta Cancer Board	$519,393	1.38
	University of Alberta	$753,033	2.00
	University of Calgary	$384,991	1.02
	University of Lethbridge	$245,000	0.65
B.C. $4,416,050 (11.73%)	BC Cancer Agency/BC Cancer Research Centre	$1,043,886	2.77
	Children's & Women's Health Centre of British Columbia (and affiliated research institute)	$707,213	1.88
	University of British Columbia	$2,470,882	6.56
	University of Victoria	$194,068	0.52
Man. $1,095,530 (2.91%)	CancerCare Manitoba/Manitoba Institute of Cell Biology	$105,707	0.28
	University of Manitoba	$989,823	2.63
N.L. $28,331 (0.08%)	Memorial University of Newfoundland	$28,331	0.08
N.S. $167,491 (0.44%)	Dalhousie University	$45,060	0.12
	IWK Health Centre	$122,431	0.33
Ont. $25,156,870 (66.80%)	Cancer Care Ontario	$46,209	0.12
	Children's Hospital/London's Health Sciences Centre (and affiliated research institute)	$91,033	0.24
	Children's Hospital of Eastern Ontario	$682,615	1.81
	Hospital for Sick Children, The	$19,358,342	51.40
	McMaster University	$376,994	1.00
	Mount Sinai Hospital	$645,272	1.71
	Ottawa Health Research Institute	$157,516	0.42
	Queen's University	$662,102	1.76
	Sunnybrook Health Sciences Centre	$148,454	0.39
	University Health Network (including Ontario Cancer Institute and Toronto Western Hospital and its research institute)	$2,313,016	6.14
	University of Toronto	$357,000	0.95
	University of Western Ontario	$260,000	0.69
	Wilfrid Laurier University	$40,817	0.11
	York University	$17,500	0.05
Que. $4,821,862 (12.80%)	Centre hospitalier universitaire Sainte-Justine (and affiliated research centre)	$1,365,350	3.63
	Centre hospitalier universitaire de Québec (CHUQ) Pavilion Centre hospitalier de l'Université Laval (CHUL)	$104,931	0.28
	Institut de recherche en immunologie et en cancérologie (IRIC)	$500,000	1.33
	McGill University	$1,442,252	3.83
	McGill University Health Centre, including Montreal Children's Hospital (and affiliated research institute), Montreal Neurological Hospital, and Sir Mortimer B. Davis Jewish General Hospital	$482,958	1.28
	Université Laval	$185,509	0.49
	Université de Montréal	$740,864	1.97
Sask. $70,787 (0.19%)	University of Regina	$12,120	0.03
	University of Saskatchewan	$58,667	0.16
TOTAL		**$37,661,420**	**100**

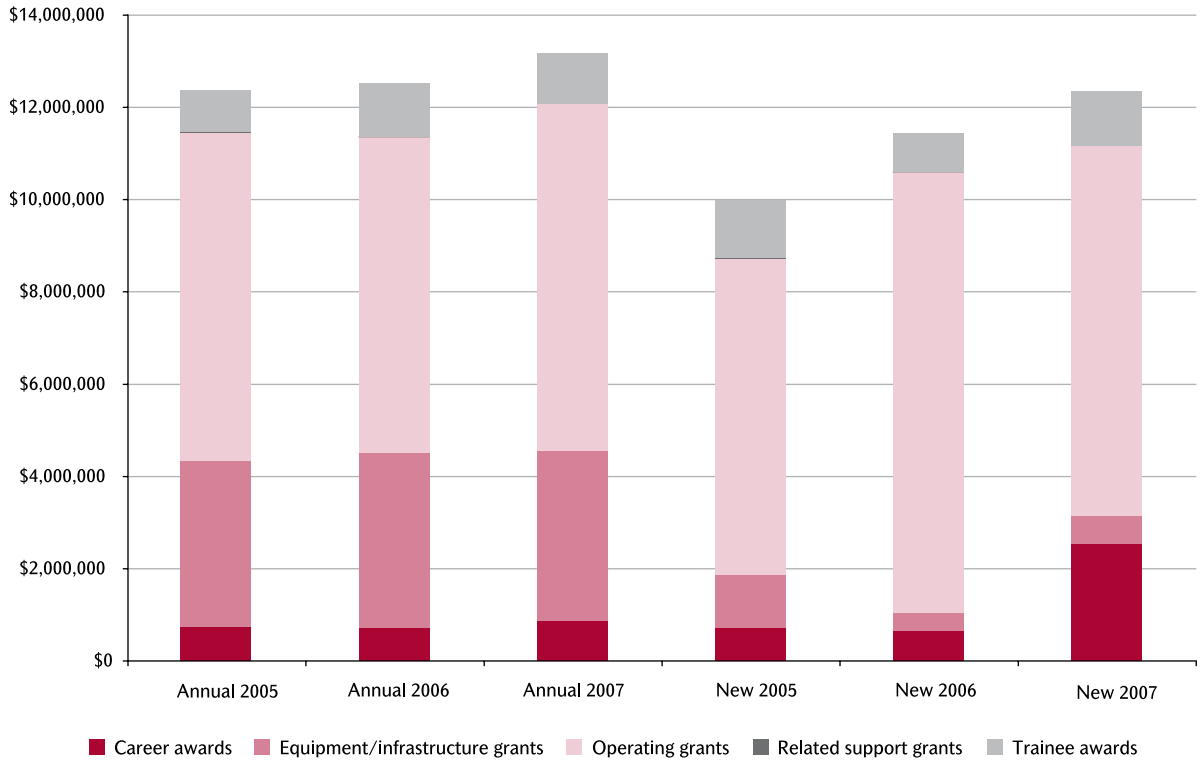
[1] Excludes trainees who were studying at institutions outside Canada.
[2] There were no projects in New Brunswick or Prince Edward Island.

Figure 4.1.2 looks at the investment by type of funding mechanism. Operating grants represented 56.4% of the annual investments and 72.3% of the new investments over the 2005-2007 period. The increase in new commitments in career awards in 2007 was due to the initiation of terms for three Canada Research Chairs working in the area of childhood/adolescent cancers. Investments in trainee awards were fairly stable over the three years.

From 2005-2007, there were 116 PIs who were funded for a career award, equipment/infrastructure grant, or operating grant that focused on childhood/adolescent cancers. This represented 5.8% of all PIs within the CCRA database who had a career award, equipment/infrastructure grant, or operating grant active at some point in this three-year timeframe.

