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Journal

Pediatric Blood and Cancer, 66(1)

Authors

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Publication Date

2019

DOI

10.1002/pbc.27426

Peer reviewed

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Pediatr Blood Cancer. Author manuscript; available in PMC 2020 January 01.

Published in final edited form as:

Pediatr Blood Cancer. 2019 January ; 66(1): e27426. doi:10.1002/pbc.27426.

Increased Clinical Trial Enrollment among Adolescent and Young Adult Cancer Patients between 2006 and 2012-2013 in the United States

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Abstract

Background: Stagnant outcomes for adolescents and young adults (AYAs) 15-39 years of age with cancer are partly attributed to poor enrollment onto clinical trials. Initiatives have focused on increasing accrual, but changes at the population-level are unknown. We examined patterns of clinical trial participation over time in AYA patients with cancer.

Procedure: We utilized medical record data from AYAs in two population-based National Cancer Institute Patterns of Care Studies identified through the Surveillance, Epidemiology and End Results Program. Among 3,135 AYAs diagnosed with non-Hodgkin lymphoma (NHL), Hodgkin lymphoma, acute lymphoblastic leukemia (ALL) and sarcoma, we used multivariate logistic regression to evaluate patient and provider characteristics associated with clinical trial enrollment. Interaction terms evaluated variation in clinical trial enrollment across patient and provider characteristics by year of diagnosis.

Results: From 2006 to 2012-2013, clinical trial participation increased from 14.8% to 17.9% ($p < 0.01$). Adjusting for patient and provider characteristics, we found lower clinical trial enrollment among those who were older at diagnosis, diagnosed with NHL vs ALL, treated by adult hematologist/oncologists only (vs. pediatric hematologist/oncologists), and of non-Hispanic Black

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Conflicts of Interest and Source of Funding: The authors have no conflict of interest to report.

Conflicts of Interest: The authors have no conflicts of interest to disclose.

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race/ethnicity (vs. Non-Hispanic White) ($p<0.05$ for all). Interaction analyses indicate improved clinical trial enrollment from 2006 to 2012-2013 among young adults 25-29 years of age and the uninsured.

Conclusions: While disparities in enrollment onto clinical trials remain for AYAs with cancer, our study identified increasing overall clinical trial participation over time. Further, we identify promising trends in enrollment uptake among AYAs 25-29 years of age and the uninsured.

Keywords

aya; clinical trial; seer

Introduction

Over the past 30 years, adolescents and young adults (AYAs) aged 15-39 with cancer have not experienced the same survival improvements relative to older and pediatric populations.[1,2] Recognizing the extent of the survival improvement disparity approximately a decade ago,[2] researchers and policy makers focused efforts on understanding underlying causes for these disparities and developing policies and programs to improve survival in AYAs. In 2006, the National Cancer Institute (NCI) formed a Progress Review Group to ascertain the current scope of AYA oncology research and provide a roadmap to address gaps in research with the potential to improve survival disparities,[3,4] including expanding clinical trial access and and increasing treatment choices to accelerate treatment advances.[4] At the time the report was published, we demonstrated low overall clinical trial enrollment in the AYAs relative to pediatric patients, with only 14% of those age 15-39 years at diagnosis enrolling onto trials.[5] However, this low clinical trial enrollment was not uniform, with uninsured, older patients and those treated by non-pediatric oncologists significantly less likely to enroll.[5] As significant efforts have been made to improve both access to trials and enrollment for AYAs with cancer,[6] it is important to determine whether these efforts have translated into population-level enrollment changes. Understanding overall trends in enrollment and potential continued disparities in subgroups of patients with low enrollment can help providers and policymakers continuously improve access to new therapies for the >70,000 AYAs diagnosed with cancer each year in the US.[7]

