Hospitalisations 1998–2000 in a British Columbia population-based cohort of young cancer survivors: Report of the Childhood/Adolescent/Young Adult Cancer Survivors (CAYACS) Research Program

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ABSTRACT

Background and objectives: Because of late effects among survivors of cancer in young people, increased hospitalisations would be expected. This study determined the occurrence, frequency and days in hospital (DIH) of hospital admissions among 5-year survivors of childhood and adolescent cancer diagnosed in British Columbia (BC), compared hospitalisation risk with the general population and examined the impact of sociodemographic, health care system and clinical factors.

Design: This population-based study frequency matched 1157 survivors of cancer diagnosed before 20 years of age from 1970 to 1992 from the BC Cancer Registry with 11,570 randomly selected individuals from BC's health insurance plan Client Registry. Administrative hospitalisation records from 1998 to 2000 were linked to study cohorts, and regression and trend analyses were carried out.

Results: From 1998 to 2000, 240 (21%) of survivors and 614 (5.3%) of the population sample were admitted to hospital at least once [adjusted OR = 4.36 (95% CI 3.68–5.16)]. Hospitalised survivors had a higher average number of admissions (2.0 versus 1.5 admissions, respectively) and longer mean DIH (10.9 versus 7.8 d, respectively) than hospitalised population controls. Female gender and older age increased the risk of hospitalisation, as did the presence of a relapse or second cancer by 5 years post-diagnosis.

Conclusion: Our cohort of child and adolescent cancer survivors had higher odds of hospitalisation, more admissions among those hospitalised and longer stay in hospital compared to the population sample. This has implications for health care system resources and appropriate management of late effects of survivors.

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1. Introduction

Over 80% of Canadian children and adolescents between the ages of 0 and 19 years diagnosed with cancer now survive 5 or more years after diagnosis.[1,2] Long-term survivors of childhood and adolescent cancers are at risk for late mortality, second cancers and multiple adverse physical, psychological and cognitive late effects from cancer or its treatment. It has been estimated that by 30 years post-diagnosis, over 40% of survivors experience severe, disabling or life-threatening physical late effects or death.[3–13]

Despite the increasing number of childhood and adolescent cancer survivors and expected late effects, health care utilisation has not been well documented in this group,[14] in particular research reporting on hospital admissions among long-term survivors.

The Childhood/Adolescent/Young Adult Cancer Survivors (CAYACS) Research Program[15] has assembled a cohort of all 5-year survivors of a cancer or tumour diagnosed before 25 years of age in British Columbia (BC) from 1970 to 1995 and population sample comparison groups, from provincial registries, and linked these records to provincial administrative datasets, including health care datasets, with follow-up data to end 2000. Within this programme, the objectives of this study are to describe the probability and frequency of hospital admission among childhood and adolescent cancer survivors over a 3-year period, to compare hospitalisation rates and length of stay between survivors and a population sample and to assess the impact of sociodemographic, health system and clinical factors.

2. Methods

2.1. Study group ascertainment and data linkage

2.1.1. Identification of the survivor cohort
A total of 1816 individuals were identified from the BC Cancer Registry, diagnosed before 20 years of age between 1 January 1970 and 31 December 1992, with a primary cancer or tumour as defined by the International Classification of Childhood Cancers (ICCC),[16] residing in BC at diagnosis, surviving 5 or more years after diagnosis and still alive on 31 December 2000. The study survivor group consisted of 1157 (64%) of these individuals registered in the provincial health insurance plan during the study period (1998–2000), indicating that they were still living in the province.

2.1.2. Identification of comparison group
A randomly selected sample of BC residents was obtained from the Client Registry of the provincial health insurance plan to serve as a comparison group. The comparison subjects were frequency matched by birth year and gender to the study cohort if they were born in the same range of years as the survivors, were 5 years of age or older during the time of study (to match for 5-year cancer survivorship) and registered in the plan during the period of observation (1998–2000).

