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DIAGNOSIS AND INITIAL TREATMENT OF

Cancer

» IN CANADIAN CHILDREN 0 TO 14 YEARS

1995–2000

Canada

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Diagnosis and Initial Treatment of Cancer in Canadian Children 0 to 14 Years, 1995–2000

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CONTENTS

List of Figures

EXECUTIVE SUMMARY

Although cancer in children is rare, it nevertheless represents the leading cause of disease-related death among Canadians between the ages of 1 and 14.

This report provides information on Canadian children diagnosed with cancer during the years 1995 to 2000 from the Treatment and Outcome Surveillance System, a component of the Canadian Childhood Cancer Surveillance and Control Program. The report includes incidence counts and rates, in addition to descriptive statistics on patterns of initial diagnosis and treatment.

The Treatment and Outcome Surveillance System is maintained by Health Canada in collaboration with pediatric oncology centres and selected provincial cancer registries. National data collection began in 1995. Staff at participating centres recruit patients for the study, review charts, collect data and provide Health Canada with case information at regular intervals.

Information is given for 5,216 children younger than 15 years of age and diagnosed with cancer in 1995 to 2000. Incidence rates are highest in the first five years of life; 25 cases per 100,000 per year for infants (younger than one year), and 21 cases per 100,000 per year for children ages one to four. Among infants, the most common cancers are neuroblastomas (22 percent) followed by leukemias (17 percent), central nervous system tumours (13 percent) and retinoblastoma (11 percent). The most common malignant neoplasms for children between the ages of one and four are leukemias (43 percent), central nervous system tumours (16 percent), followed by neuroblastoma and Wilms' tumour (both 9 percent).

As children get older, lymphomas become proportionally more important. They are the third most common cancer (12 percent) in the 5- to 9-year age group after leukemias (32 percent) and central nervous system tumours (30 percent). In the 10- to 14-year age group, cancers of the central nervous system are the most common (25 percent), followed by leukemia (23 percent) and lymphomas (20 percent).

A higher number of boys than girls are diagnosed with most cancer types. However, girls outnumbered boys in the categories of carcinomas, renal tumours and other and unspecified malignant neoplasms.

Undue delay in the diagnosis of some tumours may adversely affect prognosis. On average, the diagnosis of Canadian children with cancer is achieved rapidly. Overall, the median time between onset of initial complaint to first health care contact is 9 days, followed by a median of 4 days until first assessment by a pediatric oncologist or surgeon, then 2 days until a definitive diagnosis and finally 2 days to start anti-cancer treatment. The median time from the onset of initial complaint until the initiation of anti-cancer treatment increases with age, from 9 days for infants to 26 days for the 10- to 14-year age group.

The shortest median time from first health care contact to definitive diagnosis was for leukemia, hepatic and renal tumour cases (3, 5 and 6 days, respectively); it was longest for carcinomas (almost two months). All other cancers have a median waiting time ranging from one to almost three weeks. No marked regional differences were observed in time from first health care contact to definitive diagnosis.

Overall, the health care professional most often contacted concerning the initial complaint, was the family physician (47 percent), followed by hospital emergency department physicians (30 percent) and pediatricians (15 percent).

The extent of disease at diagnosis helps determine the treatment, and helps predict the outcome. Overall, metastasis (the spread of a tumour cell to another organ or body part different from the primary site) were present in more than one quarter of all cancer cases at the time of diagnosis. The most common sites of metastasis were regional lymph nodes, bone marrow and the lung (22, 23 and 25 percent, respectively).

Protocols outline specific treatments (e.g. drug frequency and dosage, surgery) to be administered for a particular cancer type and the extent of disease at diagnosis.

Clinical trials are studies designed to compare the effectiveness of different treatment protocols and side effects. A non-clinical trial treatment protocol may be selected when no clinical trial is available, a patient is ineligible or refuses to participate. Non-clinical trial protocols deliver the best available treatment based on previous studies. Studies have shown that treatment at pediatric oncology centres, delivered according to well-defined protocols, provides a significant survival advantage for many childhood cancers.

Over all cancers, the percentage of patients following a clinical trial or non-clinical trial protocol was 80 percent; of these, 50 percent were enrolled in clinical trials. A total of 18 percent received individualized treatment. Protocol use varied by cancer type: leukemias, lymphomas and reticuloendothelial neoplasms, renal and malignant bone tumours had the highest rate of protocol use (more than 90 percent), while the lowest percentage was noted for retinoblastoma. The enrolment of cancer patients into a clinical trial or a specific protocol was comparable across the regions.

INTRODUCTION

Cancer is relatively rare in children. In 2002, nearly 8 million Canadian children and adolescents younger than 20 years of age, an estimated 1,300 were diagnosed with cancer[1]. Notwithstanding, cancer is the most common disease-related cause of death, second only to injuries as the leading cause of death in this age group, excluding the first 28 days of life[2].

Childhood cancer survival rates have risen dramatically over the past 50 years. Progress in childhood and adolescent cancer treatment has transformed an almost uniformly fatal disease into a group of malignancies which are now curable in most children[3]. In Canada, three-year survival rates for childhood cancer now exceed 80 percent[2]. Improved survival has placed increased importance on understanding the long term consequences of cancer and its treatment.

While many possible risk factors have been investigated, little is known about the causes of childhood cancers. Ionizing radiation, chemotherapeutic agents and maternal exposure to diethylstilbestrol are a few of the better established risk factors for childhood cancers[4].

Cancers in children differ from those occurring in adults. Most cancers in adults are carcinomas (i.e. cancers arising in glands or tissues that line organs such as the breast, lung, prostate or colon), but these cancers are very rare in younger age groups. Cancer in children is more histologically diverse, and includes a much higher proportion that are of hematopoietic (blood and lymphatic) origin[2].

The Canadian Childhood Cancer Surveillance and Control Program was established in 1992 to further childhood cancer control. Originally funded through the federal government's Brighter Futures Initiative, the Program is a partnership between Health Canada, provincial governments, health care providers, researchers and voluntary organizations involved with childhood cancer. A detailed description of the Program, methods of data collection and data quality indicators are described in APPENDIX A.

The Treatment and Outcome Surveillance System is one of four original components of the Program. National data collection began in 1995. Treatment and outcome information about all Canadian cancer patients younger than 20 years of age are collected at diagnosis and at six-month follow-up intervals for a maximum of five years after diagnosis (or until death) by pediatric oncology centres. The surveillance system has four main goals:

- to describe the patterns of health care service use among childhood cancer patients in Canada;
- to determine the proportion of Canadian children and adolescents receiving state-of-the-art cancer treatment;
- to monitor and assess clinical outcomes of Canadian children and adolescents treated for cancer; and
- to develop baseline surveillance information useful for future studies.

» Scope of the Report

This report presents information on Canadian children diagnosed with cancer from 1995 to 2000. Use of the term "children" refers to individuals younger than 15 years of age. The report includes incidence counts and rates, in addition to descriptive statistics regarding diagnosis and initial treatment.

The main objective of the report is to provide health professionals, researchers and policy makers with relevant information on childhood cancer. It is hoped that these results will assist in generating awareness and also provide the basis for new research questions.

CHAPTER 1 provides counts and rates of new cases of childhood cancer in Canada. Information in subsequent chapters is based on consenting patients (78 percent of all applicable subjects). CHAPTER 2 gives descriptive statistics on time, from the onset of symptoms to definitive diagnosis and initiation of treatment. CHAPTER 3 assesses the extent of the disease at diagnosis, and CHAPTER 4 describes the patterns of initial treatment.

1 CHILDHOOD CANCER INCIDENCE IN CANADA

This chapter presents information on the number of new cases (also referred to as incidence) of childhood cancer diagnosed from 1995 though to 2000.

» Number of New Cases

The Treatment and Outcome Surveillance System identified 5,216 new cases of childhood cancer over a six-year period from 1995 to 2000. TABLE 1 presents the number of new cases of childhood cancer by region and age. Nearly half of all new cases occurred in children younger than 5 years of age.

TABLE 1
New Cases of Childhood Cancer by Region and Age Group, 1995–2000, Canada

Region	Age Group				
	< 1	1–4	5–9	10–14	0–14
Atlantic	56	158	101	132	450
Quebec	110	449	306	239	1,100
Ontario	209	749	595	491	2,000
Prairies	101	334	247	268	950
British Columbia	61	238	182	173	650
North	–	6	–	–	15
Canada	**540**	**1,950**	**1,450**	**1,300**	**5,200**
	(10.4%)	**(37.1%)**	**(27.5%)**	**(25.1%)**	**(100.0%)**

– Fewer than 5 cases.

Note: Totals may not equal the sum of the parts due to rounding.
Source: The Canadian Childhood Cancer Surveillance and Control Program.

Another measure of disease burden, the incidence rate, is shown in FIGURE 1. Due to the relatively small number of cases that occur annually for each region and age group, rates are presented as the average for the period 1995 to 2000. Variability in the rates may still occur, and as such, the reader should use caution when comparing results. Nationally, the highest incidence rates occur in the first five years of life. Rates decrease and are similar for the 5- to 9- and 10- to 14-year age groups; this pattern is observed in each region.

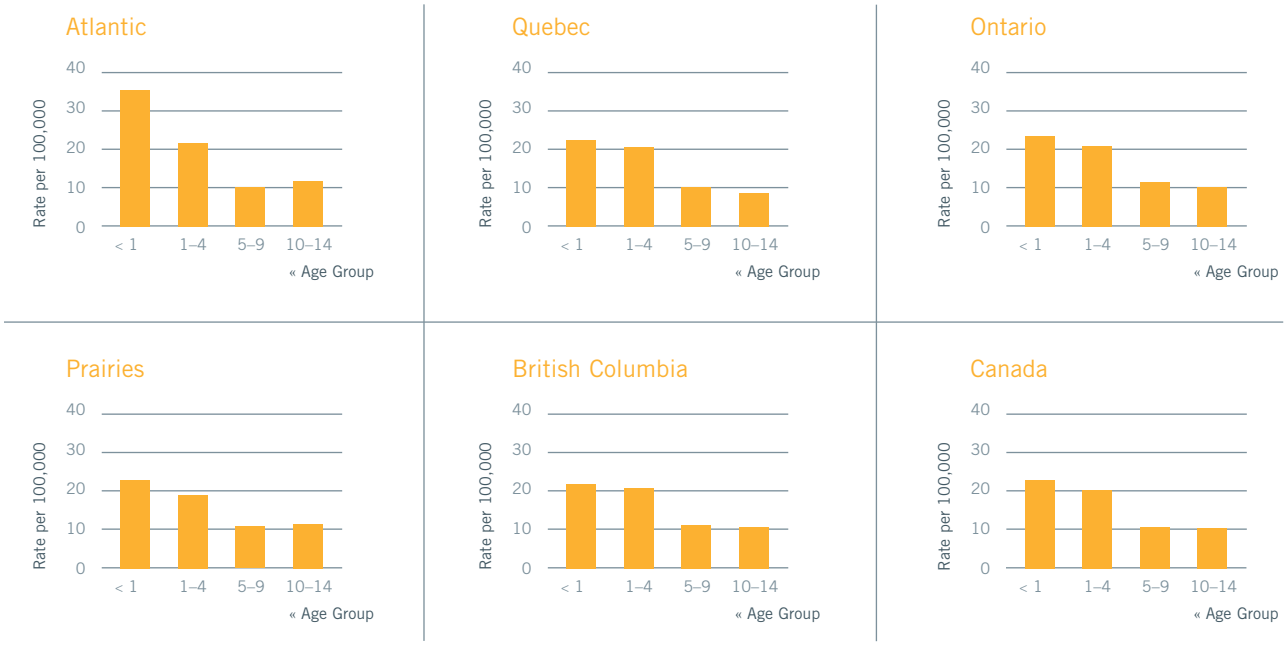
Childhood cancer rates were comparable across regions, with the exception of the Atlantic region, where the incidence rate for the younger than one-year age group was elevated. However, this may be a chance finding, reflecting the relatively small population and small number of cases in the region.