FIGURE 4.1.2

RESEARCH INVESTMENT IN CHILDHOOD/ADOLESCENT CANCERS BY FUNDING MECHANISM, ANNUAL INVESTMENTS AND NEW COMMITMENTS, 2005-2007



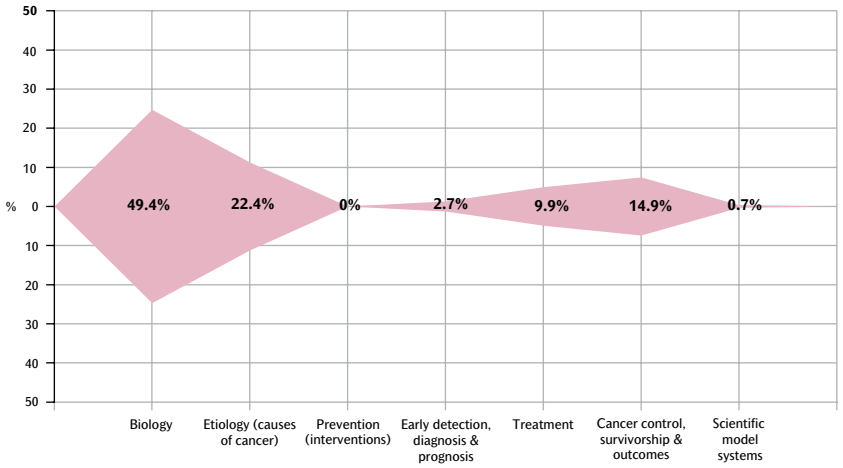
4.2 TYPES OF RESEARCH

The distribution of the annual investment and new commitments for 2007 in terms of the CSO categories is shown in Figure 4.2.1. When compared with the total cancer research investment, the research investment in childhood/adolescent cancers was proportionately more than doubled for Etiology, and also proportionately higher for the Biology and Cancer Control, Survivorship & Outcomes categories. Conversely, the proportions of the childhood/adolescent cancer research investment in Treatment and Early Detection, Diagnosis & Prognosis were less than half that found for the total cancer research investment. The Prevention category was zero because there was no research on cancer prevention interventions focused on preventing the onset of cancer in children/adolescents (as previously mentioned, the lack of research on primary prevention interventions reflects the state of knowledge of modifiable risk factors for childhood/adolescent cancers.)

Table 4.2.1 shows the distribution at the level of the 38 CSO codes, comparing the total cancer research investment with the research investment in childhood/adolescent cancers. The most striking differences were for research investments in the areas of oncogenes and tumour suppressor genes (code 1.3) and endogenous factors in the origin and cause of cancer (code 2.2), where the proportions of research investment in childhood/adolescent cancers were nearly doubled that for all cancer research. As was shown in Figure 4.2.1, the proportionate investment in Cancer Control, Survivorship & Outcomes Research was higher for the research on childhood/adolescent cancers.

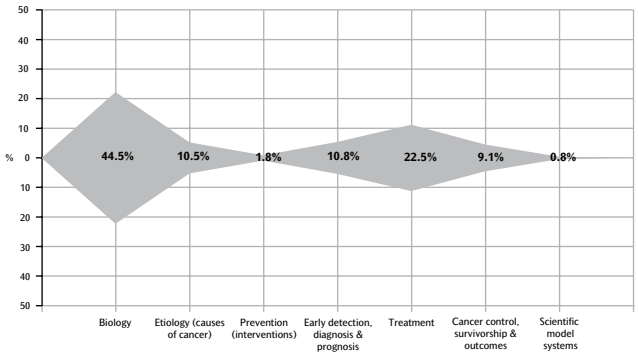
FIGURE 4.2.1

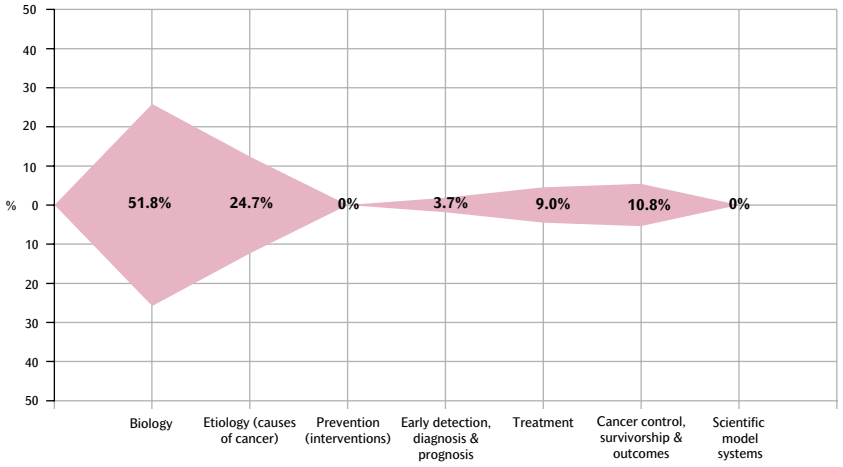
DISTRIBUTION OF RESEARCH INVESTMENT IN CHILDHOOD/ADOLESCENT CANCERS BY CSO CATEGORY, ANNUAL INVESTMENTS AND NEW COMMITMENTS, 2007



Annual research investment, Childhood/ adolescent cancers, 2007 ($13.2M)

Annual research investment, All cancer research, 2007 ($402.4M)





New research commitments, Childhood/ adolescent cancers, 2007 ($12.3M)

New research commitments, All cancer research, 2007 ($324.7M)

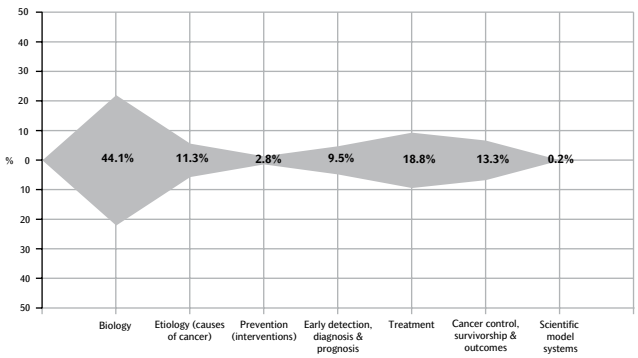


TABLE 4.2.1

DISTRIBUTION OF RESEARCH INVESTMENT IN CHILDHOOD/ADOLESCENT CANCERS AND ALL CANCER RESEARCH BY CSO CODES, THREE-YEAR CUMULATIVE ANNUAL INVESTMENTS, 2005-2007