2.2. Data collection

For each survivor, diagnosis information was obtained from the BC Cancer Registry. Treatment data were abstracted from health records at BC Cancer Agency or BC Children's Hospital; 90% of registered cases were treated at one of these centres. For both study groups, death date was obtained from death registrations and yearly residence information (recorded as postal code) and alive follow-up status (recorded as active health insurance registration) was obtained from the health insurance Client Registry. Survivor and comparator records were linked to provincial hospital separation files, using a unique, person-specific health identifier assigned to all BC residents, and de-identified for analysis.

2.3. Outcome measures

Hospital data were available until 31 March 2000; therefore 1 January 1998 to 31 March 2000 was selected as the observation period of the study, maximising study numbers and length of follow-up.

A hospitalisation is recorded upon hospital discharge and includes any visit that is not an emergency or outpatient visit. Only hospitalisations that were completed (i.e. the individual was discharged or died) by the study end date were counted. If a patient had more than one record of a hospital admission on the same day, only one admission (with the longest length of stay) was included. Length of stay was defined as the total number of days in which a patient spent all or part of the days in hospital (DIH).

Total number of hospital admissions and total DIH were determined for each individual. Types of hospital admission included acute care, surgical day care, rehabilitation and extended care. Acute care is provided for an acutely or seriously ill patient requiring nursing care, clinical observation and daily medical attention, diagnostic or treatment procedures only deliverable as an inpatient in an acute care hospital or for immediate recovery following illness or accident.[17] Day care surgical admissions involve procedures for which post-surgery inpatient services are not required and for which patients are generally admitted and discharged on the same calendar day.[17]

Hospitalisation services for acute, day surgery and rehabilitation care is provided only within the publicly funded health insurance plan, while extended care service is offered in both publicly and privately funded settings. Data on privately funded extended care were not ascertained for this study.

2.4. Potential modifying variables

Information on gender and attained age as of 31 December 2000 was determined using data from the BC Cancer Registry (for survivors) or the health insurance plan Client Registry (for the population sample). Neighbourhood-specific socioeconomic status (SES) was determined using postal code of residence in January 1998 (start of observation period) to ascertain their census-defined neighbourhood from the closest census year (1996) to the start of observation and then assigning a neighbourhood-specific income quintile based

on the average income per single-person equivalent in the census-defined neighbourhood.[18,19]

System-related factors hypothesised to influence access to hospital services included region of residence, defined by regional health administrative area (Regional Health Authority), and rural or urban status of residence, as of 1 January 1998. Urban/rural residential status was classified by initially assigning geographical areas into one of six categories based on population size and socioeconomic homogeneity.[20] We combined the rural categories to define urban or rural residential status as metropolitan area (Census Metropolitan Area), large community (tracted Census Agglomeration [CA]), small community (untracted CA) and rural (all other areas).

Clinical factors hypothesised to modify the risk of hospitalisation among survivors included cancer diagnosis (grouped according to the ICCC[16]), age at diagnosis, calendar period of diagnosis and time from diagnosis, as well as treatment modality and recurrence/relapse status or presence of a second cancer at start of survivor follow-up.

2.5. Statistical analyses

Analyses were conducted excluding hospitalisations for pregnancy and delivery (International Classification of Diseases Version 9[21] rubrics 630-677). Chi-square tests were used to detect differences in the distribution of factors between survivors and the population group and between those survivors who were hospitalised at least once and those survivors who were not hospitalised during the study period. To assess the probability and count of hospitalisation admissions and DIH, hurdle model regression[22,23] was used. For modelling the probability of having at least one hospitalisation during the study period, a logistic model was used to calculate odds ratios (ORs). To model the non-zero counts of admissions and DIH, negative binomial modelling was performed. By exponentiating the resulting coefficients, we obtained relative risks of admissions (RR_{Admit}) and relative risks of total DIH (RR_{Days}). In both parts of the model, the results were adjusted for sociodemographic factors (age, gender, SES quintile, urban/rural status and region of residence). Results of comparisons between those survivors who were hospitalised at least once and those who were not hospitalised during the study period were also adjusted for disease characteristics (ICCC group, age at diagnosis, calendar period of diagnosis and treatment). Trend tests for ordered categorical variables were performed by assigning a numeric value to each level of the factor and treating the resulting variable as a continuous covariate in the model in question; the p-value of this covariate indicates the statistical significance of the linear trend.