"DON'T GIVE UP YOUR DREAMS..."

– VANESSA, AGE 13

FIGURE 1

Average Annual Cancer Incidence Rates by Region and Age Group, 1995–2000, Canada

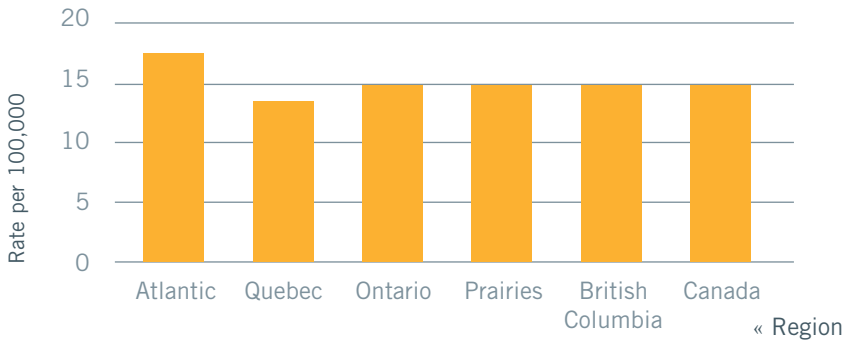


Note: Canada totals include cases from the North.
Source: The Canadian Childhood Cancer Surveillance and Control Program.

Age-standardized rates were calculated in order to compare rates from different populations and are presented in FIGURE 2 (see APPENDIX A for details on methods used). Adjusted rates ranged between 14 to 17 cases per 100,000 per year.

FIGURE 2

Age-Standardized Cancer Incidence Rates by Region, Children Ages 0–14, 1995–2000, Canada



Note: Canada totals include cases from the North. Rates are standardized using the age distribution of the 1991 Canadian population.

Source: The Canadian Childhood Cancer Surveillance and Control Program.

TABLE 2 presents the number of new cases by age and diagnosis, as categorized by the International Classification of Childhood Cancer (ICCC) (see APPENDIX C).

TABLE 2

New Cases of Childhood Cancer by Cancer Type* and Age Group, 1995–2000, Canada

Cancer Type*	New Cases						Male/Female Case Ratio
	< 1	1–4	5–9	10–14	0–14		
	No.	No.	No.	No.	No.	%	
I. Leukemia	**90**	**840**	**450**	**300**	**1,700**	**32.3**	**1.2**
Lymphoid leukemia	49	728	379	206	1,350	26.1	
Acute non-lymphocytic leukemia	32	84	57	75	250	4.8	
Chronic myeloid leukemia	8	7	–	8	25	0.5	
Other specified leukemias	–	8	–	–	15	0.2	
Unspecified leukemias	–	14	11	8	35	0.6	
II. Lymphomas and reticuloendothelial neoplasms	**15**	**70**	**170**	**260**	**520**	**9.9**	**1.7**
Hodgkin's disease	–	12	46	142	200	3.9	
Non-Hodgkin lymphoma	–	32	70	69	180	3.4	
Burkitt's lymphoma	–	14	40	32	85	1.6	
Miscellaneous lymphoreticular neoplasms	8	6	12	9	35	0.7	
Unspecified lymphomas	–	–	5	7	15	0.3	

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Cancer Type*	New Cases						Male/Female Case Ratio
	< 1	1–4	5–9	10–14	0–14		
	No.	No.	No.	No.	No.	%	
III. CNS and miscellaneous intracranial and intraspinal neoplasms	**70**	**310**	**430**	**330**	**1,150**	**21.9**	**1.1**
Ependymoma	13	43	33	21	110	2.1	
Astrocytoma	22	124	170	147	460	8.9	
Primitive neuroectodermal tumours	20	84	98	49	250	4.8	
Other gliomas	–	30	65	43	140	2.7	
Other specified intracranial and intraspinal neoplasms	8	24	53	55	140	2.7	
Unspecified intracranial and intraspinal neoplasms	–	7	8	17	35	0.7	
IV. Sympathetic nervous system tumours	**120**	**190**	**40**	**10**	**360**	**6.9**	**1.0**
Neuroblastoma and ganglioneuroblastoma	118	183	40	9	350	6.7	
Other sympathetic nervous system tumours	–	–	–	–	10	0.2	
V. Retinoblastoma	**60**	**75**	**5**	**–**	**140**	**2.7**	**1.4**
VI. Renal tumours	**40**	**180**	**75**	**20**	**310**	**6.0**	**0.7**
Wilms' tumour, rhabdoid and clear cell sarcoma	39	180	76	16	310	6.0	
Renal carcinoma	–	–	–	–	–	–	
Unspecified malignant renal tumours	–	–	–	–	–	–	
VII. Hepatic tumours	**25**	**45**	**5**	**5**	**80**	**1.6**	**1.8**
Hepatoblastoma	24	42	5	–	75	1.4	
Hepatic carcinoma	–	–	–	5	10	0.2	
Unspecified malignant hepatic tumours	–	–	–	–	–	–	
VIII. Malignant bone tumours	**–**	**20**	**60**	**130**	**210**	**4.0**	**1.2**
Osteosarcoma	–	5	28	78	110	2.1	
Chondrosarcoma	–	–	–	–	–	–	
Ewing's sarcoma	–	11	33	47	90	1.7	
Other specified malignant bone tumours	–	–	–	–	–	–	
Unspecified malignant bone tumours	–	–	–	–	5	0.1	
IX. Soft-tissue sarcomas	**35**	**80**	**85**	**85**	**290**	**5.6**	**1.4**
Rhabdomyosarcoma and embryonal sarcoma	15	61	53	31	160	3.1	
Fibrosarcoma, neurofibrosarcoma and other fibromatous neoplasms	7	–	5	11	25	0.5	
Kaposi's sarcoma	–	–	–	–	–	–	
Other specified soft-tissue sarcomas	6	10	16	22	55	1.0	
Unspecified soft-tissue sarcomas	8	9	11	23	50	1.0	

continued on next pg. »

Cancer Type*	New Cases						Male/Female Case Ratio
	< 1	1–4	5–9	10–14	0–14		
	No.	No.	No.	No.	No.	%	
X. Germ cell, trophoblastic and other gonadal neoplasms	**35**	**40**	**25**	**70**	**170**	**3.3**	**1.1**
Intracranial and intraspinal germ cell tumours	6	–	12	28	50	0.9	
Other and unspecified non-gonadal germ cell tumours	18	25	–	7	50	1.0	
Gonadal germ cell tumours	9	11	9	30	60	1.1	
Gonadal carcinomas	–	–	–	–	–	–	
Other and unspecified malignant gonadal tumours	–	–	–	6	15	0.2	
XI. Carcinomas and other malignant epithelial neoplasms	**10**	**5**	**30**	**65**	**110**	**2.1**	**0.7**
Adrenocortical carcinoma	–	–	–	–	10	0.2	
Thyroid carcinoma	–	–	9	19	30	0.6	
Nasopharyngeal carcinoma	–	–	–	6	5	0.1	
Malignant melanoma	–	–	–	7	10	0.2	
Skin carcinoma	–	–	7	11	25	0.4	
Other and unspecified carcinomas	–	–	11	19	35	0.6	
XII. Other and unspecified malignant neoplasms	**10**	**10**	**5**	**15**	**40**	**0.8**	**0.5**
Other specified malignant tumours	–	–	–	–	5	0.1	
Other unspecified malignant tumours	7	10	5	15	35	0.7	
XIII. Other cancer-related diseases	**30**	**65**	**45**	**15**	**160**	**3.0**	**1.3**
Myelodysplastic syndrome	7	9	–	6	25	0.5	
Langerhans cell histiocytosis	24	57	42	10	130	2.5	
All Cancers	**540**	**1,950**	**1,450**	**1,300**	**5,200**	**100.0**	**1.2**
	(10.4%)	**(37.1%)**	**(27.5%)**	**(25.1%)**			

– Fewer than 5 cases.

* Diagnostic groups were based on the International Classification of Childhood Cancer (ICCC) (see APPENDIX C) with the addition of category XIII: Other cancer-related diseases; this category is not part of ICCC, but is included in the cases collected in the Treatment and Outcome Surveillance System.

Note: Totals may not equal the sum of the parts due to rounding.
Source: The Canadian Childhood Cancer Surveillance and Control Program.

For all children, the most frequently diagnosed cancer categories were leukemias, central nervous system and miscellaneous intracranial and intraspinal (CNS) neoplasms, and lymphomas and reticuloendothelial neoplasms; collectively these account for approximately 70 percent of new cases. The four most frequently diagnosed specific cancers, in descending order, were lymphoid leukemia, astrocytoma, neuroblastoma and Wilms' tumours.

Fifty percent of leukemia patients were 1 to 4 years old at the time of diagnosis. The distribution of lymphomas and reticuloendothelial neoplasms varies by age group; most notably, Hodgkin's disease and non-Hodgkin lymphomas (excluding Burkitt's lymphoma) become more common as children get older.

Among children younger than one year, the most common cancers were neuroblastomas (22 percent) followed by leukemias (17 percent), CNS neoplasms (13 percent) and retinoblastoma (11 percent). Compared to older age groups, the distribution of subcategories for leukemia were distinct; lymphoid leukemia represented less than 50 percent in the younger than one-year age group. The most common diagnoses among children between the ages of 1 to 4 were leukemias (43 percent), CNS neoplasms (16 percent), followed by neuroblastoma and Wilms' tumours (9 percent). As children become older, lymphomas and reticuloendothelial neoplasms are more frequent, and represent the third most common cancer (12 percent) in the 5– to 9– year age group after leukemias and CNS neoplasms, consisting of 32 and 30 percent, respectively, of all cancer cases in this age group. In the 10– to 14– year age group, cancers of the CNS neoplasms are the most common (25 percent), followed by leukemia (23 percent) and lymphomas and reticuloendothelial neoplasms (20 percent).

Overall, males were more frequently diagnosed than females (ratio of male to female new cases was 1.2). The largest difference by gender was with hepatic tumours (ratio of males to females 1.8) and lymphomas and reticuloendothelial neoplasms (ratio of male to females 1.7). Girls outnumbered boys in renal tumours, carcinomas and other malignant epithelial neoplasms category (ratio of 0.7), and in the other and unspecified neoplasms category (ratio of 0.5).

TABLE 3 shows the distribution of cases by diagnosis within selected Canadian regions; no significant differences were observed. Small variations were present for both CNS neoplasms and neuroblastoma. The difference in the number of cases of sympathetic nervous system tumours in Quebec is observed even though the province stopped its five-year neuroblastoma screening study in early 1994[5].