		ANNUAL INVESTMENT 2005-2007			
		Childhood/Adolescent (C/A) Cancers		All Cancer Research	
CSO Category	CSO Code [1]	% total investment	% category investment	% total investment	% category investment
1 - BIOLOGY C/A $18,914,721 (49.65%) All $504,081,153 (44.09%)	1.1 - Normal functioning	5.43	10.94	15.68	35.57
	1.2 - Cancer initiation: alterations in chromosomes	2.82	5.68	2.48	5.63
	1.3 - Cancer initiation: oncogenes and tumour suppressor genes	23.46	47.26	10.48	23.78
	1.4 - Cancer progression and metastasis	4.24	8.54	6.31	14.31
	1.5 - Resources and infrastructure	13.69	27.58	9.13	20.71
2 - ETIOLOGY (CAUSES OF CANCER) C/A $8,115,225 (21.30%) All $121,041,804 (10.59%)	2.1 - Exogenous factors [2] in the origin and cause of cancer	2.63	12.35	2.91	27.51
	2.2 - Endogenous factors [3] in the origin and cause of cancer	11.74	55.14	4.94	46.64
	2.3 - Interactions of genes and/or genetic polymorphisms [4] with exogenous and/or endogenous factors	0.16	0.77	0.70	6.59
	2.4 - Resources and infrastructure	6.76	31.74	2.04	19.27
3 - PREVENTION (INTERVENTIONS) C/A 0 All $19,711,955 (1.72%)	3.1 - Interventions to prevent cancer: personal behaviours that affect cancer risk			0.85	49.47
	3.2 - Nutritional science in cancer prevention			0.16	9.27
	3.3 - Chemoprevention			0.13	7.59
	3.4 - Vaccines			0.06	3.74
	3.5 - Complementary and alternative prevention approaches			0.12	6.89
	3.6 - Resources and infrastructure			0.40	23.04
4 - EARLY DETECTION, DIAGNOSIS & PROGNOSIS C/A $1,400,172 (3.68%) All $118,650,881 (10.38%)	4.1 - Technology development and/or marker discovery	1.71	46.58	4.11	39.60
	4.2 - Technology and/or marker evaluation with respect to fundamental parameters of method	0.69	18.88	1.99	19.16
	4.3 - Technology and/or marker testing in a clinical setting	0.07	1.96	0.95	9.20
	4.4 - Resources and infrastructure	1.20	32.58	3.33	32.05
5 - TREATMENT C/A $4,160,937 (10.92%) All $269,988,443 (23.62%)	5.1 - Localized therapies [5] – discovery and development	0.00	0.00	1.65	6.98
	5.2 - Localized therapies – clinical applications	0.00	0.00	0.81	3.44
	5.3 - Systemic therapies [6] – discovery and development	7.98	73.01	11.85	50.18
	5.4 - Systemic therapies – clinical applications	1.47	13.46	1.85	7.84
	5.5 - Combinations of localized and systemic therapies	0.00	0.00	0.18	0.74
	5.6 - Complementary and alternative treatment approaches	0.00	0.00	0.08	0.33
	5.7 - Resources and infrastructure	1.47	13.44	7.20	30.50
6 - CANCER CONTROL, SURVIVORSHIP & OUTCOMES RESEARCH C/A $5,385,136 (14.13%) All $99,677,215 (8.72%)	6.1 - Patient care and survivorship issues	4.85	34.33	2.43	27.88
	6.2 - Surveillance	0.08	0.58	0.56	6.40
	6.3 - Behaviour	2.35	16.64	1.23	14.14
	6.4 - Cost analyses and healthcare delivery	2.06	14.56	1.20	13.79
	6.5 - Education and communication	0.89	6.27	0.60	6.93
	6.6 - End-of-life care	1.70	12.06	0.90	10.30
	6.7 - Ethics and confidentiality in cancer research	0.06	0.42	0.09	1.07
	6.8 - Complementary and alternative approaches for supportive care of patients and survivors	0.00	0.00	0.16	1.79
	6.9 - Resources and infrastructure	2.14	15.13	1.54	17.70
7 - SCIENTIFIC MODEL SYSTEMS C/A $122,729 (0.88%) All $10,076,047 (0.88%)	7.1 - Development and characterization of model systems [7]	0.19	60.48	0.76	86.30
	7.2 - Application of model systems	0.00	0.00	0.00	0.00
	7.3 - Resources and infrastructure	0.13	39.52	0.12	13.70

[1] For a full description of the CSO codes, please refer to http://www.cancerportfolio.org/cso.jsp.
[2] Exogenous (originating outside) factors: Lifestyle and environmental factors, and infectious agents like viruses and bacteria which are involved in the origins and causes of cancer.
[3] Endogenous (originating within) factors: Internal factors such as free radicals and genetic factors which are involved in the origins and causes of cancer.
[4] Polymorphisms: Mutations or common variations in a person's DNA.
[5] Localized treatments: Treatments which are administered locally (such as radiotherapy and surgery).
[6] Systemic treatments: Treatments which are administered throughout the body (such as drugs).
[7] Model systems: Specially developed animals, cell cultures and computer stimulations which are used to study cancer processes.

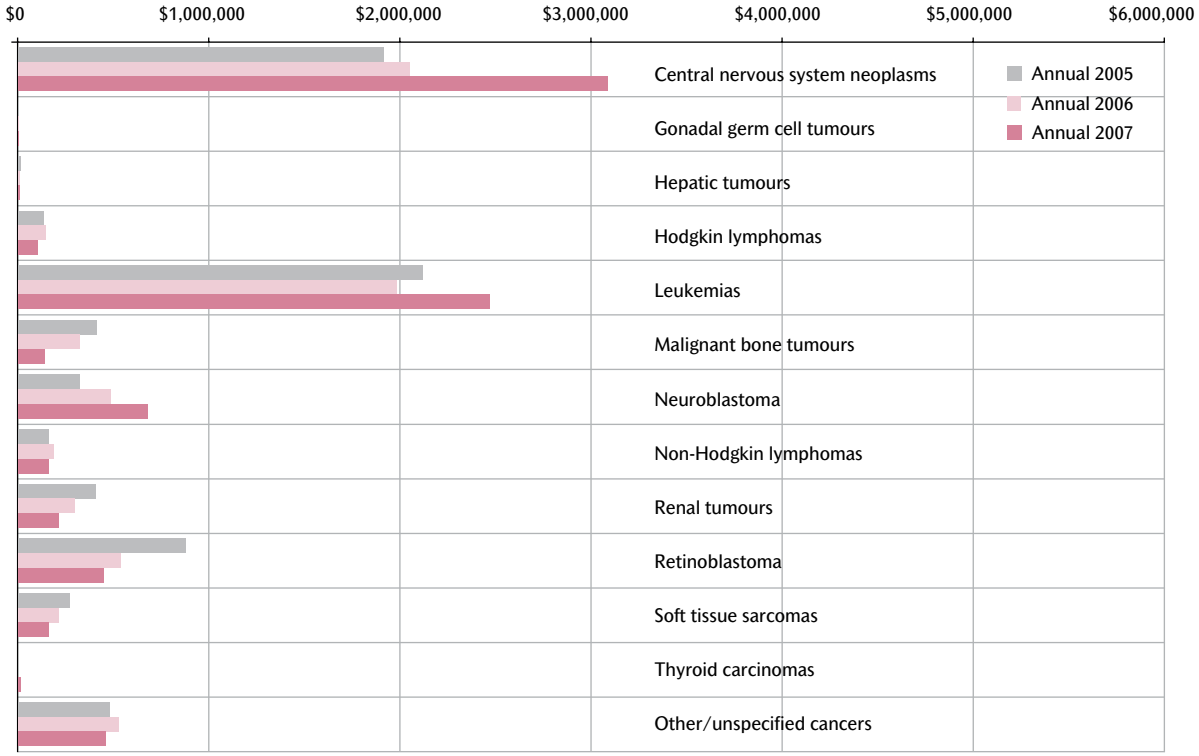
4.3 CANCER SITES

When looking at annual investments for the 2005-2007 cumulative period, the estimates for the investment in childhood/adolescent cancer research tended to have a lower percentage of projects which were not focused on a specific cancer site (42.8% versus 52.1% for the total cancer research investment).

A detailed breakdown of both the annual investment and new commitments by cancer sites is shown in Figure 4.3.1. Site-specific investments varied considerably from site to site, and year to year. Most notably, there was a substantial increase in research focused on central nervous system neoplasms (includes cancers of the brain and spinal cord) in 2007. This represented an over 100% increase in new commitments and a 61.2% increase in annual investments from 2005 to 2007. Proportional representations of these same data are provided in Figure 4.3.2.