All analyses were performed using R Foundation for Statistical Sciences, version 1.8.1.[24] All tests were two-sided with $\alpha = 0.05$.

2.6. Study and data approvals

Ethics approval was obtained from the BC Cancer Agency/University of British Columbia (UBC) Clinical Research Ethics Board (REB) and BC Children's Hospital/UBC REB. Approvals for access, use and linkage of administrative data were obtained from the BC Cancer Registry, Health Records Departments and the BC Ministry of Health. No patient consent was required for this record linkage study; however, the BC Ministry of Health required that cell sizes less than five be masked in all tables and text.

3. Results

3.1. Description of study populations

Slightly more than 50% of subjects were aged 20–34 years by the end of follow-up; maximum attained age was 49 years (Table 1). In 1998, a smaller proportion of survivors than the general population sample were living in metropolitan areas and rural areas, and the regional distribution of survivors and comparators was different.

Table 2 compares sociodemographic, health system and clinical characteristics of hospitalised and non-hospitalised survivors. Being female, surviving longer since diagnosis, living in some specific regions and having relapsed or being diagnosed with a second cancer by 5 years post-diagnosis significantly increased survivors' risk of hospitalisation. Diagnosis, age at diagnosis and treatment type, however, did not affect the overall probability of hospitalisation.

3.2. Factors affecting hospital admissions among survivors

Factors affecting hospital admissions among survivors are presented in Table 2. Based on the multivariate analysis, rural residential status, region of residence and SES, all indicators of possible differential access to care, did not appear to affect hospitalisation risk among survivors, so these were removed from the analysis of clinical factors. After adjustment for the remaining system and clinical factors, female survivors had 1.56 times the odds (95% CI 1.17–2.09) of being hospitalised compared to males. As expected, risk of hospitalisation increased with increasing age ($p = 0.056$), with those over 35 having an OR of 1.64 (95% CI 1.06–2.52) compared to survivors aged under 20 years at end of follow-up. Similar patterns of risk were found for acute care and surgical day care admissions, though the results were not statistically significant (data not shown).

There was a trend of increasing relative risk of overall hospitalisation with increasing time since diagnosis ($p = .021$) (Table 2). Survivors who had experienced a relapse had twice the odds of being hospitalised (OR 1.92, 95% CI 1.27–2.90), in particular for acute care (OR 2.70, 95% CI 1.72–2.90) (data not shown), as did those with a second malignancy (OR 2.20, 95% CI 1.16–4.19). Survivors who had received radiation treatment, with or without other forms of therapy, had the highest risk of admission, although this risk was not statistically significant (e.g. OR (radiation and surgery) 1.53, 95% CI 0.91–2.59). Survivors who had received chemotherapy and surgery (but no radiation) were at increased risk of an admission for surgical day care (OR 2.14, 95% CI 1.12–4.08) (data not shown). No other factors were found to be significant, although those with an original central nervous system tumour had the highest risk of later hospitalisation of all diagnoses, compared to