TABLE 3

New Cases of Cancer by Cancer Type* and Region, Children Ages 0–14, 1995–2000, Canada

Cancer Type*		Region													
		Atlantic		Quebec		Ontario		Prairies		British Columbia		North		Canada	
		No.	%	No.	%	No.	%	No.	%	No.	%	No.	%	No.	%
I.	**Leukemia**	**150**	**33.6**	**380**	**34.1**	**650**	**31.9**	**290**	**30.3**	**210**	**32.4**	**5**	**29.4**	**1,700**	**32.3**
	Lymphoid leukemia	117		331		498		235		179		–		1,350	26.1
	Acute non-lymphocytic leukemia	22		41		113		45		25		–		250	4.8
	Chronic myeloid leukemia	–		–		11		5		5		–		25	0.5
	Other specified leukemias	5		–		–		–		–		–		15	0.2
	Unspecified leukemias	–		–		27		–		–		–		35	0.6
II.	**Lymphomas and reticuloendothelial neoplasms**	**40**	**9.4**	**130**	**11.3**	**190**	**9.4**	**90**	**9.6**	**65**	**9.8**	**–**	**–**	**520**	**9.9**
	Hodgkin's disease	18		47		73		41		25		–		200	3.9
	Non-Hodgkin lymphoma	14		44		63		31		21		–		180	3.4
	Burkitt's lymphoma	–		28		32		12		10		–		85	1.6
	Miscellaneous lymphoreticular neoplasms	5		–		16		–		8		–		35	0.7
	Unspecified lymphomas	–		–		9		–		–		–		15	0.3
III.	**CNS and miscellaneous intracranial and intraspinal neoplasms**	**110**	**24.6**	**220**	**19.7**	**450**	**21.9**	**220**	**23.1**	**140**	**21.9**	**5**	**23.5**	**1,150**	**21.9**
	Ependymoma	11		23		32		23		21		–		110	2.1
	Astrocytoma	35		87		194		97		49		–		460	8.9
	Primitive neuroectodermal tumours	33		58		88		41		29		–		250	4.8
	Other gliomas	9		26		53		33		19		–		140	2.7
	Other specified intracranial and intraspinal neoplasms	15		22		58		19		25		–		140	2.7
	Unspecified intracranial and intraspinal neoplasms	7		–		22		6		–		–		35	0.7
IV.	**Sympathetic nervous system tumours**	**30**	**6.7**	**90**	**8.2**	**140**	**6.6**	**55**	**5.9**	**45**	**6.9**	**–**	**–**	**360**	**6.9**
	Neuroblastoma and ganglioneuroblastoma	26		90		133		56		44		–		350	6.7
	Other sympathetic nervous system tumours	–		–		–		–		–		–		10	0.2
V.	**Retinoblastoma**	**15**	**3.6**	**30**	**2.7**	**55**	**2.7**	**25**	**2.7**	**10**	**1.7**	**–**	**–**	**140**	**2.7**

continued on next pg. »

Cancer Type*	Region													
	Atlantic		Quebec		Ontario		Prairies		British Columbia		North		Canada	
	No.	%	No.	%	No.	%	No.	%	No.	%	No.	%	No.	%
VI. Renal tumours	**25**	**5.4**	**75**	**6.7**	**120**	**5.9**	**65**	**6.7**	**30**	**4.9**	**–**	**–**	**310**	**6.0**
Wilms' tumour, rhabdoid and clear cell sarcoma	24		73		119		64		31		–		310	6.0
Renal carcinoma	–		–		–		–		–		–		–	–
Unspecified malignant renal tumours	–		–		–		–		–		–		–	–
VII. Hepatic tumours	**5**	**1.6**	**15**	**1.4**	**30**	**1.4**	**15**	**1.6**	**15**	**2.1**	**–**	**–**	**80**	**1.6**
Hepatoblastoma	6		14		25		14		12		–		75	1.4
Hepatic carcinoma	–		–		–		–		–		–		10	0.2
Unspecified malignant hepatic tumours	–		–		–		–		–		–		–	–
VIII. Malignant bone tumours	**15**	**3.4**	**40**	**3.8**	**80**	**3.8**	**40**	**4.0**	**35**	**5.5**	**–**	**–**	**210**	**4.0**
Osteosarcoma	8		18		41		22		22		–		110	2.1
Chondrosarcoma	–		–		–		–		–		–		–	–
Ewing's sarcoma	7		21		34		15		14		–		90	1.7
Other specified malignant bone tumours	–		–		–		–		–		–		–	–
Unspecified malignant bone tumours	–		–		–		–		–		–		5	0.1
IX. Soft-tissue sarcomas	**20**	**4.9**	**50**	**4.7**	**120**	**5.9**	**50**	**5.5**	**40**	**6.3**	**–**	**–**	**290**	**5.6**
Rhabdomyosarcoma and embryonal sarcoma	15		37		49		32		27		–		160	3.1
Fibrosarcoma, neurofibrosarcoma and other fibromatous neoplasms	–		6		5		6		6		–		25	0.5
Kaposi's sarcoma	–		–		–		–		–		–		–	–
Other specified soft-tissue sarcomas	–		7		31		8		–		–		55	1.0
Unspecified soft-tissue sarcomas	–		–		36		6		5		–		50	1.0
X. Germ cell, trophoblastic, and other gonadal neoplasms	**15**	**3.8**	**25**	**2.4**	**65**	**3.1**	**40**	**4.0**	**25**	**4.0**	**–**	**–**	**170**	**3.3**
Intracranial and intraspinal germ cell tumours	6		5		17		11		9		–		50	0.9
Other and unspecified non-gonadal germ cell tumours	6		7		20		10		8		–		50	1.0

continued on next pg. »

Cancer Type*	Region													
	Atlantic		Quebec		Ontario		Prairies		British Columbia		North		Canada	
	No.	%	No.	%	No.	%	No.	%	No.	%	No.	%	No.	%
Gonadal germ cell tumours	5		11		17		17		9		–		60	1.1
Gonadal carcinomas	–		–		–		–		–		–		–	–
Other and unspecified malignant gonadal tumours	–		–		10		–		–		–		15	0.2
XI. Carcinomas and other malignant epithelial neoplasms	**5**	**1.3**	**20**	**1.6**	**35**	**1.7**	**40**	**4.4**	**10**	**1.7**	**–**	**–**	**110**	**2.1**
Adrenocortical carcinoma	–		–		–		–		–		–		10	0.2
Thyroid carcinoma	–		–		15		6		–		–		30	0.6
Nasopharyngeal carcinoma	–		–		–		–		–		–		5	0.1
Malignant melanoma	–		–		–		5		–		–		10	0.2
Skin carcinoma	–		–		–		21		–		–		25	0.4
Other and unspecified carcinomas	–		7		12		8		–		–		35	0.6
XII. Other and unspecified malignant neoplasms	**–**	**–**	**5**	**0.4**	**30**	**1.6**	**–**	**–**	**5**	**0.5**	**–**	**–**	**40**	**0.8**
Other specified malignant tumours	–		–		–		–		–		–		5	0.1
Other unspecified malignant tumours	–		–		32		–		–		–		35	0.7
XIII. Other cancer-related diseases	**5**	**1.6**	**35**	**3.1**	**85**	**4.1**	**20**	**2.0**	**15**	**2.4**	**–**	**–**	**160**	**3.0**
Myelodysplastic syndrome	–		–		14		–		–		–		25	0.5
Langerhans cell histiocytosis	–		32		69		16		12		–		130	2.5
All Cancers	**450**	**100.0**	**1,100**	**100.0**	**2,000**	**100.0**	**950**	**100.0**	**650**	**100.0**	**15**	**100.0**	**5,200**	**100.0**

– Fewer than 5 cases.

* Diagnostic groups were based on the International Classification of Childhood Cancer (ICCC) (see APPENDIX C) with the addition of category XIII: Other cancer-related diseases; this category is not part of ICCC, but is included in the cases collected in the Treatment and Outcome Surveillance System.

Note: Totals may not equal the sum of the parts due to rounding.
Source: The Canadian Childhood Cancer Surveillance and Control Program.

» Microscopic Confirmation

In collecting and reporting cancer information, the percentage of microscopically confirmed diagnoses serves as a way to verify the presence of malignant disease. Microscopic verification is defined as the confirmation of the cancer by histologic or cytologic testing. Histology includes the examination of tissue sections from the primary or metastatic tumour. Cytological diagnosis includes haematological examination of peripheral blood specimens[6].

In the Treatment and Outcome Surveillance System, the most accurate procedure used to establish treatment and define diagnosis is recorded. The percentage of cases with microscopic confirmation of the definitive diagnosis is presented in TABLE 4. For all childhood cancers, 92 percent were microscopically confirmed. Children diagnosed with CNS neoplasms and retinoblastoma were less frequently confirmed microscopically, which is consistent with the known technical limitation in performing biopsies. CNS neoplasms and retinoblastoma are the most common cancer types which may not be biopsiable; when these are excluded, the percent of microscopically confirmed cases is increased overall from 92 to 96 percent.

TABLE 4

Percentage of Microscopically Confirmed Cases by Cancer Type*, Children Ages 0–14, 1995–2000, Canada

Cancer Type*	Number of Cases	Microscopically Confirmed %
I. Leukemia	1,626	98.3
II. Lymphomas and reticuloendothelial neoplasms	497	96.8
III. CNS and miscellaneous intracranial and intraspinal neoplasms	1,098	80.6
IV. Sympathetic nervous system tumours	348	94.3
V. Retinoblastoma	133	62.4
VI. Renal tumours	301	94.4
VII. Hepatic tumours	78	88.5
VIII. Malignant bone tumours	200	95.0
IX. Soft-tissue sarcomas	277	96.8
X. Germ cell, trophoblastic and other gonadal neoplasms	166	89.8
XI. Carcinomas and other malignant epithelial neoplasms	106	97.2
XII. Other and unspecified malignant neoplasms	38	97.4
XIII. Other cancer-related diseases	152	96.1
All Cancers	**5,020**	**92.1**

* Diagnostic groups were based on the International Classification of Childhood Cancer (ICCC) (see Appendix C) with the addition of category XIII: Other cancer-related diseases; this category is not part of ICCC, but is included in the cases collected in the Treatment and Outcome Surveillance System.

Note: A small percentage of cases have a definitive diagnostic procedure entered as unknown, (*n*= 57). Calculations exclude cases with missing information (*n*= 196).

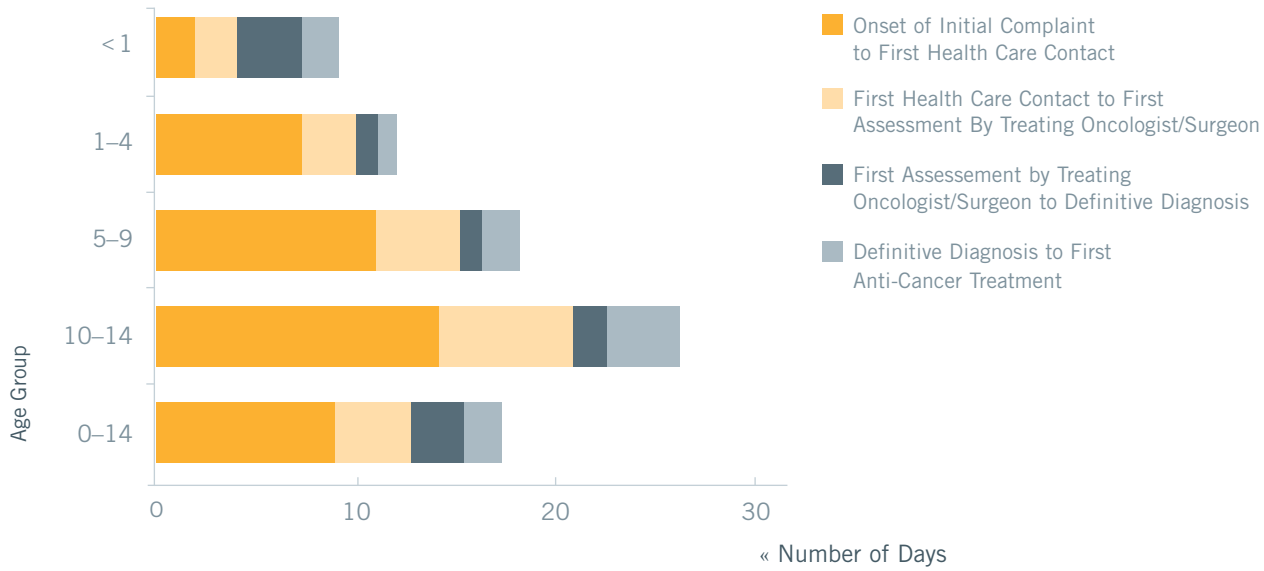
2 DIAGNOSIS AND INITIAL TREATMENT WAITING TIMES

Undue delay in the diagnosis of some tumours may adversely affect prognosis. This chapter explores the time from the patient's initial complaint to his/her first contact with a health care professional, to the assessment and diagnosis of their cancer, and the initiation of treatment.