Underlying reasons for low clinical trial enrollment are multi-factorial and include a combination of patient, provider and system factors. Patient factors have included inadequate social support; work, school, and child care demands as well as underinsurance that have hindered AYAs' ability to adhere to clinical trial protocols.[3,8–10] Provider factors have included high administrative burden for enrollment.[3,10,11] Finally, system factors have included restrictive inclusion criteria, treatment of AYAs in community settings without access or systems in place to easily enroll on trials, and limited trials focused on cancer types most prevalent in the AYA population.[3,10] Over the past decade, a series of policies have attempted to address some underlying barriers to clinical trial enrollment more broadly including: Improved insurance rates under the Affordable Care Act[9] and expanded access to community-based clinical trials through the NCI Community Oncology Research Program (NCORP).[12,13] Other initiatives have focused on AYAs specifically by expanding age eligibility, where appropriate, to provide more clinical trial options for AYAs.[11] Recent

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research from the Community Clinical Oncology Program (CCOP), the predecessor to NCORP, demonstrated that, despite systemic changes, a lower proportional enrollment of AYAs were included on CCOP trials relative to older adults, with enrollment declining from 2004 to 2013.[14] Due to their study design, the investigators were not able to conduct a population-based assessment of AYA clinical trial enrollment over time or examine disparities across cancer and demographic characteristics. Therefore, to further understand the trends and variation in AYA clinical trial enrollment over time in select common, yet understudied, cancers, we used the population-based 2006 and 2012-2013 NCI Patterns of Care (POC) Studies.

Methods

Data Sampling

For the NCI POC study, we identified patients aged 15-39 at diagnosis in the Surveillance, Epidemiology and End Results Cancer (SEER) Program in 2006 and 2012-2013.[15] Individuals with acute lymphoblastic leukemia (ALL), Non-Hodgkin lymphoma (NHL), Hodgkin lymphoma (HL) and sarcoma were included to evaluate a spectrum of common, but understudied, cancers in the AYA population- in line with the goals of the POC annual studies.[15] The SEER Program is a set of population-based cancer registries that collects information on cancer characteristics (stage, initial course of treatment, patient demographics) and follow-up for vital status from approximately 28% of the US population annually.[16] As the SEER Program potentially under-reports outpatient-administered therapy, NCI developed the annual POC study to review medical records and query physicians in order to obtain more complete treatment information for select cancers.[15]

In the 2006 and 2012-2013 NCI POC studies, eligible patients from SEER registries were stratified by cancer site, age, race/ethnicity and SEER registry, with a random sample selected by stratum.[15] To obtain more stable estimates, non-Hispanic Blacks, Hispanics, Asians/Pacific Islanders and American Indians/Alaskan Natives were proportionately oversampled. Medical records were re-abstracted at each SEER registry for patient, provider and facility characteristics to confirm treatment and clinical trial enrollment according to registry records. Additionally, all treating physicians were contacted to verify treatment administered, enrollment onto clinical trials, and medical specialty according to their records. Characteristics of the treating facility were also recorded. All sites received Institutional Review Board approval as required by individual registries.

Patient Selection

We included 1,040 AYAs diagnosed with NHL, HL, ALL, and sarcoma in 2006 and 2,095 AYAs diagnosed with these same cancers in 2012-2013. Patients were excluded if they had previous history of cancer other than non-melanoma skin cancer; were diagnosed with another cancer simultaneously; or were diagnosed by autopsy/death certificate.

Measures

We classified patients as enrolling on a clinical trial (yes/no) if the medical record or treating physician confirmed enrollment or identified a specific protocol/sponsor. We used the

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original SEER record to identify a patient's cancer type (NHL, HL, ALL, or sarcoma), age at diagnosis (15-19, 20-24, 25-29, 30-34, 35-39 years), sex, marital status (married, other), race/ethnicity (non-Hispanic (NH)-White, NH Black, Hispanic, NH Asian, American Indian/Alaskan Native), and health insurance at diagnosis (private, public, no insurance/unknown). American Joint Commission on Cancer (AJCC)[17] cancer stage from the SEER record was confirmed by additional medical record abstraction. Comorbidity classification was reported based on previously developed methodology and categorized as yes/no.[5] Specifically, we categorized individuals as having a comorbidity if they had medical record based evidence of asthma, cardiovascular events, cerebral vascular events, diabetes, endocrine disorders, gastrointestinal disorders, HIV/AIDS, hematologic disorders, hypertension, liver disorders, life-threatening infections, mental health disorders, neurologic disorders, obesity, renal disorders, or rheumatologic/autoimmune disorders.[5] Physician specialty (pediatric oncology only, hematology/oncology only, pediatric oncology and other, hematology/oncology and other/unknown), census tract median income and treating facility characteristics (number of beds and residency training program) were additionally obtained from SEER. Other specialties included any other specialty involved in the first course of treatment, such as primary care.