Table 1 – Sociodemographic characteristics of survivors and comparison group.						
		Survivors (N = 1157)		Comparison group (N = 11570)		p-Value[a]
		N	%	N	%	
Gender	Male	611	52.8	6110	52.8	NA
	Female	546	47.2	5460	47.2	
Attained age	0–19 years	358	30.9	3404	29.4	0.479
	20–34 years	621	53.7	6276	52.4	
	35+ years	178	15.4	1890	16.3	
SES quintile	5 (highest)	244	21.1	1727	17.8	0.086
	4	216	18.7	1778	18.3	
	3	190	16.4	1757	18.1	
	2	221	19.1	1896	19.5	
	1 (lowest)	223	19.3	2043	21.0	
	Unknown	63	5.4	511	5.3	
Urban/rural residential status	Metropolitan area	624	53.9	5465	56.3	0.0247
	Large community	191	16.5	1363	14.0	
	Small community	174	15.0	1304	13.4	
	Rural area	168	14.5	1580	16.3	
Regional residential status	Vancouver coastal	245	21.2	2362	24.3	0.017
	Interior	208	18.0	1611	16.6	
	Fraser	402	34.7	3185	32.8	
	Island	202	17.5	1595	16.4	
	Northern	99	8.6	881	9.1	
	Unknown	<5[b]	0.1	78	0.8	

a p = p-value from chi-squared test.
b Exact number suppressed for confidentiality reasons.

those with acute lymphatic leukaemia (OR 1.40, 95% CI 0.89–2.21).

The relative rate of admissions and total days spent in hospital among survivors were not, in general, affected by sociodemographic factors (Table 2). Relative rates of admissions and DIH were not affected by treatment modality, time since diagnosis or age at diagnosis (data not shown). Survivors who had relapsed had nearly twice the average length of stay as survivors with no relapse (RR_{Days} 1.91, 95% CI 1.27–2.86) (data not shown), indicating their greater morbidity. Survivors of non-Hodgkins lymphoma (RR_{Admit} 8.42, 95% CI 1.97–36.00), bone tumours (RR_{Admit} 6.45, 95% CI 1.47–28.43) and carcinomas (RR_{Admit} 6.67, 95% CI 2.07–21.47) all had a significantly increased risk of multiple admissions (data not shown).

Very few survivors were hospitalised for more than one surgical admission, so accurate modelling of risk for this subgroup was not feasible.

3.3. Comparison of hospital admissions between survivors and population sample

Table 3 presents ORs for probability of hospital admission (OR) among survivors and controls and the relative risks of admissions (RR_{Admit}) and days spent in hospital (RR_{Days}) for hospitalised survivors compared to the hospitalised population sample, adjusted for gender, age, SES and urban/rural status and region of residence. From 1998 to 2000, 240 survivors (21%) and 614 (5.3%) of the general population group were admitted to hospital at least once, for an adjusted OR of 4.36 (95% CI 3.68–5.16). Hospitalised survivors had a significantly higher average number of admissions per individual compared to the population group (2.0 versus 1.5) (RR_{Admit}

1.83, 95% CI 1.30–2.56). The mean DIH for hospitalised survivors was 10.9 d, while that for the hospitalised population sample was 7.8 d (RR_{Days} 1.71, 95% CI 1.19–2.46).

Acute care hospitalisations were the most frequent type of admission. Overall, 12.7% of survivors and 2.9% of the population group were admitted to acute care at least once. After adjustment for sociodemographic factors, the survivors had five times the odds of hospitalisation for acute care than the population sample (95% CI 4.07–6.15). Hospitalised survivors also had more acute care admissions (RR_{Admit} 1.41, 95% CI 0.97–2.12) and more total DIH in the acute care setting (RR_{Days} 1.13, 95% CI 0.80–1.61) compared to those hospitalised in the general population, although these differences were not statistically significant.

Surgical day care admissions were the second most frequent type of hospitalisation. A total of 10.6% of survivors and 2.9% of the comparison group had at least one surgical day care admission (adjusted OR 3.58, 95% CI 2.87–4.47). The relative risk of surgical day care admissions (RR_{Admit}) between cases and comparators hospitalised at least once was 2.94 (95% CI 1.59–5.43) and hospitalised survivors had significantly more total DIH in the surgical day care setting (RR_{Days} 2.99, 95% CI 1.64–5.47) compared to those hospitalised in the general population.