FIGURE 4.3.1

RESEARCH INVESTMENT IN CHILDHOOD/ADOLESCENT CANCERS BY CANCER SITE, ANNUAL INVESTMENTS AND NEW COMMITMENTS, 2005-2007



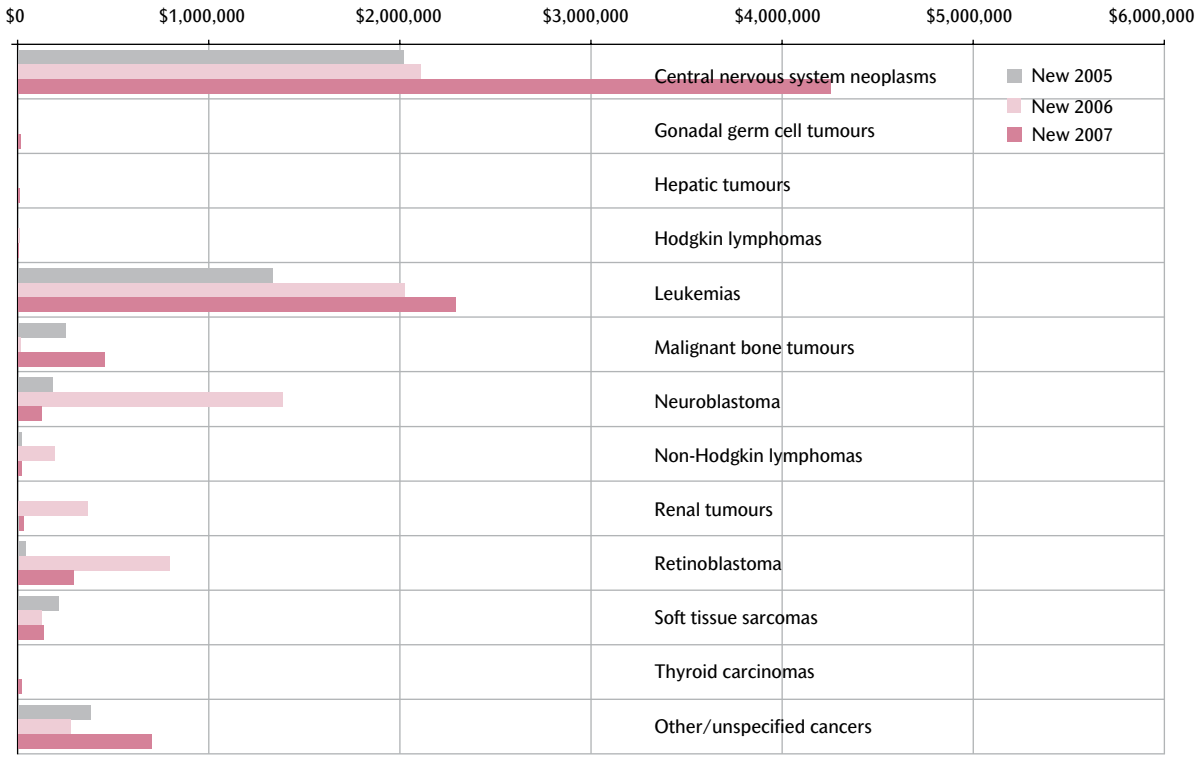
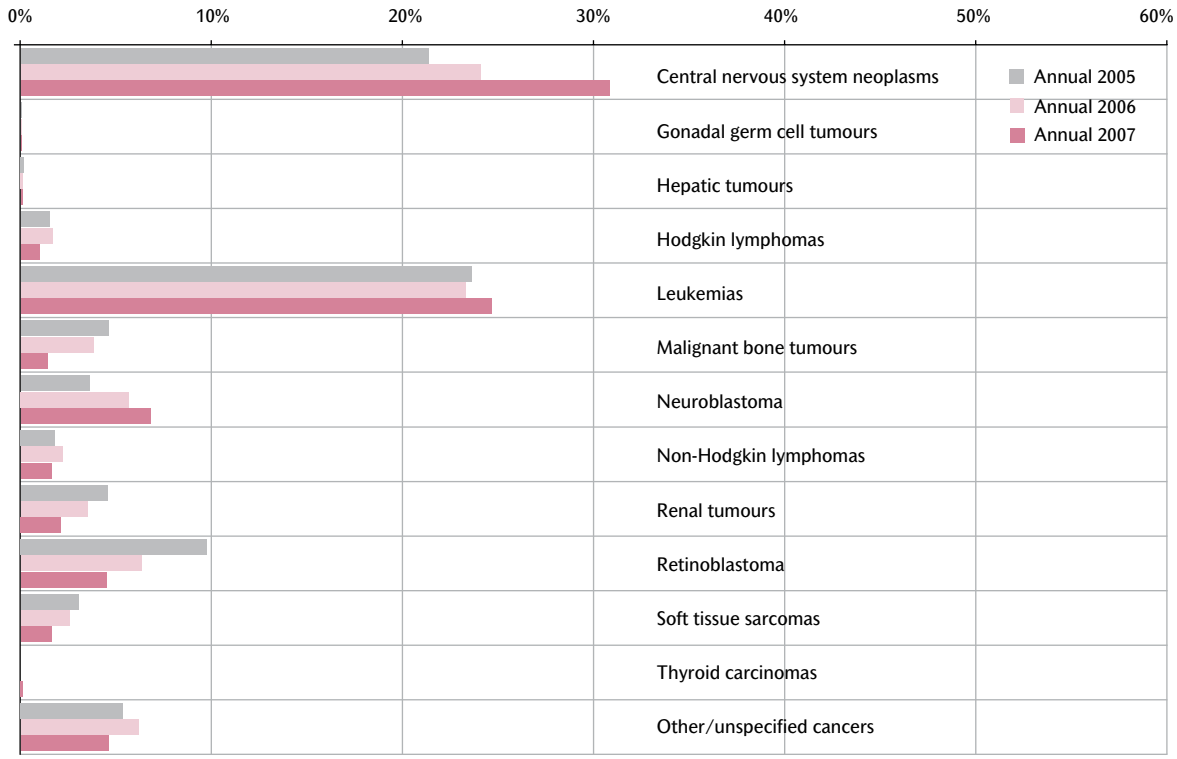


FIGURE 4.3.2

DISTRIBUTION OF RESEARCH INVESTMENT IN CHILDHOOD/ADOLESCENT CANCERS BY CANCER SITE, ANNUAL INVESTMENTS AND NEW COMMITMENTS, 2005-2007