The type of health care professional first contacted is also indicated. The analysis excludes non-consenting cases (*n*= 576), and cases for which complete information was not available. Ontario cases were excluded from all analyses (due to differences in data collection processes) except for results involving the time from diagnosis to the initiation of treatment.

FIGURE 3 shows the median time between each consecutive event leading to a diagnosis and the initiation of treatment. Cases diagnosed before being assessed by a treating oncologist or surgeon as well as persons who were treated before the date of definitive diagnosis were excluded from calculations (7 and 5 percent of cases, respectively). On average, the diagnosis of Canadian children with cancer is achieved rapidly. In children under one year of age, a median time of 9 days from the child's initial complaint to the initiation of treatment was observed. In comparison, 10- to 14-year olds required a median time of 26 days from initial complaint to initial treatment. This pattern of increasing time to diagnose cancer with increasing age is consistent with the biology of the tumours that predominate in each age group.

FIGURE 3
Median Time Between Consecutive Events to Diagnosis and Initiation of Treatment by Age Group, 1995–2000, Canada



Note: Data presented are for consenting patients and patients with information available on each specific date. Ontario cases were excluded (due to differences in data collection processes) except for results involving the time from diagnosis to initiation of treatment.
Source: The Canadian Childhood Cancer Surveillance and Control Program.

"I THINK MY BROTHER IS BRAVE."

– MIRANDA, AGE 4 1/2

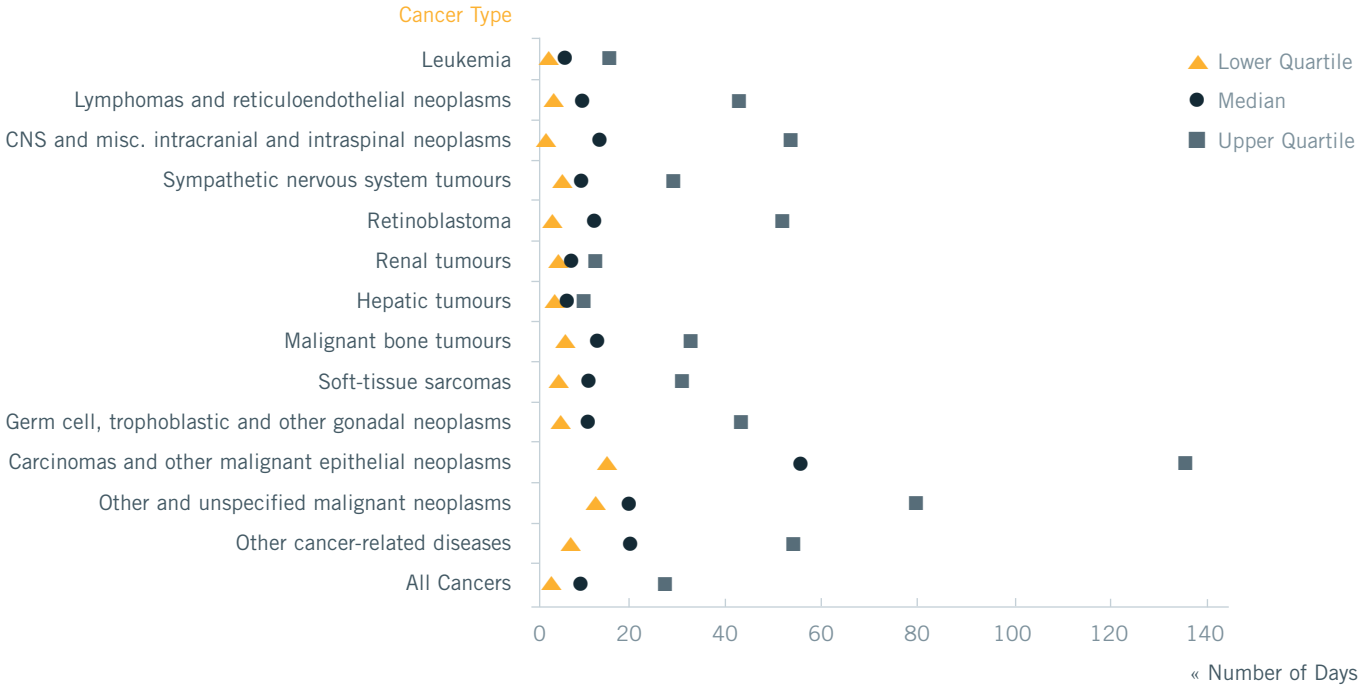
Factors influencing the time to diagnosis in childhood cancer include the biology of the neoplasm, the anatomic site, the patient's age, the care and/or perception of the disease by the parents, clinical suspicion by physicians, and the organization of the health care system[7]. These data suggest opportunities for public health education efforts to be directed to the families and health professionals at first point of contact.

FIGURE 4 shows quartiles* of the time from first health care contact to definitive diagnosis by cancer type.

Data illustrate that Canadian children were generally diagnosed quickly. For all cancers, the median time between first health care contact and definitive diagnosis is 7 days. The shortest median time is observed for leukemia, hepatic and renal tumour patients (3, 5 and 6 days, respectively) and the longest, for cases diagnosed with carcinomas and other malignant epithelial neoplasms, which took almost two months. All other cancers have a median time to definitive diagnosis of between 7 and 21 days.

FIGURE 4

Time from First Health Care Contact to Definitive Diagnosis, Children Ages 0–14, 1995–2000, Canada



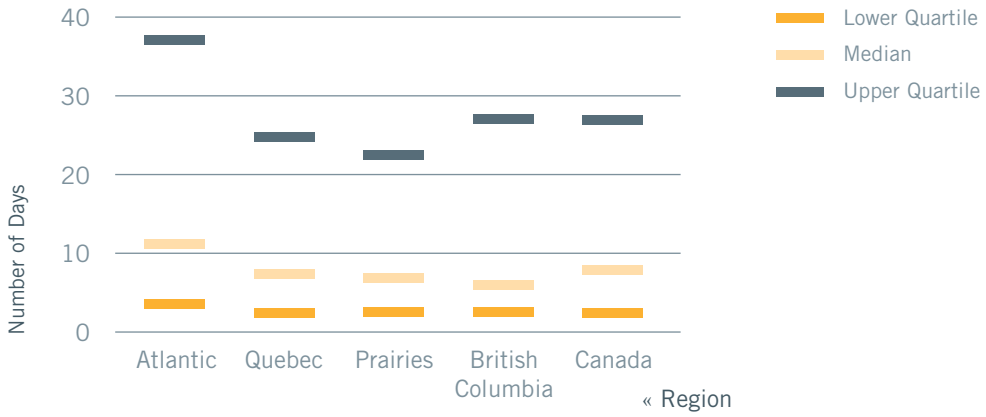
Note: Data is based on *n*= 2,469 subjects; excludes non-consenting cases, cases with information missing and Ontario cases due to differences in data collection.

Source: The Canadian Childhood Cancer Surveillance and Control Program.

* The lower quartile represents the point at which 25 percent of cases experienced a time lapse between first health care contact and definitive diagnosis. Similarly, 75 percent of cases experienced a time lapse between first health care contact to definitive diagnosis at the upper quartile.

The time from first health care contact to definitive diagnosis is shown by region in FIGURE 5. Overall, waiting times were similar with only small regional differences.

FIGURE 5
Time of First Health Care Contact to Definitive Diagnosis by Region, Children Aged 0–14, 1995–2000, Canada



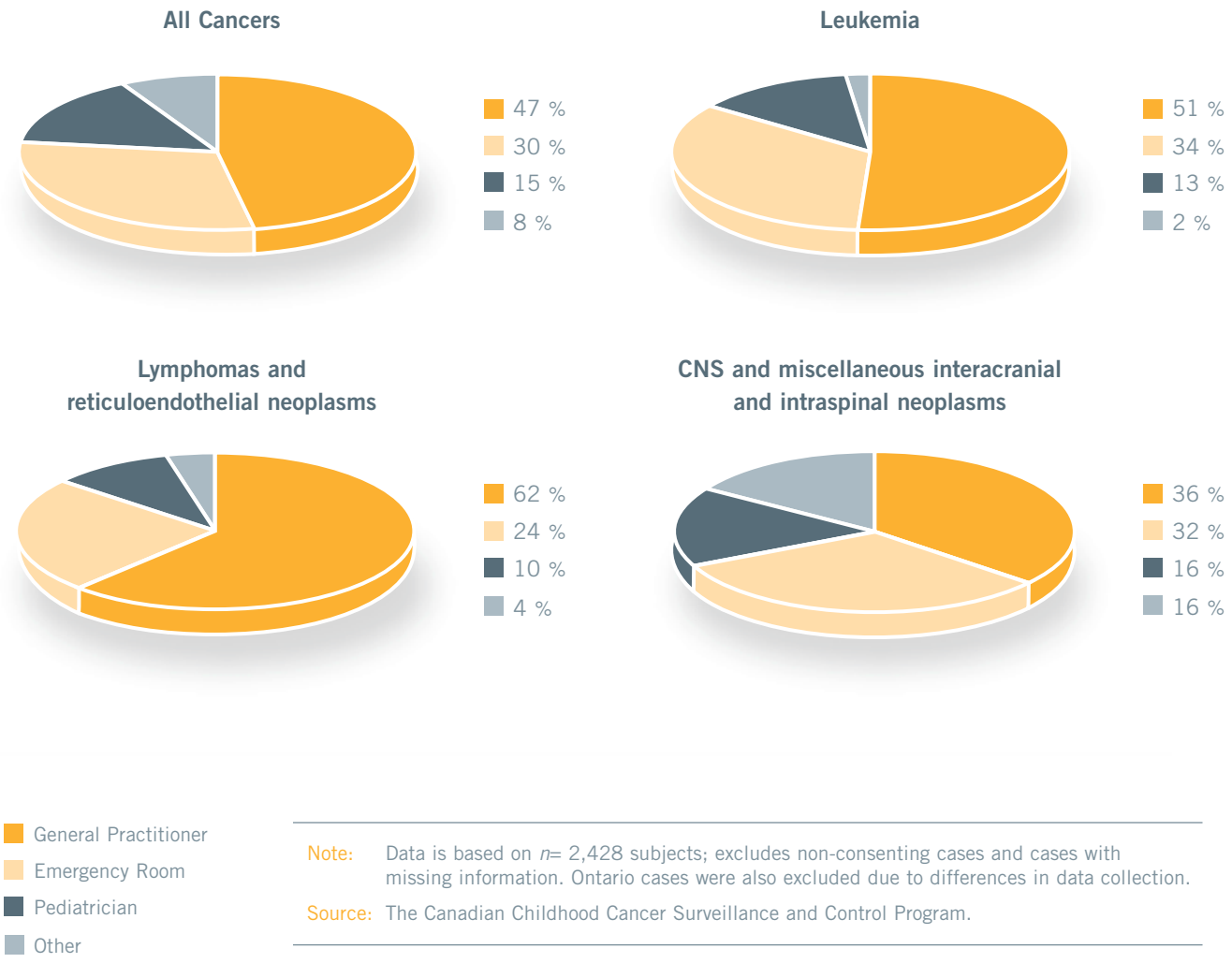
Note: Canada totals include cases from the North. Data is based on *n*= 2,469 subjects; excludes non-consenting and cases with information missing. Ontario cases were excluded due to differences in data collection.

Source: The Canadian Childhood Cancer Surveillance and Control Program.

A breakdown of health care professionals first sought when a child initially complains of symptoms is shown for all cancers and the three most frequent cancer types in FIGURE 6. In general, patterns of first health care contact remained similar by diagnosis. For all cancer types, the health care professional most often contacted was the general practitioner (47 percent), followed by hospital emergency department physicians (30 percent) and pediatricians (15 percent). Other first points of health care contact included ophthalmologists, optometrists, neurologists, surgeons and chiropractors.