Female survivors hospitalised at least once had a significantly lower number of acute care admissions than hospitalised female controls and higher numbers of surgical day care admissions (RR_{Admit} 0.85, 95% CI 0.47–1.52 for acute care; RR_{Admit} 5.42, 95% CI 2.35–12.47 for surgical care). For male survivors, numbers of both acute care and surgical day care admissions were higher than those for hospitalised controls (RR_{Admit} 2.13, 95% CI 1.15–3.96 for acute care; RR_{Admit} 1.16, 95% CI 0.38–3.55 for surgical care) (Table 3). Rehabilitation

Table 2 – Sociodemographic and clinical characteristics of hospitalised and non-hospitalised survivors and factors affecting risk of hospitalisation among survivors.

		Non-hospitalised survivors (N = 917)		Hospitalised survivors (N = 240)		Chi-square test	Risk of hospitalisation	
		N	%	N	%	p	OR_adj[a]	95% CI
Sociodemographic characteristics								
Gender	Male	505	82.7	106	17.3	0.003	1.00	
	Female	412	75.5	134	24.5		1.56	1.17–2.09
Attained age (in 2000)	5–19 years	289	80.7	69	19.3	0.032	1.00	
	20–34 years	500	80.5	121	19.5		0.99	0.71–1.38
	35+ years	128	71.9	50	28.1		1.64	1.06–2.52
	p for trend						0.056	
SES quintile	5 (highest)	199	81.6	45	18.4	0.355	1.00	
	4	179	82.9	37	17.1		0.87	0.54–1.42
	3	149	78.4	41	21.6		1.14	0.70–1.86
	2	175	79.2	46	20.8		1.09	0.68–1.74
	1 (lowest)	167	74.9	56	25.1		1.40	0.89–2.21
	Unknown	48	76.1	15	23.8			
	p for trend						0.068	
Urban/rural residential status	Metropolitan area	494	79.2	130	20.8	0.527	1.00	
	Large community	146	76.4	45	23.6		1.28	0.79–2.06
	Small community	144	82.8	30	17.2		0.82	0.48–1.40
	Rural area	133	79.2	35	20.8		1.00	0.57–1.77
	p for trend						0.630	
Regional residential status	Vancouver coastal	197	80.4	48	19.6	<0.001	1.00	
	Interior	169	81.3	39	18.8		0.89	0.49–1.63
	Fraser	313	77.9	89	22.1		1.14	0.76–1.72
	Island	162	80.2	40	19.8		1.00	0.60–1.67
	Northern	76	76.8	23	23.2		1.24	0.63–2.43
	Unknown	0	0.0	<5[b]	100.0			
Clinical characteristics								
Diagnosis	All[c]	198	81.8	44	18.2	0.736	1.00	
	Other leukaemia	23	76.7	7	23.3		1.22	0.48–3.08
	Hodgkins lymphoma	109	80.7	26	19.3		0.86	0.48–1.54
	Non-Hodgkins lymphoma	54	83.1	11	16.9		0.88	0.42–1.85
	Central nervous system	171	74.7	58	25.3		1.40	0.89–2.21
	Renal	59	80.8	14	19.2		1.04	0.53–2.06
	Bone	42	80.8	10	19.2		0.90	0.41–1.97
	Carcinomas	82	80.4	20	19.6		0.85	0.46–1.59
	Other cancers	179	78.2	50	21.8		1.17	0.74–1.87
Age at diagnosis	0–4 years	324	80.2	80	19.8	0.522	1.00	
	5–9 years	164	75.6	53	24.4		1.20	0.78–1.85
	10–14 years	175	80.3	43	19.7		0.82	0.50–1.35
	15–19 years	252	80.0	63	20.0		0.69	0.42–1.14
Time since diagnosis	5–9 years	162	83.5	32	16.5	0.009	1.00	
	10–14 years	307	81.4	70	18.6		1.21	0.76–1.93
	15–19 years	229	80.9	54	19.1		1.29	0.77–2.15
	20–24 years	135	71.8	53	28.2		2.03	1.14–3.63
	25+ years	74	71.8	29	28.2		1.83	0.92–3.64
	p for trend						0.021	
Second cancer status	No second cancer	890	80.0	223	20.0	0.005	1.00	
	Second cancer	27	61.4	17	38.6		2.20	1.16–4.19
Relapse status	No relapse	829	80.7	198	19.3	<0.001	1.00	
	Relapse	88	67.7	42	32.3		1.92	1.27–2.90
Treatment modality	Surgery only	200	82.3	43	17.7	0.458	1.00	
	Chemo only	160	82.5	34	17.5		0.99	0.59–1.66
	Radiation only	33	71.7	13	28.3		1.56	0.73–3.36
	Chemo and surgery	119	79.3	31	20.7		1.27	0.75–2.14
	Chemo and radiation	166	79.8	42	20.2		1.30	0.8–2.1
	Radiation and surgery	102	73.9	36	26.1		1.53	0.91–2.59
	Chemo, radiation and surgery	79	75.2	26	24.8		1.54	0.88–2.69
	Unknown	58	79.5	15	20.5			