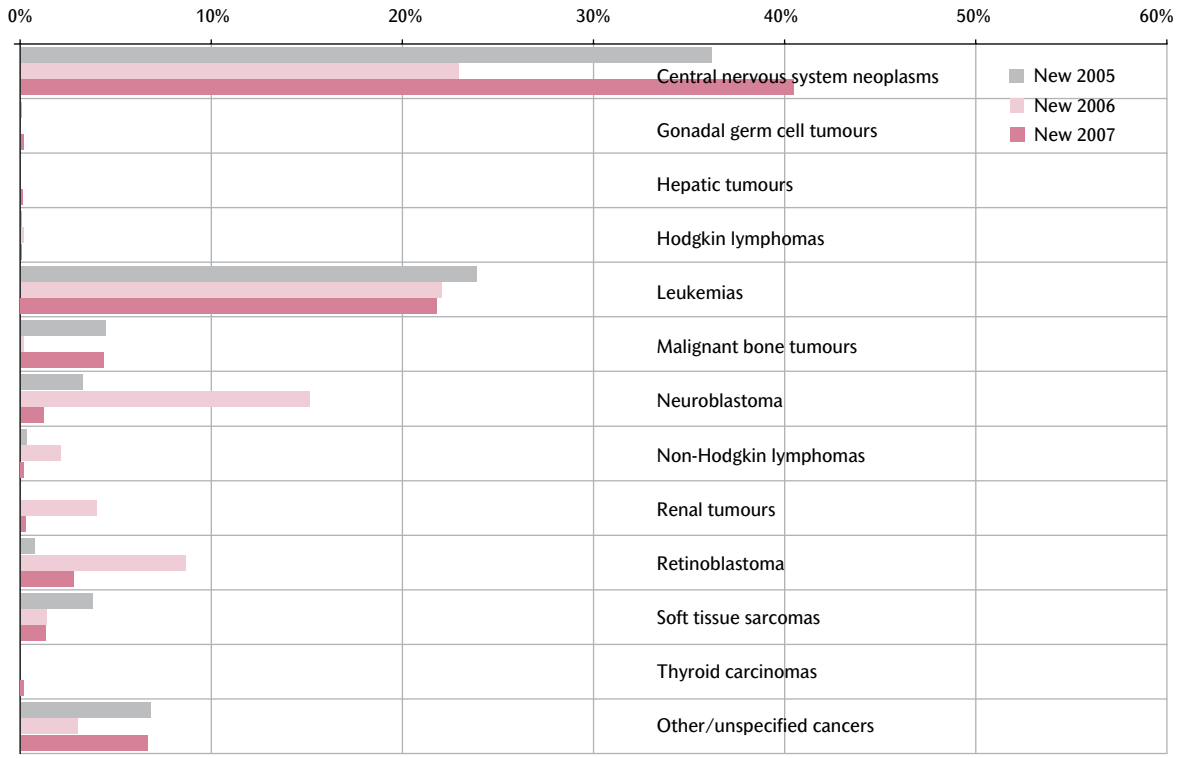


Figure 4.3.3 shows the distribution of the combined annual investments (2005-2007) for the main cancers affecting children/adolescents. A more detailed representation of this data is provided in Figure 4.3.4, which shows the site-specific investment relative to the new cancer cases. In the bubble chart (see Figure 4.3.5), cancer sites are compared in terms of proportion of cancer research investment (x-axis), estimated five-year observed survival proportions estimates (y-axis), and number of new cases (bubble size). This shows that central nervous system neoplasms and leukemias, both with high incidence in this age group, also have the highest investments.

FIGURE 4.3.3

DISTRIBUTION OF RESEARCH INVESTMENT IN CHILDHOOD/ADOLESCENT CANCERS BY CANCER SITES, THREE-YEAR CUMULATIVE ANNUAL INVESTMENTS, 2005-2007

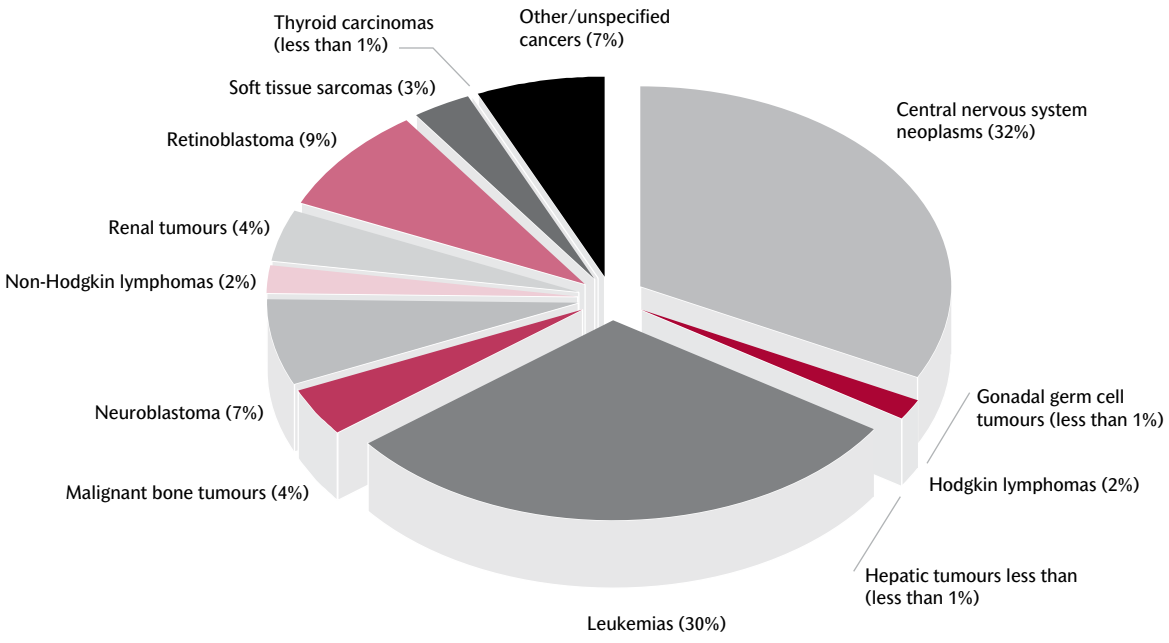
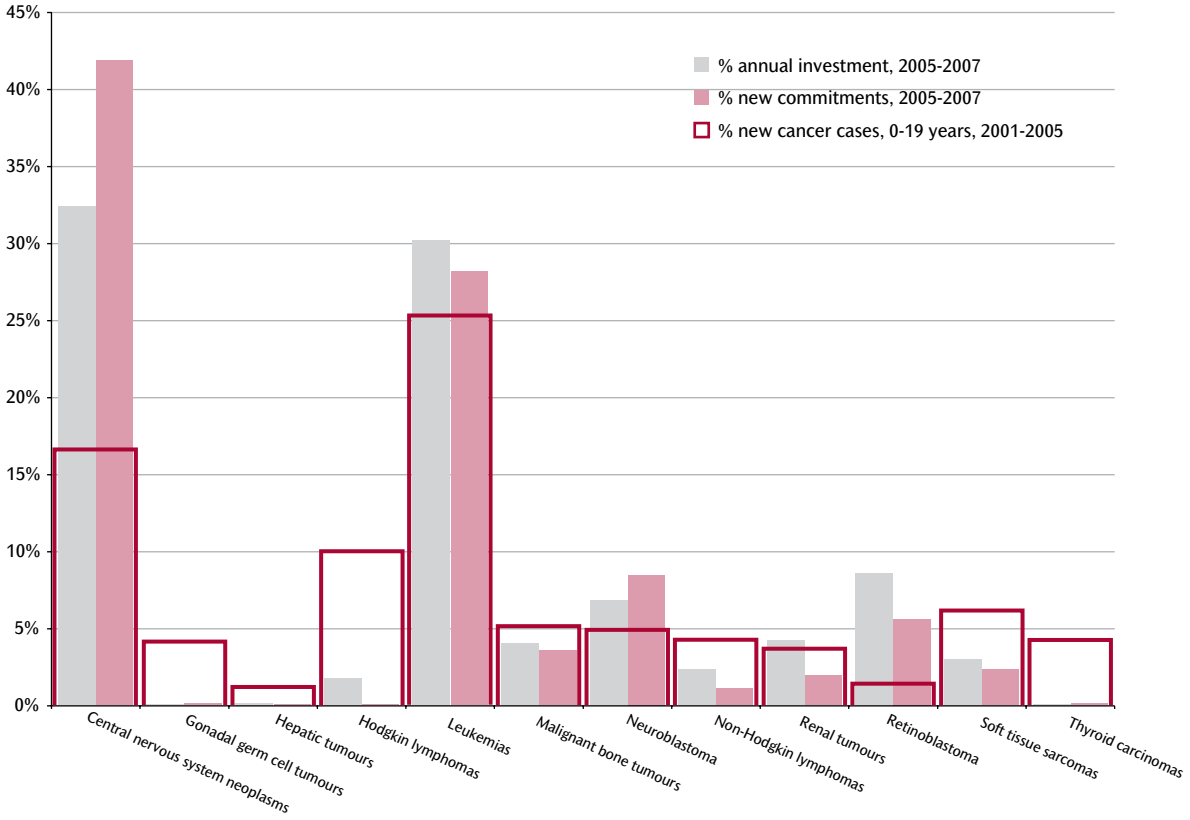