FIGURE 6

Health Care Professional First Contacted Regarding Cancer Symptoms by Selected Diagnosis, Children Ages 0–14,1995–2000, Canada



Note: Data is based on *n*= 2,428 subjects; excludes non-consenting cases and cases with missing information. Ontario cases were also excluded due to differences in data collection.

Source: The Canadian Childhood Cancer Surveillance and Control Program.

3 INITIAL EXTENT OF DISEASE

The initial extent of disease in cancer patients is used to establish treatment. In general, more aggressive therapy is required for more advanced disease stages.

Tumour size and the degree of spread to other organs or systems (metastasis), patient symptoms and biomarker measurements are used to define the extent of the disease. This chapter explores the proportion of cases with metastasis present at diagnosis, and the distribution of the observed metastatic sites, for the various cancer types. Non-consenting cases (n = 576), and subjects for whom complete information was not available, were excluded from the results in this chapter. In addition, cases diagnosed with leukemia, lymphomas and reticuloendothelial neoplasms, Langerhans cell histiocystosis and myelodysplastic syndrome were not applicable, as these are diseases which are systemic.

In TABLE 5, the proportion of patients with metastatic disease at diagnosis is shown by cancer type. Metastases were present at diagnosis in approximately one quarter of all cancer cases. Sympathetic nervous system tumours and hepatic tumours had the greatest proportion of metastases at diagnosis ranging from 56 to 35 percent. Retinoblastoma had the lowest rate of metastasis (5 percent), followed by CNS neoplasms (13 percent).

TABLE 5
Percentage of Patients With Metastasis Present at Diagnosis by Cancer Type*, Children Ages 0–14, 1995–2000, Canada

Cancer Type*	Number of Cases	Presence of metastasis at diagnosis %
III. CNS and miscellaneous intracranial and intraspinal neoplasms	852	12.9
IV. Sympathetic nervous system tumours	315	55.6
V. Retinoblastoma	100	5.0
VI. Renal tumours	280	31.1
VII. Hepatic tumours	65	35.4
VIII. Malignant bone tumours	173	16.8
IX. Soft-tissue sarcomas	233	27.0
X. Germ cell, trophoblastic and other gonadal neoplasms	138	21.7
XI. Carcinomas and other malignant epithelial neoplasms	69	30.4
XII. Other and unspecified malignant neoplasms	39	28.2
All Cancers	**2,264**	**24.5**

* Leukemia, lymphomas and reticuloendothelial neoplasms, Langerhans cell histiocytosis and myelodysplastic syndrome have been excluded.

Note: Data excludes the non-consenting cases and cases with missing information.
Source: The Canadian Childhood Cancer Surveillance and Control Program.

"TAKE IT DAY BY DAY..."

– KRISTIN, AGE 10

For cases with metastatic disease at diagnosis, the distribution of sites of metastases by cancer type is given in TABLE 6. Figures in TABLE 6 correspond to the number of metastases and are not individual cases. Therefore, one child with several metastatic sites is represented in multiple columns. Percentages given express the proportion of cases with a metastatic site for each given location. Sixty-five percent of cases had a single site of metastasis; 23 percent had two sites involved while 12 percent involved tumour spread to three or more sites. Metastatic disease occurred in the lung, bone marrow and regional lymph nodes in 25, 23 and 22 percent of cases respectively. Sympathetic nervous system tumours, and soft-tissue sarcoma cases metastasized to the largest variety of sites. CNS neoplasms cases metastasize mostly to other parts of the brain and the central nervous system.

TABLE 6

Location of Metastases in Patients with Solid Tumours Present at Diagnosis by Cancer Type*, Children Ages 0–14, 1995–2000, Canada

Cancer Type*

	Lung	Bone	Bone Marrow	Brain	Lymph Nodes Regional	Lymph Nodes Distant	Liver	Other
III. CNS and miscellaneous intracranial and intraspinal neoplasms	2	1	1	51	0	0	1	56
IV. Sympathetic nervous system tumours	11	70	101	7	38	18	31	25
V. Retinoblastoma	0	0	0	2	0	0	0	4
VI. Renal tumours	40	2	0	1	37	4	8	9
VII. Hepatic tumours	16	1	0	0	4	1	3	5
VIII. Malignant bone tumours	17	6	1	0	0	0	0	3
IX. Soft-tissue sarcomas	18	9	9	4	9	3	3	25
X. Germ cell, trophoblastic and other gonadal neoplasms	9	1	0	4	5	1	1	11
XI. Carcinomas and other malignant epithelial neoplasms	3	1	0	0	11	1	0	1
XII. Other and unspecified malignant neoplasms	4	1	0	1	2	1	3	5
All Cancers	**120 (25.2%)**	**92 (19.3%)**	**112 (23.5%)**	**70 (14.7%)**	**106 (22.2%)**	**29 (6.1%)**	**50 (10.5%)**	**144 (30.2%)**

* Leukemia, lymphomas and reticuloendothelial neoplasms, Langerhans cell histiocytosis and myelodysplastic syndrome cases have been excluded.

Note: Data are based on 477 cases with metastases present at diagnosis; excludes non-consenting cases and cases for which the metastatic sites are unavailable. Counts correspond to the number of metastases and are not individual cases. Percentages represent the proportion of cases with a metastatic site for each given location.

Source: The Canadian Childhood Cancer Surveillance and Control Program.

Acute non-lymphocytic leukemia cases can be further categorized using the French-American-British (FAB) cooperative group system. Beginning in 1976[8-11], FAB was developed to provide standard terminology for morphologic and histochemical differences in acute leukemias. FAB categorizes acute non-lymphocytic leukemia cases (ANLL) into subtypes according to the degree of maturation of the leukemic cells and their lineage differentiation. Under the FAB system, eight distinct types of ANLL are considered. FAB categories do not necessarily indicate severity of the diagnosis, although some FAB categories have shown better response to treatment than others.

TABLE 7 shows the distribution of FAB classification for cases of ANLL. Types M1, M4 and M2 are the most common FAB types.

TABLE 7
FAB Classification of Acute Non-Lymphocytic Leukemia (ANLL) Cases, Children Ages 0–14, 1995–2000, Canada

FAB Classification	Total	
	No.	%
M0: acute myeloblastic leukemia without localized differentiation	17	8.8
M1: acute myeloblastic leukemia without maturation	36	18.7
M2: acute myeloblastic leukemia with maturation	33	17.1
M3: acute promyelocytic leukemia	21	10.9
M4: acute myelomonocytic leukemia	34	17.6
M5: acute monocytic leukemia	17	8.8
M6: acute erythroleukemia	9	4.7
M7: acute megakaryotic leukemia	26	13.5
Total	**193**	**100.0**

Note: Data excludes non-consenting cases and cases of ANLL with missing FAB.
Source: The Canadian Childhood Cancer Surveillance and Control Program.

4 INITIAL TREATMENT

Treatment for cancer is substantially more effective for children than adults.

Development and refinement of therapy have been a direct result of cooperative clinical trials conducted by groups such as the Children's Oncology Group[3], which includes almost all centres treating children diagnosed with cancer in Canada.

Information in this chapter describes the proportions of patients receiving treatment by way of clinical trials, non-clinical trial treatment protocols, or individualized treatment plans. Ontario cases were excluded from all analysis (due to differences in data collection processes) except for the regional anaylsis presented in FIGURE 9. Non-consenting cases were also excluded, resulting in 2,532 cases analyzed.

» Clinical Trials and Other Treatment Protocols

Clinical trials are studies primarily designed to compare the efficacy, including side effects, of different treatment protocols, with the ultimate goal of increasing survival and reducing undesirable long-term effects. Most clinical trials established are multi- centre (due to the relatively small number of cases occurring at individual pediatric centres) and have a greater proportion of children, compared to adults, that are registered in them. At the time of data collection, the Children's Cancer Group and the Pediatric Oncology Group coordinated treatment protocols and clinical trials for childhood cancer in North America[12].

Treatment protocols are treatment plans specific to the diagnosis, and the extent of disease and its clinical presentation. Treatment protocols are selected as options when clinical trials are not available or inappropriate, or when a family declines to participate in a clinical trial. Treatment protocols deliver the best available treatment based on previous clinical trials. It has been shown that well-defined treatment protocols delivered through pediatric oncology centres provide significant survival advantage for many childhood cancers[13].

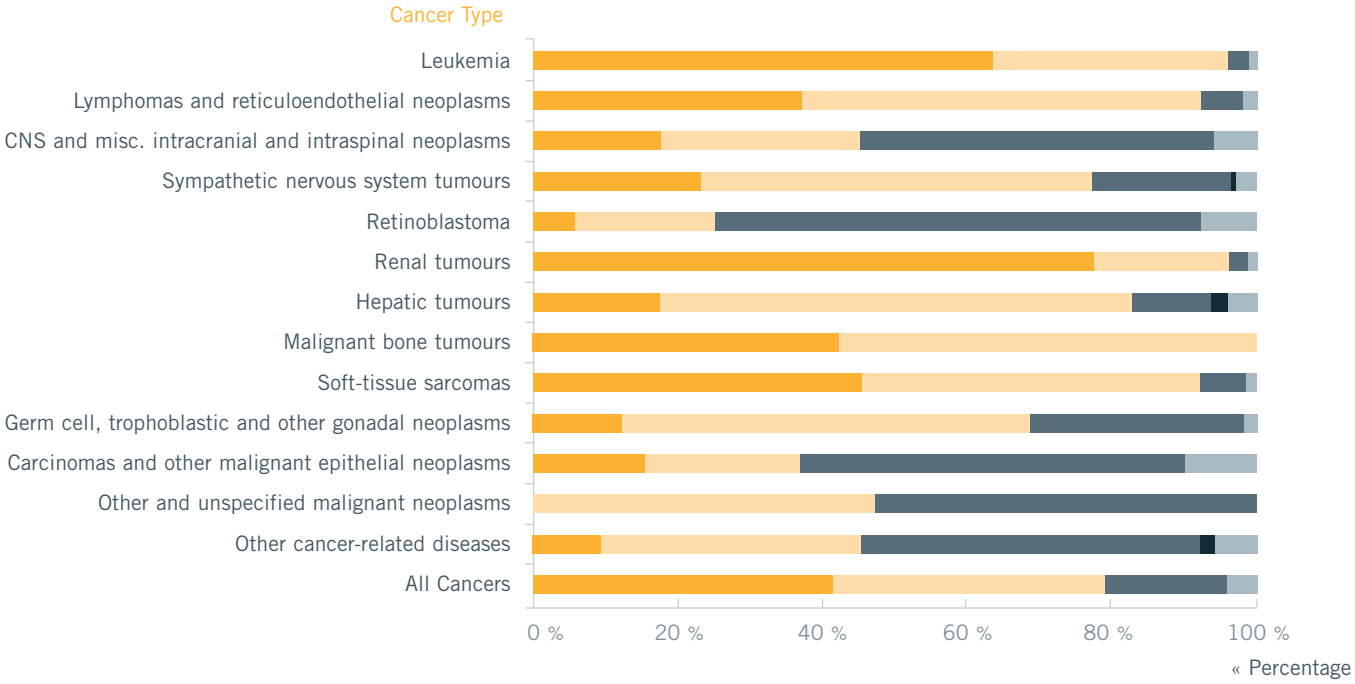
Nearly 80 percent of children receive their treatment by either clinical trial or treatment protocol, but diagnosis is an important determining factor for participation (FIGURE 7). Only 50 percent of children with CNS neoplasms, compared with 95 percent of children with leukemia, receive their treatment in these formats. Specifically, 41 percent of children participate in clinical trials, but this ranges from 5 to 80 percent by diagnosis, whereas 39 percent receive their care by treatment protocol (range 18 to 68).

"THANKS DOC!"