Analysis

Chi-squared tests assessed the unadjusted association between patient and provider characteristics, clinical trial enrollment and year of diagnosis. We then used multivariable logistic regression to evaluate the relationship between patient and provider characteristics and clinical trial enrollment. Effect modification between year of diagnosis and patient/provider characteristics and clinical trial enrollment was assessed by including first order interaction terms in the multivariable model. Analyses were weighted to reflect the SEER populations and the magnitude of associations were summarized as adjusted odds ratios (OR) with 95% confidence intervals (CI). Analyses were performed using SAS® (9.4) and a p-value <0.05 was considered statistically significant.

Results

Among 3,135 AYA patients in our study, over 70% were diagnosed with NHL or HL (Table 1). Approximately 45% were diagnosed with AJCC Stages I and II disease. In the study population, approximately 60% of individuals were diagnosed prior to age 30; 58% were male; and 31% were married.

Overall, the population was relatively healthy, with over 60% of individuals having no medical-record evidence of comorbidities. The population was also predominately insured, with only 7% of individuals uninsured. Fewer than 12% of individuals lived in census tracts with median income less than $55,000 (Table 1).

Most individuals were treated by adult hematologists/oncologists and other non-pediatric specialties. Only 15% of individuals were treated by pediatric hematologists/oncologists. Approximately 60% of individuals were treated in facilities with >300 beds, and 70% were treated in facilities with residency programs.

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Trends in Clinical Trial Enrollment

From 2006 to 2012-2013, clinical trial participation increased from 14.8% to 17.9% among AYAs diagnosed with NHL, HL, ALL, and sarcoma ($p<0.01$, Table 2). However, this increase in clinical trial enrollment was not uniform across patient and provider characteristics. In unadjusted analyses, individuals with HL had decreased clinical trial participation over time (2006: 13.1%; 2012-2013: 9.4%, $p=0.01$) as did those with AJCC stage III disease (2006: 16.7%; 2012-2013: 9.9%, $p=0.01$). Of note, clinical trial participation for those aged 30-34 at diagnosis saw their clinical participation drop from 7.9% in 2006 to only 4.6% in 2012-2013 ($p=0.02$).

While clinical trial participation decreased in some AYA populations, several key populations had increased participation thus driving the overall increase in clinical trial enrollment (Table 2). Specifically, clinical trial enrollment doubled for AYAs aged 25-29 from 6.3% in 2006 to 13.2% in 2012-2013 ($p<0.01$). Additionally, individuals who were unmarried, treated in smaller facilities (<200 beds), treated in facilities with residency training programs, and those with no documented comorbidities all had significant increases in clinical trial participation over time. Unexpectedly, those who were uninsured saw a doubling in clinical trial participation from 5.7% in 2006 to 12.9% in 2012-2013 ($p=0.01$).

Multivariate Analyses

After adjusting for patient and provider characteristics, year of diagnosis was no longer significantly associated with clinical trial enrollment (Odds Ratio (OR) (95% Confidence Interval): 0.75 (0.55, 1.02); Table 3), driven by the significant variability in trial enrollment across participant demographics. In other words, while we do see significant unadjusted trends toward improved clinical trial enrollment over time, the variability in improvement vs. decreasing enrollment across populations makes gains appear more stable over time. Of note, we found clinical trial enrollment significantly decreased with increasing age at diagnosis, with the lowest odds of enrollment for those 30-34 vs. 15-19 (OR (95%CI): 0.28 (0.17, 0.49)). There was also significantly lower likelihood of clinical trial enrollment for AYAs diagnosed with NHL vs. ALL or Sarcoma, those treated by adult hematologist/oncologists only (vs. pediatric hematologist/oncologists only) (OR (95% CI): 0.31(0.11, 0.85)), and those of NH Black race/ethnicity (vs. NH White) (OR (95% CI): 0.65(0.43, 0.98)), ($p<0.05$ for all).