a adj = for sociodemographic factors, odds ratios were adjusted for all other sociodemographic factors in the table; for clinical factors, odds ratios were not adjusted for urban/rural residential status, regional residential status and SES.
b Exact number suppressed for confidentiality reasons.
c ALL = acute lymphoblastic leukaemia.

Table 3 – Survivors with hospitalisations compared to population sample.

	Survivors			Comparison group			OR$_{adj}$[a] (95% CI)	RR$_{Admit adj}$[a] (95% CI)	RR$_{Days adj}$[a] (95% CI)
	N (%)	Mean # adm[a] (SD[a])	Mean # DIH[a] (SD)	N (%)	Mean # adm (SD)	Mean # DIH (SD)			
Overall									
Total with hospitalisations (excl. pregnancy)	240 (20.7)	2 (3.8)	10.9 (41)	614 (5.3)	1.5 (1.6)	7.8 (26.7)	4.36 (3.68–5.16)	1.83 (1.30–2.56)	1.71 (1.19–2.46)
Acute care hosp	147 (12.7)	1.7 (1.8)	12.2 (25.8)	336 (2.9)	1.5 (1.6)	10.8 (21.7)	5.00 (4.07–6.15)	1.41 (0.97–2.12)	1.13 (0.80–1.61)
Surgical day care hosp	123 (10.6)	1.9 (4.7)	1.9 (4.7)	341 (2.9)	1.3 (1.0)	1.3 (1.0)	3.58 (2.87–4.47)	2.94 (1.59–5.43)	2.99 (1.64–5.47)
Females									
Total with hospitalisations (excl. pregnancy)	134 (24.5)	2.2 (4.8)	7.3 (14)	332 (6.1)	1.6 (1.7)	7.1 (21.7)	4.77 (3.78–6.02)	1.57 (0.98–2.52)	1.57 (0.98–2.52)
Acute care hosp	120 (22.0)	1.5 (1.1)	8.1 (1.1)	165 (3.0)	1.5 (1.4)	11.0 (1.4)	5.87 (4.42–7.81)	0.85 (0.47–1.52)	0.74 (0.39–1.40)
Surgical day care hosp	79 (14.5)	2.2 (5.9)	2.2 (5.9)	211 (3.9)	1.3 (1.1)	1.3 (1.1)	3.47 (2.59–4.65)	5.42 (2.35–12.47)	5.98 (2.97–12.06)
Males									
Total with hospitalisations	65 (10.6)	1.9 (2.1)	15.5 (59.5)	282 (4.6)	1.5 (1.5)	8.6 (31.7)	4.04 (3.15–5.18)	1.90 (1.13–3.21)	3.11 (1.73–5.56)
Acute care hosp	52 (8.5)	2.0 (2.3)	17 (35.6)	171 (2.8)	1.5 (1.7)	10.5 (18.4)	4.24 (3.14–5.72)	2.13 (1.15–3.96)	2.21 (1.35–3.63)
Surgical day care hosp	52 (8.5)	1.2 (0.5)	1.2 (0.5)	130 (2.1)	1.2 (0.7)	1.2 (0.7)	3.86 (2.74–5.42)	1.16 (0.38–3.55)	1.16 (0.38–3.55)