FIGURE 4.3.4

DISTRIBUTION OF NEW CANCER CASES AGES 0-19 FOR 2001-2005 [1] AND SITE-SPECIFIC RESEARCH INVESTMENT IN CHILDHOOD/ADOLESCENT CANCERS FOR 2005-2007 [2] BY CANCER SITES, ANNUAL INVESTMENTS AND NEW COMMITMENTS, 2005-2007

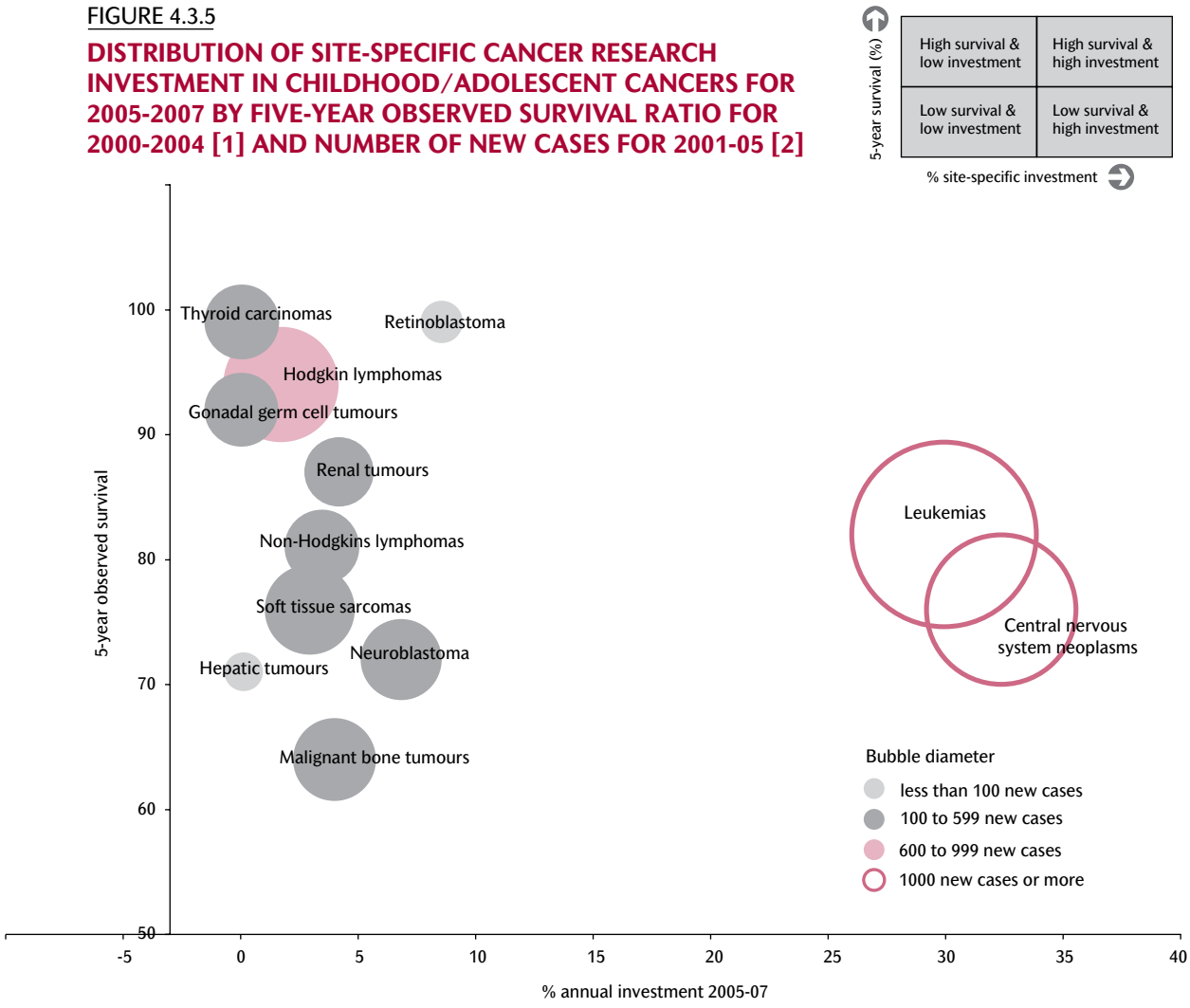


[1] Data on new cases from supplementary Table W2 to Canadian Cancer Society's Steering Committee. *Canadian Cancer Statistics 2009*. Toronto: Canadian Cancer Society, 2009. Available exclusively online at http://www.cancer.ca/canada-wide/about%20cancer/cancer%20statistics/~/media/CCS/Canada%20wide/Files%20List/English%20files%20heading/pdf%20not%20in%20publications%20section/stats%202009E%20Cancer%20in%20Children.ashx.

[2] Annual investments and new commitments were based on all three years of data.

FIGURE 4.3.5

DISTRIBUTION OF SITE-SPECIFIC CANCER RESEARCH INVESTMENT IN CHILDHOOD/ADOLESCENT CANCERS FOR 2005-2007 BY FIVE-YEAR OBSERVED SURVIVAL RATIO FOR 2000-2004 [1] AND NUMBER OF NEW CASES FOR 2001-05 [2]



[1] Data from supplementary Table W2 to Canadian Cancer Society's Steering Committee. *Canadian Cancer Statistics 2009*. Toronto: Canadian Cancer Society, 2009. Available exclusively online at: http://www.cancer.ca/canada-wide/about%20cancer/cancer%20statistics/~/media/CCS/Canada%20wide/Files%20List/English%20files%20heading/pdf%20not%20in%20publications%20section/stats%202009E%20Cancer%20in%20Children.ashx. Five year observed survival proportions estimates exclude Quebec because of methodological differences.