Interaction analyses indicated significant variation in clinical trial enrollment by year of diagnosis across several key patient and provider characteristics. As a result, we present multivariate models stratified by diagnosis year (Table 4). Of note, when data were stratified by year, we found that in 2012-2013, young adults up to age 29 years no longer had significant differences in clinical trial enrollment relative to those aged 15-19 years. Additionally, those treated by hematologists/oncologists only no longer had significant differences in clinical trial enrollment relative to those treated by pediatric hematologist/oncologists only. Finally, in 2012-2013, those who are uninsured no longer had significant differences in clinical trial enrollment relative to those with private insurance.

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Discussion

In our population-based study of 3,135 AYAs with NHL, HL, ALL and sarcoma, we found clinical trial enrollment increased significantly from 2006 to 2012-2013, although disparities in enrollment onto these clinical trials remain. Further, we identified promising trends in enrollment uptake among AYAs aged 25-29 years at diagnosis and the uninsured. Overall, these findings can inform the continued adoption and revision of programs and policies aimed to reduce disparities and improve clinical trial enrollment among AYAs with cancer.

The most recent clinical trial estimates from our study demonstrate significant increases in clinical trial enrollment from 14.8% to 17.9% over a six-year period, which may be due, in part, to a highly intensive period of new programming and policy initiatives at both the national and local levels.[5,11,13] Our findings are comparable to recently published studies of clinical trial enrollment among AYAs in single or affiliated institutions. [18] In a single-institution study, Collins et al found 6% of AYAs were enrolled on clinical trials from 2008-2012.[19] Sanford et al. examined AYA enrollment onto clinical trials from 2010 to 2014 in affiliated pediatric and adult NCI-designated cancer centers, finding 11% of AYAs were enrolled in the adult setting while 42% were enrolled in the pediatric setting.[18] While our population-based study demonstrated higher overall clinical trial enrollment, as well as improvements over time, in the cancer types studied, the persistent issue of lower overall clinical trial enrollment relative to the pediatric populations remains. The relatively lower proportional enrollment of AYAs relative to other age groups was recently demonstrated in a study of clinical trial enrollment within the NCI's CCOP. In this study, Roth et al. found lower proportional enrollment (number of AYA enrollments divided by total enrollments) of AYAs from 2004 to 2013 relative to both pediatric and adult populations, decreasing from 26.7% to 21.6%, within the program over time.[14] These findings are consistent with patient accrual data from the NCI Cancer Therapy Evaluation Program, identifying clinical trial enrollment rates among AYAs that are approximately 10% of the enrollment rates among children and half the rate of adults 40-65 years old.[20] While we acknowledge that clinical trial enrollment remains low in this population, our study identified promising signs of increasing overall clinical trial participation over time in a population-based study of AYAs with NHL, HL, ALL and sarcoma, representative of over 28% of the US population.[7,16]

We additionally found the overall increase in clinical trial participation was driven by increases in several key populations. Specifically, we found clinical trial participation among AYAs aged 25-29 years doubled between 2006 and 2012-2013, increasing from 6.3% to 13.2% of individuals. As a result, in multivariable analyses stratified by year of diagnosis, we no longer found significant differences in clinical trial enrollment between 25-29 year olds and 15-19 year olds in 2012-2013 (Table 4). This change may have been driven by several factors, namely the push by the Children's Oncology Group,[21] SWOG[22] and others trial groups to expand restrictive age criteria, increasing eligibility in many cases up to age 30 (or beyond) for many pediatric protocols.[10,11,23] Additionally, we saw some indication of improvements in enrollment among those treated in smaller facilities (<200 beds), which may be indicative of recent efforts to expand access and enrollment on trials within smaller communities without strong ties to clinical research networks through the NCORP program. [14,24] While other improvements were less surprising, namely improved accrual among those