[a] adm = admissions per person, DIH = days in hospital per person, SD = standard deviation, OR = odds ratio for probability of admission, RR$_{Admit}$ = relative risk of admission, RR$_{Days}$ = relative risk of days in hospital, CI = confidence interval, adj = adjusted for sociodemographic factors.

and extended care admissions each accounted for less than one percent of hospital admissions and therefore were not included in analyses.

4.   Discussion

This study is the first, to the authors' knowledge, to examine hospitalisation patterns of a geographically defined group of survivors of child and adolescent cancers compared to the general population and between subgroups of survivors. Survivors had over four times the odds of hospitalisation compared to the population sample, significantly more admissions per person and more total DIH. This is most likely related to the burden of late morbidity and treatment-related late effects occurring in survivors years after diagnosis. Survivors of a central nervous system tumour and those having had radiation treatment had higher risks of hospitalisation, presumably because of higher hospital-related morbidity, although these differences were not statistically significant. Several indicators of differential access to care (region and rural status of residence and SES) did not affect risk of hospitalisation, suggesting that risk of hospitalisation was not affected by these characteristics.

The use of geographically defined study cohorts ascertained from population registries and linked administrative datasets provides comprehensive, verified ascertainment of hospital utilisation in a total representative population. The Canada Health Act mandates publicly funded, universal access to medically necessary health care for all residents of Canada.[25] The single payer system is administered provincially, through provincial health insurance plans, and all hospitals are required to report admission/separation data. From these sources, data on several sociodemographic, disease-related and health care system-related predictors were available for analysis. In addition, clinical data was available through health records at treating hospitals. However, assessment of potential additional modifiers of hospitalisation risk including disease severity, comorbidity and hospital characteristics could not be carried out in this study because of unavailability of data. And, small study numbers precluded separate analysis of diagnosis-specific subgroups.

Approximately 64% of the total number of survivors registered in the provincial cancer registry from 1970 linked to the provincial health insurance database in 1998. Those not linked had likely moved out of province by 1998. The population controls were chosen and matched to those still active in 1998, so were comparable to the linked survivors. Survivors of carcinomas, those diagnosed at older ages and those with longer time since diagnosis were less likely to be linked. Provincial outmigration statistics indicate that, on average, approximately 2% of the population of any age leaves BC each year, which would result in a similar proportion of survivors retained in the active cohort by 1998. Despite these limitations, this study provides insight into an under-researched area of health care utilisation by child and adolescent cancer survivors.[15]

Based on the increasing prevalence of survivors[26] and the higher rates of hospitalisation among them, presumably due to late effects, this population would be expected to have an increasing impact on the Canadian health care system and increasing demand for hospital services. Individuals with chronic conditions and co-morbidity have been shown to be more likely to experience preventable hospitalisations,[27,28] which are defined as hospital episodes that could be prevented with adequate provision of primary and secondary prevention and primary care. Further investigation is required to determine to what extent long-term survivors are experiencing preventable hospitalisations.

High costs associated with the provision of hospital care and limited hospital services have provoked great interest in the provision of acute care within hospitals among health care professionals, policymakers, health system managers and the public alike.[27,28] Research on the late effects of cancer survivors, health service utilisation over time and risk factors for hospital admissions in this vulnerable cohort can be informative to primary and community health care providers, health care system managers and policymakers. With increasing numbers of adult survivors of childhood cancer, comprehensive research into late effects risks and evidence-based improvements in primary and secondary prevention, early intervention and continuity of care in the surveillance, prophylactic management, treatment and palliation of survivors' late effects are warranted to mitigate the occurrence of potentially preventable hospitalisations among survivors of childhood and adolescent cancers.

Conflict of interest statement

The authors report no conflicts of interest.

Acknowledgements

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