– LUCY, AGE 10

FIGURE 7

Percent Distribution of Initial Treatment by Cancer Type, Children Ages 0–14, 1995–2000, Canada*



* Excludes Ontario cases due to differences in data collection.

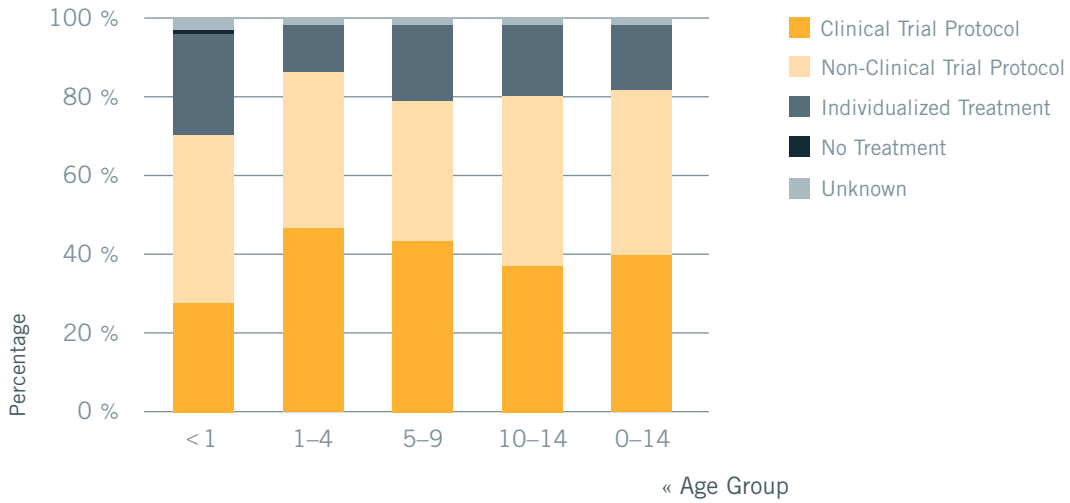
Note: Data excludes non-consenting cases and cases with missing information.

Source: The Canadian Childhood Cancer Surveillance and Control Program.

Age at diagnosis showed some influence on participation in clinical trials, with the lowest levels noted in the under one-year-old category (FIGURE 8). The types of cancer diagnosed within each age group likely influence these patterns of participation. Lastly, some differences in protocol treatment use and clinical trial registration was noted by geographical region (FIGURE 9). In Ontario, a higher proportion of institutional study protocols resulted in differences for the non-clinical trial category. Elsewhere, the Atlantic region showed slightly lower clinical trial participation levels.

FIGURE 8

Percent Distribution of Initial Treatment by Age Group, 1995–2000, Canada*

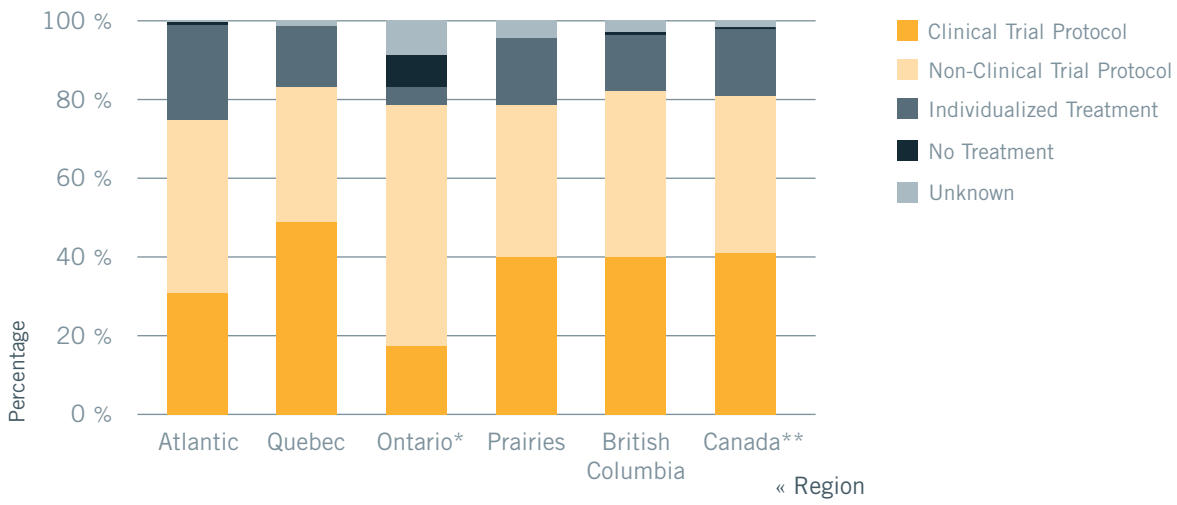


* Excludes Ontario cases due to differences in data collection.

Note: Data excludes non-consenting and cases with missing information.

FIGURE 9

Percent Distribution of Initial Treatment by Region, Children Ages 0–14, 1995–2000, Canada



* Ontario cases represent 1997–2000 cases only. For years 1995–1996, Ontario cases did not include clinical trial registration information.

** Excludes Ontario cases.

Note: Data excludes non-consenting cases and cases with missing information. Canada totals included cases from the North.

GLOSSARY

age-specific rate
The number of new cases of cancer during the year, expressed as a rate per 100,000 persons in a given age group.

age-standardized rate
The number of new cases of cancer per 100,000 that would have occurred in the standard population (1991 Canadian population) if the actual age-specific rates observed in a given population had prevailed in the standard population.

astrocytoma
A type of brain tumor.

benign
A tumour that does not invade surrounding tissue or spread to other parts of the body.

biopsy
Surgical removal of tissue for a diagnosis under the microscope.

bone marrow
The soft tissue inside bones where red and white blood cells and platelets are made.

bone marrow aspiration
Removal of bone marrow by use of a needle inserted into bone.

cancer
Cancer is a general term for more than 200 diseases. It is the uncontrolled abnormal growth of cells that can invade and destroy healthy tissues. Most cancers can also spread to other parts of the body.

carcinoma
Cancer arising in the cellular covering of the inner and outer body surfaces, including the glands, the lining of vessels and small cavities.

central nervous system (CNS)
Brain and spinal cord.

clinical Trial
Studies primarily designed to compare the effectiveness of different treatments and their side effects.

crude rate
The number of new cases of cancer during the year, expressed as a rate per 100,000 persons in the population.

epidemiology
The study of the distribution and determinants of disease in populations.

epithelial
Referring to the cellular layer covering all inner and outer body surfaces, including the glands.

etiology
Cause(s).

Ewing's sarcoma
A malignant bone or soft tissue tumour, different from osteosarcoma.

germ cells
Eggs/ova and sperm.

gonadal
Referring to an ovary or testis.

hepatic
Referring to the liver.

incidence
The number of new cases of a given type of cancer diagnosed during the year.

ICD-O
The International Classification of Diseases for Oncology.

ionizing radiation
High energy radiation that causes the formation of ions in substances through which it passes. These ions may damage tissue.

Langerhans cell histiocytosis
A proliferative disorder of bone marrow-derived Langerhans' cells, which may be found in various organs.

leukemia
A malignant disease of uncontrollable growth of unusually immature blood cells, generally starting in the bone marrow.

lymph nodes
Small, bean-sized organs throughout the body that protect against infection. They enlarge in response to disease.

lymphoid
Pertaining to or resembling lymph or lymphatic tissue.

lymphoma
Malignancy of lymphatic tissue usually arising in the lymph nodes but also in other tissue.

malignant
A tumour that can invade surrounding tissues and/or spread to other parts of the body.

median
The value that is the middle of a distribution (ie. half the values are above the median and half are below the median).

meninges
The membranes covering the brain and spinal cord.

metastases
Cancer that has spread from one part of the body to another through the bloodstream or lymph system (the process is called *metastasis*).

myelodysplastic syndrome
Myelodysplastic syndrome, also called pre-leukemia or "smoldering" leukemia, are diseases in which the bone marrow does not function normally and not enough normal blood cells are made.

neoplasm
An abnormal growth of cells. The term is usually used to describe a malignant tumour.

neuroblastoma
A malignant tumour that arises in nerve cells of the sympathetic nervous system.

oncologist
Physician who treats patients with cancer.

oncology
The study of cancer.

osteosarcoma
A malignant tumour that begins in the bone.

prognosis
The likely outcome of a disease.

prophylaxis
Prevention or protection against disease.

protocol
Detailed set of instructions about how a treatment is to be administered.

puberty
Sexual maturity.

radiation therapy (radiotherapy)
High energy beams used to kill cancer cells.

renal
Referring to the kidney.

retinoblastoma
Malignant tumour that occurs in the retina, the membrane at the back of the eye.

rhabdomyosarcoma
A malignant tumour derived from skeletal muscle.

sarcoma
Malignant tumour arising in muscles, nerve sheaths, fat, blood vessels or connective tissue.

soft tissue
Inner body tissues other than bone and specific organs, e.g. muscle, connective tissue and blood vessels.

staging
Classification of spread of disease.

sympathetic nervous system
A system of nerves controlling blood pressure, heart rate and other internal bodily functions.

syndrome
Symptoms and findings constituting a particular disease.

tumour
A lump or swelling; can be malignant or benign.

Wilms' tumour
A malignant tumour that arises within the kidney during embryonic life.

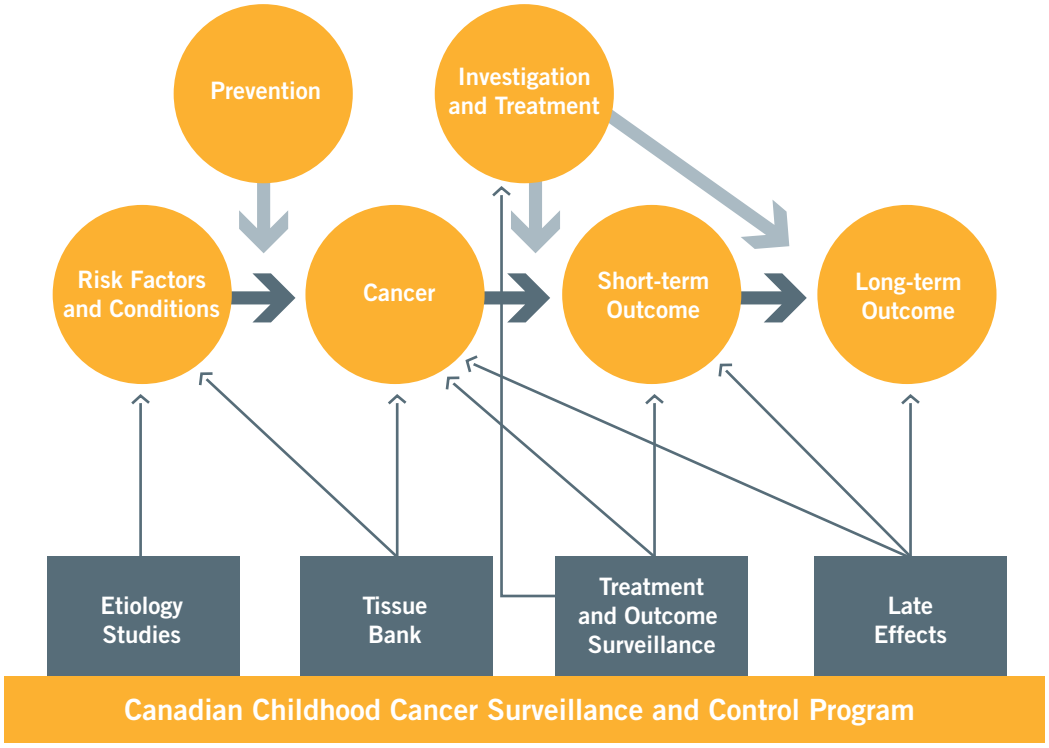
A APPENDIX: DATA SOURCES AND METHODOLOGY

» History of the Canadian Childhood Cancer Surveillance and Control Program (CCCSCP)

The Canadian Childhood Cancer Surveillance and Control Program was established in 1992. Originally funded through the federal government's Brighter Futures Initiative, the Program is a partnership between health care providers, researchers, consumers, provincial/territorial and federal governments, voluntary agencies, and stakeholders in the area of childhood cancer. A management committee, consisting of childhood cancer experts was established to oversee the Program, and in 1993 a national consensus conference established its parameters. It became operational nationally in 1995.