[2] Ibid.

Table 4.3.1 provides a detailed breakdown of investment dollars (three-year cumulative annual investment was used) by cancer site and CSO category and Table 4.3.2 provides the same data, showing the site-specific distributions across the CSO categories. While for many cancer sites, the largest proportionate investments were in the Biology area, all the site-specific investment for thyroid carcinomas and 52.6% for hepatic tumours were in the Etiology category. Malignant bone tumours emerged as somewhat unique in that 41.2% of the investment was in the Early Detection, Diagnosis & Prognosis category. Almost all of the research investment for Hodgkin lymphomas was in the Treatment category. Much of the investment (61.1%) for gonadal germ cell tumours was in the Cancer Control, Survivorship & Outcomes category.

TABLE 4.3.1

RESEARCH INVESTMENT IN CHILDHOOD/ADOLESCENT CANCERS BY CSO CATEGORY [1] AND CANCER SITES, THREE-YEAR CUMULATIVE ANNUAL INVESTMENT, 2005-2007

CANCER SITE	Biology	Etiology (causes of cancer)	Early detection, diagnosis & prognosis	Treatment	Cancer control, survivorship & outcomes	Scientific model systems	Total
Central nervous system neoplasms	$4,091,054	$1,753,061	$230,249	$664,721	$312,150	$0	$7,051,234
Gonadal germ cell tumours	$0	$2,659	$550	$0	$5,041	$0	$8,250
Hepatic tumours	$13,449	$15,324	$0	$0	$335	$0	$29,108
Hodgkin lymphomas	$0	$0	$0	$370,866	$4,334	$0	$375,200
Leukemias	$2,522,485	$2,121,298	$180,931	$845,594	$821,561	$74,227	$6,566,095
Malignant bone tumours	$264,252	$227,576	$359,572	$16,990	$5,115	$0	$873,505
Neuroblastoma	$873,306	$216,801	$25,987	$370,913	$0	$0	$1,487,007
Non-Hodgkin lymphomas	$156,751	$225,188	$24,684	$8,712	$89,227	$0	$504,562
Renal tumours	$487,084	$427,368	$0	$0	$0	$0	$914,451
Retinoblastoma	$1,258,985	$170,933	$0	$421,109	$8,000	$0	$1,859,028
Soft tissue sarcomas	$389,538	$7,049	$45,153	$116,456	$85,211	$0	$643,407
Thyroid carcinomas	$0	$11,552	$0	$0	$0	$0	$11,552
Other/unspecified cancers	$989,579	$214,057	$56,450	$201,533	$682	$0	$1,462,301
Non-specific/Relevant to all sites	$7,868,239	$2,722,359	$476,597	$1,144,043	$4,053,481	$48,502	$16,313,220
TOTAL	**$18,914,721**	**$8,115,225**	**$1,400,172**	**$4,160,937**	**$5,385,137**	**$122,729**	**$38,098,920**

[1] There was no investment in Prevention interventions.

TABLE 4.3.2

DISTRIBUTION OF RESEARCH INVESTMENT IN CHILDHOOD/ADOLESCENT CANCERS BY CSO CATEGORY [1] FOR CANCER SITES, THREE-YEAR CUMULATIVE ANNUAL INVESTMENT, 2005-2007

CANCER SITE	Biology	Etiology (causes of cancer)	Early detection, diagnosis & prognosis	Treatment	Cancer control, survivorship & outcomes	Scientific model systems	Total [2]
Central nervous system neoplasms	58.02	24.86	3.27	9.43	4.43	0.00	100%
Gonadal germ cell tumours	0.00	32.23	6.67	0.00	61.10	0.00	100%
Hepatic tumours	46.20	52.65	0.00	0.00	1.15	0.00	100%
Hodgkin lymphomas	0.00	0.00	0.00	98.84	1.16	0.00	100%
Leukemias	38.42	32.31	2.76	12.88	12.51	1.13	100%
Malignant bone tumours	30.25	26.05	41.16	1.95	0.59	0.00	100%
Neuroblastoma	58.73	14.58	1.75	24.94	0.00	0.00	100%
Non-Hodgkin lymphomas	31.07	44.63	4.89	1.73	17.68	0.00	100%
Renal tumours	53.27	46.73	0.00	0.00	0.00	0.00	100%
Retinoblastoma	67.72	9.19	0.00	22.65	0.43	0.00	100%
Soft tissue sarcomas	60.54	1.01	7.02	18.10	13.24	0.00	100%
Thyroid carcinomas	0.00	100.00	0.00	0.00	0.00	0.00	100%
Other/unspecified cancers	67.67	14.64	3.86	13.78	0.05	0.00	100%
Non-specific/Relevant to all sites	48.23	16.69	2.92	7.01	24.85	0.30	100%

[1] There was no investment in Prevention interventions.
[2] Project equivalents per cancer site ranged from less than 1 to 72.

5. Summary

This report provides baseline information on the level and nature of research investment in childhood/adolescent cancers in Canada. The analyses revealed that:

- Research focused on childhood/adolescent cancers represented about 3% of all cancer research investment among government and voluntary sector cancer research funders. This is comparable with figures reported by the US National Cancer Institute, the leading cancer research funder in the US.
- The Canadian Institutes of Health Research and the Canadian Cancer Society were the two major funders of research focused on childhood/adolescent cancers.
- Annualized investment in research increased from 2005 to 2007, especially for provincial cancer agencies and the voluntary sector.
- The Hospital for Sick Children was a major centre for research focused on childhood/adolescent cancers.
- Much of the research focused on childhood/adolescent cancers was in the areas of cancer biology and etiology. With respect to the latter, there was a major focus on endogenous factors involved in cancer causation.
- Research focused on central nervous system neoplasms and leukemias had the largest share of the site-specific research investment.
- In 2007, there was a dramatic rise in the annualized investment for research focused on central nervous system neoplasms among children/adolescents.
- Research investment tended to be greater for cancers that had a higher incidence in this age group.
- The type of research conducted varied by cancer site.

WHY INVEST IN RESEARCH ON CHILDHOOD/ADOLESCENT CANCERS?

- The causes of childhood cancers are largely unknown.[1]
- While there have been substantial improvements in survival, some childhood/adolescent cancers (e.g. acute myeloid leukemias, intracranial and intraspinal embryonal tumours, osteosarcomas) continue to have poor survival rates.[2]
- Cancers among children/adolescents have a disproportionate impact on the health, economic and social welfare systems.[3]
- Families of children/adolescents with cancer face significant financial and emotional burdens.[4]
- Many childhood/adolescent cancer survivors experience serious and long-term health effects as a consequence of their cancer and/or treatment.[5]
- The number of childhood/adolescent cancer survivors is growing.[6]

---

1. Inskip PD, Ries LAG, Cohen RJ, Curtis RE. (2006). New malignancies following childhood cancer. In Curtis RE, Freedman DM, Ron E, Ries LAG, Hacker DG, Edwards BK, Tucker MA, Fraumeni JF Jr. (Eds), *New Malignancies Among Cancer Survivors: SEER Cancer Registries, 1973-2000.* National Cancer Institute, NIH Publ. No. 05-5302. Bethesda, MD, 2006. Available at http://seer.cancer.gov/publications/mpmono/Ch18_Childhood.pdf.
2. Ellison LF, Pogany L & Mery LS. (2007). Childhood and adolescent cancer survival: A period analysis of data from the Canadian Cancer Registry. *European Journal of Cancer*, 43:1967-1975.
3. Barr RD & Sala A. (2003). Hidden financial costs in the treatment for childhood cancer. *Journal of Pediatric Hematology/Oncology*, 25(11):842-844.
4. Limburg H, Shaw AK & McBride ML. (2008). Impact of childhood cancer on parental employment and sources of income: a Canadian pilot study. *Pediatric Blood & Cancer*, 51(1):93-98.
5. Landier W & Bhatia S. (2008). Cancer survivorship: a pediatric perspective. *The Oncologist*, 13:1181-1192.
6. Ibid.