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seen in facilities with residency training programs and those with no documented comorbidities (both with historically higher enrollment),[5] doubling of enrollment among the uninsured was unexpected. Specifically, we saw a doubling in clinical trial participation from 5.7% in 2006 to 12.8% in 2012-2013 among the uninsured. During this time, we showed significant reductions in the overall uninsured population as a result of the early provisions from the Affordable Care Act (e.g., AYAs ability to remain on their parents' insurance until age 25, Medicaid expansion, healthcare exchanges), which should have improved access to cancer care and clinical trials for the newly insured.[9] However, these policies should not have influenced access to or use of medical care among those who remained uninsured. We speculate that reductions in the overall uninsured population increased resources (e.g., foundation, facility-based) available and access to care for uninsured individuals to support their non-reimbursed, trial-related expenses that had previously gone to general medical care for the uninsured. While positive, we should remain cautious of the overall potential impact, as only 7% of our population was uninsured at the time of diagnosis. Overall, the promising trends within some key AYA populations with NHL, HL, ALL and sarcoma point toward the positive impact of national and local initiatives to improve clinical trial enrollment.

While enrollment improved overall across AYAs with NHL, HL, ALL and sarcoma, challenges remain for some historically underserved populations. Specifically, while we found improved enrollment among those aged 25-29 years, we found significantly decreased enrollment among those aged 30-35 years, driving the overall relationship between lower clinical trial enrollment with increased age in this AYA population. While expanded eligibility criteria in pediatric protocols have shown promising results in younger adults, future efforts should strategize on how best to capture those 30-39 years at diagnosis by thinking beyond expanding eligibility criteria to improve access (e.g., time costs of participation, travel, non-covered costs). Additionally, we continue to see enrollment disparities by cancer type and type of treating physician (pediatric vs. adult)—two inter-related characteristics. Among those with HL specifically, the declining rates of clinical trial participation are not unexpected and may have been driven in part due to high cure rates,[25] recent landmark studies on the treatment of early-stage HL[26] and a paucity of clinical trial options.[27,28] The true driver of improved clinical trial enrollment may have actually been increased participation among those with ALL and Sarcoma (Tables 3 and 4), each with greater availability of open trials during the follow-up period. However, there are promising efforts to improve AYA clinical trial participation across cancer sites and physician specialties with the introduction of an AYA specific sub-committee in SWOG. Future efforts should continue to monitor how AYAs learn about and enroll on clinical trials to understand potential barriers in the pathway to enrollment from institutional and patient perspectives. Finally, we identified an emerging disparity in our population not seen in our original investigation of clinical trial enrollment—significantly lower enrollment among NH Blacks and Other races relative to NH Whites.[5] A recent systematic review of cancer clinical trial enrollment in racial/ethnic minorities identified that although the proportion of adult NH Blacks participating in clinical trials increased from 2000-2010, NH Whites continue to comprise the largest majority of participants in these trials.[29] While racial/ethnic disparities have historically persisted in access to medical care and outcomes, there remain significant

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opportunities to target this underserved population with the reorganization of NCORP sites specifically designated as Minority/Underserved sites.[30]