Initially, the Program was designed to be nationally integrated and to fill gaps in knowledge about the control of cancer among Canadian children[14]. Provincial cancer registries collect information on incidence and mortality as well as basic demographic data, while clinical trial databases gather information about the particular intervention that is under investigation. The Program was intended to complement these sources by adding additional information on the complete cancer continuum of risk factors and conditions, investigations, treatment, and short- and long-term outcomes (see FIGURE A1).

FIGURE A1
The CCCSCP and the Childhood Cancer Continuum



To accomplish the Program's objectives, four interconnecting components were identified.

TREATMENT AND OUTCOME SURVEILLANCE:
This component is a nationwide population-based surveillance program conducted in pediatric oncology centres and selected provincial cancer registries across Canada. Information about diagnosis, treatment and outcomes is collected from patients during diagnosis and at six-month intervals up to five years. The main objective of this component is to assess such issues as access to care, appropriateness of care, extent of the disease and clinical outcomes. This component was also designed to be a study base for future studies.

LATE EFFECTS STUDY:
The goal of the Late Effects Study is two-fold. The first is to assess the long-term psycho-social and physical effects of cancer and its treatment on children and young adults who have survived cancer. The second goal is to develop a risk profile of late effects in order to potentially minimize future impacts on future generations of survivors.

ETIOLOGY COMPONENT:
The etiology component aims to establish a national population-based database of childhood cancer cases and matched controls with detailed information regarding possible risk factors.

TISSUE BANK:
The objective of this component is to establish tissue banks in four pediatric oncology centres in strategic geographic locations. Normal and tumour tissue from newly diagnosed children who were involved in the Treatment and Outcome Surveillance System, as well as blood from parents, were to be collected and stored in the bank making it possible to incorporate molecular characteristics in a population-based cohort, unique to Canada.

» Data Sources and Processing

Data for this report were primarily based on the Treatment and Outcome Surveillance System. Population estimates used in the calculation of rates were obtained from Statistics Canada[15]. Canadian Cancer Registry data, maintained by the Health Statistics Division at Statistics Canada, were used in comparisons involving data quality.

The Treatment and Outcome Surveillance System is based at pediatric oncology centres across the country. Local Principal Investigators and Clinical Research Associates at participating centres recruit patients, review charts, collect data and provide Health Canada with case information at regular intervals. TABLE A1 lists the participating centres and their respective involvement with provincial cancer registries.

Case recruitment varies by province. In Newfoundland and Labrador, Nova Scotia, Prince Edward Island, New Brunswick, Ontario and Quebec, childhood cancer patients seen only at pediatric oncology centres are recruited. Patients residing in Prince Edward Island and New Brunswick are generally treated in Nova Scotia. In Manitoba, Saskatchewan, Alberta and British Columbia, the majority of cases are recruited at pediatric oncology centres and may also be identified through the provincial cancer registries and included; however, the vast majority of childhood cancer cases are treated at pediatric oncology centres. In Ontario, patients are recruited by the Pediatric Oncology Group of Ontario. Cases from the North (Yukon, Northwest Territories and Nunavut) may be referred to any of the pediatric oncology centres.

TABLE A1

Provincial Data Sources of the Treatment and Outcome Surveillance System

Province*	Pediatric Oncology Centres	Provincial Cancer Registry Involvement
Newfoundland and Labrador	Janeway Children's Health and Rehabilitation Centre, St. John's	No
Nova Scotia, Prince Edward Island and New Brunswick	IWK Health Centre, Halifax	No
Quebec	Hôpital Sainte-Justine, Montreal The Montreal Children's Hospital, Montreal Centre hospitalier de l'Université Laval, Ste-Foy Centre hospitalier universitaire de Sherbrooke, Fleurimont	No
Ontario**	Children's Hospital of Western Ontario, London The Hospital for Sick Children, Toronto McMaster-Chedoke Hospital, Hamilton Children's Hospital of Eastern Ontario, Ottawa Kingston General Hospital, Kingston	No
Manitoba	CancerCare Manitoba, Winnipeg	Yes
Saskatchewan	Allan Blair Cancer Centre, Regina Saskatoon Cancer Centre, Saskatoon	Yes
Alberta	Alberta Children's Hospital, Calgary Cross Cancer Institute, Edmonton	Yes
British Columbia	British Columbia Children's Hospital, Vancouver	Yes†

* Cases from the North (Yukon, Northwest Territories and Nunavut) may be treated in any of the pediatric oncology centres.

** Collectively submitted through the Pediatric Oncology Group of Ontario (POGO).

† For years 1995-1996 only.

» Patient Eligibility and Case Definitions

Patients included in the Treatment and Outcome Surveillance System are Canadian residents diagnosed with one of the following diseases before the age of 20:

- a cancer listed in the International Classification of Childhood Cancer;
- Langerhans cell histiocytosis; or
- myelodysplastic syndrome.

In 1996, Birch and Marsden's internationally accepted classification scheme for childhood cancer[16] was revised to create the International Classification of Childhood Cancer (ICCC)[17]. This allowed for the new and expanded coding of cancer introduced by the second edition of the International Classification of Diseases for Oncology[18] and the tenth revision of the International Classification of Diseases[19]. All the centres participating in the Treatment and Outcome Surveillance System have reviewed their records and added cases involving all the cancers now listed in the ICCC.

The International Classification of Childhood Cancer (ICCC) (see APPENDIX C for details) combines morphology and the tumour location to group similar diagnoses into categories. Langerhans cell histiocytosis and myelodysplastic syndrome diseases are not included in this classification, but are part of the Treatment and Outcome Surveillance System due to their cancer-related characteristics.

» Data Collection

Data are collected using similar methods at all participating centres, except in Ontario. The Pediatric Oncology Group of Ontario (POGO) collects and manages information on childhood cancer cases for residents of Ontario and those patients treated at Ontario pediatric centres (see APPENDIX B for more information on POGO).

Herein is outlined the process used by centres other than those in Ontario. A Clinical Research Associate collects detailed information about consenting patients at the time of diagnosis and at six-month follow-ups for a maximum of five years or until the patient dies; minimal information is collected for non-consenting patients.

» Data Quality

This section describes the methods used to ensure the quality of the information in the national database, as well as the database's limitations as a complete source of information about the entire Canadian population of cancer patients younger than 20 years of age.

Comparisons with the Canadian Cancer Registry

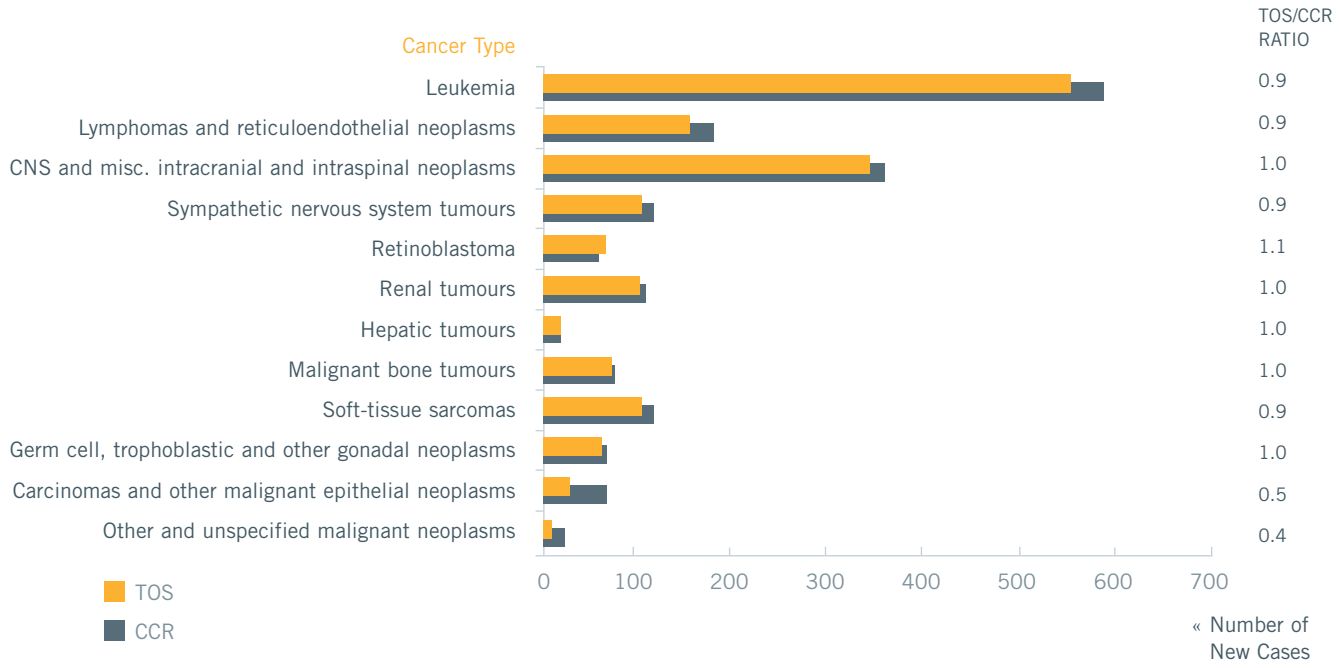
To assess case completeness, data from the Treatment and Outcome Surveillance System are compared with the Canadian Cancer Registry for the years 1995 to 1996. The Canadian Cancer Registry is maintained by the Health Statistics Division at Statistics Canada and is derived using information provided from Provincial and Territorial Cancer Registries[20]. For this comparison, eligibility criteria for the Treatment and Outcome Surveillance System was matched to that of the Canadian Cancer Registry, thus excluding patients diagnosed with Langerhans cell histiocytosis, myelodysplastic syndrome, skin carcinomas and benign brain tumours.

Comparisons between the two data sources for the total number of new cases by region and age group yielded similar estimates (data not shown).

A breakdown of new cases by cancer type from the two data sources is given in FIGURE A2. Overall, Treatment and Outcome Surveillance data agree with Canadian Cancer Registry data. Diagnoses for which the Treatment and Outcome Surveillance System appears to report significantly fewer cases include carcinomas and other malignant epithelial neoplasms (ratio = 0.5) and other and unspecified malignant neoplasms (ratio = 0.4). The first of these two discrepancies may be a result of carcinomas diagnosed and treated in hospitals without referral to pediatric oncology centres. The latter ratio may indicate less of a discrepancy in the number of cases, but rather in the specificity of the diagnosis.

FIGURE A2

Comparison of New Cases* in the Treatment and Outcome Surveillance (TOS) System and Canadian Cancer Registry (CCR) by Cancer Type, Children Ages 0–14, 1995–1996, Canada



* Malignant neoplasms only, excluding Langerhans cell histiocytosis, myelodysplastic syndrome, and skin carcinomas.

Duplicate Records

Over-coverage can occur for a number of reasons, including the presence of duplicate records and records for ineligible patients in the database. Duplicate records were eliminated from the 1995 to 2000 patients by conducting internal record linkage. The actual number of duplicates was very low, approximately one percent.

The International Classification of Diseases for Oncology topography and morphology codes in the 1995 to 2000 data were converted to their associated ICCC diagnosis group using the Child-Check program developed by the International Agency for Research on Cancer[21].

Site Audits

In 1998, site audits were performed at four participating centres to assess the accuracy of the data, to ensure that informed consent had been obtained and securely filed, and to verify that the centres obtained yearly ethics review board approvals.