APPENDIX A. CANCER SITES

Diagnostic Group [1]		Key Definitions	How Used in Report
I. Leukemias, myeloproliferative diseases, and myelodysplastic diseases	a. Lymphoid leukemias b. Acute myeloid leukemias c. Chronic myeloproliferative diseases d. Myelodysplastic syndrome and other myeloproliferative diseases e. Unspecified and other specified leukemias	Leukemias are cancers of the blood or bone marrow and characterized by abnormal proliferation of blood cells, usually leukocytes (white blood cells).	The term "Leukemias" is used to represent this diagnostic group.
II. Lymphomas and reticuloendothelial neoplasms	a. Hodgkin lymphomas b. Non-Hodgkin lymphomas c. Burkitt lymphoma d. Miscellaneous lymphoreticular neoplasms e. Unspecified lymphomas	Lymphomas are cancers that originate in the white blood cells of the immune system (lymphocytes).	Hodgkin lymphomas (a) and Non-Hodgkin lymphomas (b) are reported separately. Other lymphomas (c, d, e) are grouped under "Other Cancers."
III. Central Nervous System (CNS) and miscellaneous intracranial and intraspinal neoplasms	a. Ependymomas and choroid plexus tumour b. Astrocytomas c. Intracranial and intraspinal embryonal tumours d. Other gliomas e. Other specified intracranial and intraspinal neoplasms	Central nervous system cancers include cancers of the brain and spinal cord. These cancers are named on the basis of the type of cells/tissues where they originate (e.g. ependyma, astrocytes).	The term "Central nervous system neoplasms" is used to represent this diagnostic group.
IV. Neuroblastoma and other peripheral nervous cell tumours	a. Neuroblastoma and ganglioneuroblastoma b. Other peripheral nervous cell tumours	These cancers develop from tissues that form the peripheral nervous system (the part of the nervous system that resides or extends outside the central nervous system).	The term "Neuroblastoma" is used to represent IVa. IVb is grouped under "Other Cancers."
V. Retinoblastoma		Retinoblastoma is a rapidly developing cancer of the cells of the retina, which are the cells of the eye that detect light.	"Retinoblastoma" diagnostic group is used.
VI. Renal tumours	a. Nephroblastomas and other nonepithelial renal tumours b. Renal carcinomas c. Unspecified malignant renal tumours	These are cancers of the kidney, and are usually very different from the kidney cancers found in adults.	"Renal tumours" diagnostic group is used.
VII. Hepatic tumours	a. Hepatoblastoma b. Hepatic carcinomas c. Unspecified malignant hepatic tumours	These are cancers of the liver.	"Hepatic tumours" diagnostic group is used.
VIII. Malignant bone tumours	a. Osteosarcomas b. Chondrosarcomas c. Ewing tumour and other related sarcomas of the bone d. Other specified malignant bone tumours e. Unspecified malignant bone tumours	These are cancers of the bone.	"Malignant bone tumours" diagnostic group is used.
IX. Soft tissue and other extraosseous sarcomas	a. Rhabdomyosarcomas b. Fibrosarcomas, peripheral nerve sheath tumours, and other fibrous neoplasms c. Kaposi sarcoma d. Other specified soft tissue sarcomas e. Unspecified soft tissue sarcomas	These are cancers of the soft tissues which connect, support, and surround body parts and organs.	The term "Soft tissue sarcomas" is used to represent this diagnostic group.
X. Germ cell tumours, trophoblastic tumours, and neoplasms of gonads	a. Intracranial and intraspinal germ cell tumours b. Malignant extracranial and extragonadal germ cell tumours c. Malignant gonadal germ cell tumours d. Gonadal carcinomas e. Other and unspecified malignant gonadal tumours	These are tumours that arise from germ cells (reproductive cells that develop into the testicles or ovaries). They may be located within the gonads or may have travelled outside the gonads.	The term "Gondal germ cell tumours" is used to represent Xc. All other cancers (a, b, d, e) are grouped under "Other Cancers."
XI. Other malignant epithelial neoplasms and malignant melanomas	a. Adrenocortical carcinomas b. Thyroid carcinomas c. Nasopharyngeal carcinomas d. Malignant melanomas e. Skin carcinomas f. Other and unspecified carcinomas	Epithelial neoplasms develop in the cells that line organs. Melanomas are due to uncontrolled growth of pigment cells, called melanocytes.	Thyroid carcinomas (XIb) are reported separately. All other cancers (a, c, d, e, f) are grouped under "Other Cancers."
XII. Other and unspecified malignant neoplasms	a. Other specified malignant tumours b. Other unspecified malignant tumours		These cancers are grouped under "Other cancers."

[1] Source: Steliarova-Foucher E, Stiller C, Lacour B & Kaatsch P. (2005). International Classification of Childhood Cancer, Third Edition. *Cancer*, 103(7):1457-1467.

Our Members

Alberta Health Services
Alberta Cancer Research Institute

AHFMR
Alberta Heritage Foundation for Medical Research

BC Cancer Agency
Care & Research

CAPCA

Canadian Breast Cancer Foundation
Fondation canadienne du cancer du sein

CBCRA
Canadian Breast Cancer Research Alliance

Canadian Cancer Society
Société canadienne du cancer

CIHR IRSC
Canadian Institutes of Health Research
Instituts de recherche en santé du Canada

Canadian Partnership Against Cancer
Partenariat canadien contre le cancer

CancerCare Manitoba
ActionCancerManitoba

Cancer Care Nova Scotia

cancer care ontario | action cancer ontario

Fonds de la recherche en santé Québec

GenomeCanada

Government of Canada
Gouvernement du Canada

Michael Smith Foundation for Health Research

NRC-CNRC Canada

New Nouveau Brunswick
Be...in this place • Être...ici on le peut

Ontario Institute for Cancer Research
Institut ontarien de recherche sur le cancer

Prostate Cancer Canada

Saskatchewan Cancer Agency

La Société de recherche sur le cancer
The Cancer Research Society

A single dream. A world of hope.
The Terry Fox Foundation

CCRA ACRC

Canadian Cancer Research Alliance • Alliance canadienne pour la recherche sur le cancer

Canadian Cancer Research Alliance (CCRA)
1 University Avenue, Suite 300
Toronto, Ontario M5J 2P1 CANADA

http://www.ccra acrc.ca

Aussi offert en français.