While our study includes timely, relevant information on access to innovative care through clinical trials among AYAs with NHL, HL, ALL and sarcoma, we acknowledge several data-related limitations. First, to evaluate cancer-specific trends in enrollment, the POC study included select cancers in the AYA population; future population-based studies should evaluate trends across the spectrum of cancers that occur in AYAs. Second, we recognize trial availability (e.g., whether a trial exists and was open at an institution) and accessibility (e.g., provider and patient participation) directly influences enrollment. We know from prior literature that interest in, access to and eventual enrollment on clinical trials varies significantly by patient and provider demographics.[10] For example, providers in community practices may have fewer resources (e.g., staffing, record keeping) that would allow for ready access to trials, even if they were open. Further, patients with fewer resources may be unable to commit the time and money to participating in trials (e.g., driving costs, hotels, etc.). Emerging research has also demonstrated that even when AYAs have equivalent availability of clinical trials, their enrollment is lower than in pediatric populations-suggesting factors other than clinical trial availability serve as a strong barrier to enrollment.[31] While trial availability was not evaluated in our study, we encourage future studies to evaluate whether certain populations are less likely to enroll because a trial is not open or is inaccessible. Third, we did not collect information on reasons for forgoing clinical trial enrollment, an important consideration for future research to more fully understand the continued barriers leading to disparities in this population. Finally, we did not have information on costs of enrollment, another consideration historically leading to lower overall enrollment and the long-term financial burden of cancer.

Despite these limitations, our study demonstrates clinical trial trends for one of the largest population-based studies of AYAs with NHL, HL, ALL and sarcoma to date. We find that while disparities in enrollment onto clinical trials remain for AYAs with cancer, clinical trial participation increased over time in this population, with promising trends in enrollment uptake among AYAs 25-29 years of age and the uninsured.

Acknowledgment:

This study was made possible through the efforts of the Principal Investigators and the personnel at the Surveillance, Epidemiology and End Results registries.

Funding: National Cancer Institute contracts: HHSN261201000024C; HHSN261201000025C, HHSN261201000032C, HHSN261201000027C, HHSN261201000026C, HHSN261201000140C, HHSN261201000037C, HHSN261201000033C, HHSN261201000034C, HHSN261201000035C, HHSN261201000029C, HHSN261201000031C, HHSN261201000028C, HHSN261201000030C and the UC Davis Comprehensive Cancer Center.

Abbreviations Key

AYA	Adolescent and Young Adult
SEER	Surveillance Epidemiology and End Results
NCI	National Cancer Institute

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POC	Patterns of Care
NCORP	National Cancer Institute Community Oncology Research Program
CCOP	Community Clinical Oncology Program
NHL	non-Hodgkin lymphoma
HL	Hodgkin lymphoma
ALL	acute lymphoblastic leukemia
NH	non-Hispanic
AJCC	American Joint Commission on Cancer
OR	odds ratios
CI	confidence interval

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Table 1:

Demographic and Cancer Characteristics of Adolescents and Young Adults with Cancer, 2006 and 2012-2013 National Cancer Institute Patterns of Care Study

Characteristic	Total Population N=3,135	
	N	W %
Total	3,135	100
Provider Characteristics		
Cancer Type		
Non-Hodgkin Lymphoma	1027	37.52
Hodgkin Lymphoma	1018	34.49
Acute Lymphoblastic Leukemia	586	14.89
Sarcoma	504	13.09
American Joint Commission on Cancer Stage		
I	468	16.13
II	817	29.40
III	383	11.94
IV	609	20.28
0/Unknown/Unstaged	858	22.26
Age at Diagnosis, Years		
15-19	648	20.75
20-24	669	20.12
25-29	598	18.72
30-34	617	20.14
35-39	603	20.27
Race/Ethnicity		
Non-Hispanic White	1562	54.11
Non-Hispanic Black	452	11.36
Hispanic	814	27.18
Other *	307	7.34
Sex		
Male	1795	57.80
Female	1340	42.20
Marital Status		
Married	897	31.05
Other	2238	68.95
Comorbidities		
No	1934	62.22

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Characteristic	Total Population N=3,135	
	N	W %
Yes	1201	37.78
Insurance		
Private	2094	68.48
Public	801	24.27
No-Insurance/Unknown	240	7.25
Census Tract Median Family Income ($, Thousands)		
<35	9	0.18
35-<55	382	11.65
55-<75	1489	49.73
>=75	1255	38.44
Provider Characteristics		
Physician Specialty		
Pediatric Hematology/Oncology only	107	3.45
Adult Hematology/Oncology Only	501	14.86
Pediatric Hematology/Oncology + Other	426	12.59
Adult Hematology/Oncology + Other/Unknown	2101	69.10
Treating Hospital Bed Size		
<200	479	17.00
200-299	535	18.92
300-399	463	16.62
>=400	1536	43.88
Unknown + Outpatient/Physician Office	122	3.58
Residency Training Program		
Yes	2278	68.80
No/Unknown	857	31.20