A random sample of patients in the four centres was selected for an independent chart review by an audit team. A comparison between the original and re-abstracted records yielded an error rate of less than 3 percent across all audited data fields. Problematic fields were identified and a number of recommendations were implemented.

» Data Processing

Much of the statistical information presented in this report is by cancer type, age group and geographical region. Wherever possible, information is presented on all cases. However, due to missing information, lack of consent or non-applicable cases, not all calculations are based on the same number of patients; the reader is made aware of exclusions in the footnotes of each table or figure.

Regions used in this report are as follows: Atlantic (Nova Scotia, Newfoundland and Labrador, New Brunswick and Prince Edward Island); the Prairies (Manitoba, Saskatchewan and Alberta); and the provinces of Quebec, Ontario and British Columbia. Regions were based on the most accurate resident information for cases at the time of diagnosis. Childhood cases have been defined as 0 to 14 years of age at the time of diagnosis. Age groups used in the report are: less than 1, 1 to 4, 5 to 9 and 10 to 14 years.

To respect the Data Confidentiality Guidelines of the Canadian Childhood Cancer Surveillance and Control Program, categories with fewer than five cases have been suppressed. Crude rates were calculated for the period 1995 to 2000 due to the small number of cancer cases by region, sex and age group. Age-standardized rates were calculated using the direct method[22] and standardized to the 1991 Canadian population.

Totals, when presented in tables, may not equal the sum of the parts due to rounding. Totals were rounded as follows[1]: counts between 0 and 99 to the nearest 5; counts between 100 and 999 to the nearest 10; counts between 1000 and 1999 to nearest 50; and counts greater than or equal to 2000 to the nearest 100. Percentages and all rates were rounded to the nearest tenth.

B APPENDIX: PEDIATRIC ONCOLOGY GROUP OF ONTARIO

» Data from the Pediatric Oncology Group of Ontario

POGO began in 1983 as a grassroots alliance of programs and professionals committed to developing a comprehensive and integrated childhood cancer control system for the province. POGO is now the official source of advice on childhood cancer control to the Ontario Ministry of Health and Long-Term Care, from which it receives its funding.

POGO's five partners are the pediatric cancer programs at The Hospital for Sick Children in Toronto, McMaster-Chedoke Hospital in Hamilton, the Children's Hospital of Western Ontario in London, Kingston General Hospital in Kingston, and the Children's Hospital of Eastern Ontario in Ottawa.

Since 1985, every child between the ages of 0 to 17 years who is a resident of Ontario and who is diagnosed with cancer at these five centres has been registered in the POGO database. Cancers are classified according to the POGO Pediatric Cancer Diagnostic Nomenclature and Classification System, which closely approximates the International Classification of Childhood Cancer, and incorporates, for further specificity, the World Health Organization's Classification of Brain Tumours. Registration information is gathered from pathology reports and, when appropriate, from discussions with the responsible pediatric oncologist.

The electronic POGO Networked Information System (POGONIS) was implemented in 1997. POGONIS was developed in phases, with new data elements defined, standardized and agreed to, and necessary training completed, prior to data collection. The database includes only limited data on cases from 1985 to 1994, and more detailed information on cases from 1995 onward. Since the POGONIS and the Treatment and Outcome Surveillance System databases were developed with slightly different objectives, not all fields and variables are comparable.

POGONIS is a population-based database that is comprehensive, relational, unique and exportable. Each program partner can submit queries of its own data through the system. The data dictionary is an electronic database with standardized screens and pull-down range lists, which facilitate standardized data entry. Each pediatric oncology program is electronically networked to a central server housed in the POGO Office. The POGONIS Data Administrator provides ongoing support to local data managers and Clinic Research Associates, and regularly scrutinizes data for accuracy, plausibility and consistency using query and reporting features built into the system.

POGONIS contains essential and detailed information about diagnosis and demographics, along with selected service delivery information. Future expansions will add psycho-social and late effects data. In addition to incident cases in the province, the limited registry component of POGONIS captures information about patients investigated or partially treated by childhood cancer professionals elsewhere (e.g. Ontario residents living out of the province or country).

All patients are assigned a unique POGO identifier upon registration, and POGONIS contains no patient-identifying information.

C APPENDIX: INTERNATIONAL CLASSIFICATION OF CHILDHOOD CANCER

Diagnostic group	ICD-O-2 codes Morphology		Topography
I Leukaemia			
a) Lymphoid leukaemia	9820-9827, 9850		
b) Acute non-lymphocytic leukaemia	9840, 9841, 9861, 9864, 9866, 9867, 9891, 9894, 9910		
c) Chronic myeloid leukaemia	9863, 9868		
d) Other specified leukaemias	9830, 9842, 9860, 9862, 9870-9890, 9892, 9893, 9900, 9930-9941		
e) Unspecified leukaemias	9800-9804		
II Lymphomas and reticuloendothelial neoplasms			
a) Hodgkin's disease	9650-9667		
b) Non-Hodgkin lymphoma	9591-9595, 9670-9686, 9690-9714, 9723		
c) Burkitt's lymphoma	9687		
d) Miscellaneous lymphoreticular neoplasms	9720, 9731-9764		
e) Unspecified lymphomas	9590		
III CNS and miscellaneous intracranial and intraspinal neoplasms			
a) Ependymoma	9383, 9390-9394	**	
b) Astrocytoma	9380, 9381, 9400-9441		C72.3
c) Primitive neuroectodermal tumours	9470-9473		
d) Other gliomas	9380		C70.0- C72.2, C72.4-C72.9
	9382, 9384	*	
	9442-9460, 9481		
e) Other specified intracranial and intraspinal neoplasms	8270-8281, 8300, 9350-9362, 9480, 9505, 9530-9539	**	
f) Unspecified intracranial and intraspinal neoplasms	8000-8004	**	C70.0-C72.9, C75.1-C75.3
IV Sympathetic nervous system tumours			
a) Neuroblastoma and ganglioneuroblastoma	9490, 9500		
b) Other sympathetic nervous system tumours	8680, 8693-8710, 9501-9504, 9520-9523		

continued on next pg. »

* Behaviour code /1 is included.
** Behaviour code /0 and /1 are included.

Diagnostic group	ICD-O-2 codes Morphology	Topography
V Retinoblastoma		
	9510-9512	
VI Renal tumours		
a) Wilms' tumour, rhabdoid and clear cell sarcoma	8960, 8964	
	8963	C64.9, C80.9
b) Renal carcinoma	8010-8041, 8050-8075, 8082, 8120-8122, 8130-8141, 8143, 8155, 8190-8201, 8210, 8211, 8221-8231, 8240, 8241,8244-8246, 8260-8263,8290, 8310, 8320, 8323, 8401,8430, 8440, 8480-8490, 8504, 8510, 8550, 8560-8573, 8312	C64.9
c) Unspecified malignant renal tumours	8000-8004	C64.9
VII Hepatic tumours		
a) Hepatoblastoma	8970	
b) Hepatic carcinoma	8010-8041, 8050-8075, 8082, 8120-8122, 8140, 8141, 8143, 8155, 8190-8201, 8210, 8211, 8230, 8231, 8240, 8241, 8244-8246, 8260-8263, 8310, 8320, 8323, 8401, 8430, 8440, 8480-8490, 8504, 8510, 8550, 8560-8573, 8160-8180	C22.0, C22.1
c) Unspecified malignant hepatic tumours	8000-8004	C22.0, C22.1
VIII Malignant bone tumours		
a) Osteosarcoma	9180-9200	
b) Chondrosarcoma	9220-9230, 9231, 9240	C40.0-C41.9
c) Ewing's sarcoma	9260	C40.0-C41.9, C80.9
	9363, 9364	C40.0-C41.9
d) Other specified malignant bone tumours	8812, 9250, 9261-9330, 9370	
e) Unspecified malignant bone tumours	8000-8004, 8800, 8801, 8803, 8804	C40.0-C41.9
IX Soft-tissue sarcomas		
a) Rhabdomyosarcoma and embryonal sarcoma	8900-8920, 8991	
b) Fibrosarcoma, neurofibrosarcoma and other fibromatous neoplasms	8810, 8811, 8813-8833, 9540-9561	
c) Kaposi's sarcoma	9140	

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Diagnostic group	ICD-O-2 codes Morphology		Topography
d) Other specified soft-tissue sarcomas	8840-8896, 8982, 8990, 9040-9044, 9120-9134, 9150-9170, 9251, 9581		
	8963		C00.0-C63.9, C65.9-C76.8
	9231, 9240, 9363, 9364		C00.0-C39.9, C47.0-C80.9
	9260		C00.0-C39.9, C47.0-C76.8
e) Unspecified soft-tissue sarcomas	8800-8804		C00.0-C39.9, C44.0-C80.9
X Germ-cell, trophoblastic and other gonadal neoplasms			
a) Intracranial and intraspinal germ cell tumours	9060-9102	**	C70.0-C72.9, C75.1-C75.3
b) Other and unspecified non-gonadal germ cell tumours	9060-9102		C00.0-C55.9, C57.0-C61.9, C63.0-C69.9, C73.9-C75.0, C75.4-C80.9
c) Gonadal germ cell tumours	9060-9102		C56.9, C62.0-C62.9
d) Gonadal carcinomas	8010-8041, 8050-8075, 8082, 8120-8122, 8130-8141, 8143, 8155, 8190-8201, 8210, 8211, 8221-8241, 8244-8246, 8260-8263, 8290, 8310, 8320, 8323, 8430, 8440, 8480-8490, 8504, 8510, 8550, 8560-8573		C56.9, C62.0-C62.9
	8380, 8381, 8441-8473		
e) Other and unspecified malignant gonadal tumours	8590-8670, 9000 8000-8004		C56.9, C62.0-C62.9
XI Carcinomas and other malignant epithelial neoplasms			
a) Adrenocortical carcinoma	8370-8375		
b) Thyroid carcinoma	8010-8041, 8050-8075, 8082, 8120-8122, 8130-8141, 8155, 8190, 8200, 8201, 8211, 8230, 8231, 8244-8246, 8260-8263, 8290, 8310, 8320, 8323, 8430, 8440, 8480, 8481, 8500-8573		C73.9
	8330-8350		

continued on next pg. »

* Behaviour code /1 is included.
** Behaviour code /0 and /1 are included.

Diagnostic group	ICD-O-2 codes Morphology	Topography
c) Nasopharyngeal carcinoma	8010-8041, 8050-8075, 8082, 8120-8122, 8130-8141, 8155, 8190, 8200, 8201, 8211, 8230, 8231, 8244-8246, 8260-8263, 8290, 8310, 8320, 8323, 8430, 8440, 8480, 8481, 8504, 8510, 8550, 8560-8573	C11.0-C11.9
d) Malignant melanoma	8720-8780	
e) Skin carcinoma	8010-8041, 8050-8075, 8082, 8090-8110, 8140, 8143, 8147, 8190, 8200, 8240, 8246, 8247, 8260, 8310, 8320, 8323, 8390-8420, 8430, 8480, 8542, 8560, 8570-8573, 8940	C44.0-C44.9
f) Other and unspecified carcinomas	8010-8082, 8120-8155, 8190-8263, 8290, 8310, 8314-8323, 8430-8440, 8480-8580, 8940, 8941	C00.0-C10.9, C12.9-C21.8, C23.9-C39.9, C48.0-C48.8, C50.0-C55.9, C57.0-C61.9, C63.0-C63.9, C65.9-C72.9, C75.0-C80.9
XII Other and unspecified malignant neoplasms		
a) Other specified malignant tumours	8930, 8933, 8950, 8951, 8971-8981, 9020, 9050-9053, 9110, 9580	
b) Other unspecified malignant tumours	8000-8004	C00.0-C21.8, C23.9-C39.9, C42.0-C55.9, C57.0-C61.9, C63.0-C63.9, C65.9-C69.9, C73.9-C75.0, C75.4-C80.9

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