* Includes Asian/Pacific Islander; American Indian/Alaskan Native; W%-Weighted %

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Table 2:

Clinical Trial Enrollment Over Time Among Adolescents and Young Adults (AYA) with Cancer, 2006 and 2012-2013 National Cancer Institute Patterns of Care Study

Characteristic	Clinical Trial Enrollment, 2006 (N=186/1040)		Clinical Trial Enrollment, 2012-2013 (N=342/2095)		P-Value
	N	W %	N	W %	
Total AYA Population	1040		2095		
Total Enrolled on a Clinical Trial	186	14.81	342	17.85	<0.01
Provider Characteristics					
Cancer Type					
Non-Hodgkin Lymphoma	29	6.23	38	6.87	0.57
Hodgkin Lymphoma	43	13.17	61	9.40	0.01
Acute Lymphoblastic Leukemia	68	37.36	156	42.31	0.19
Sarcoma	46	32.12	87	31.16	0.81
American Joint Commission on Cancer Stage					
I	11	6.09	16	6.78	0.68
II	44	13.31	61	15.36	0.25
III	19	16.68	28	9.91	0.01
IV	22	11.72	59	14.07	0.27
0/Unknown/Unstaged	90	27.35	178	34.65	0.01
Age at Diagnosis, Years					
15-19	106	42.05	170	44.16	0.49
20-24	32	14.22	74	17.25	0.18
25-29	15	6.32	51	13.25	<0.01
30-34	16	7.98	19	4.64	0.02
35-39	17	5.98	28	5.71	0.85
Race/Ethnicity					
Non-Hispanic White	89	14.89	180	18.33	0.01
Non-Hispanic Black	28	12.45	34	12.38	0.98
Hispanic	52	16.12	98	20.17	0.06
Other *	17	13.7	30	13.72	0.99
Sex					
Male	111	16.62	223	19.37	0.05
Female	75	12.47	119	15.69	0.03
Marital Status					
Married	32	8.97	48	7.64	0.32
Other	154	18.05	294	21.77	0.01

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Characteristic	Clinical Trial Enrollment, 2006 (N=186/1040)		Clinical Trial Enrollment, 2012-2013 (N=342/2095)		P-Value
	N	W %	N	W %	
Comorbidities					
No	116	14.89	220	19.48	0.01
Yes	70	14.68	122	15.28	0.71
Insurance					
Private	135	14.98	222	16.94	0.11
Public	44	18.71	109	20.99	0.34
No-Insurance/Unknown	7	5.71	11	12.86	0.01
Census Tract Median Family Income ($, Thousands)					
<55	25	16.77	51	20.31	0.26
55-<75	84	13.13	142	18.32	<0.01
>=75	77	16.73	149	16.72	0.99
Provider Characteristics					
Physician Specialty					
Pediatric Hematology/Oncology only	22	69.73	38	57.04	0.13
Adult Hematology/Oncology Only	19	12.51	59	16.54	0.14
Pediatric Hematology/Oncology + Other	72	50.94	147	54.25	0.41
Adult Hematology/Oncology + Other/Unknown	73	8.86	98	7.34	0.09
Treating Hospital Bed Size					
<200	22	9.35	47	16.82	<0.01
200-299	34	12.86	65	16.84	0.08
300-399	35	14.87	33	19.27	0.08
>=400	89	18.21	193	19.15	0.58
Residency Training Program					
Yes	155	18.25	306	21.25	0.03
No/Unknown	31	9.21	36	8.34	0.53

*Includes Asian/Pacific Islander; American Indian/Alaskan Native; W%- Weighted %

+Unknown + Outpatient/Physician Office category suppressed due to sample size.

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Table 3:

Association Between Patient/Demographic Characteristics and Enrollment on a Clinical Trial, Multivariable Logistic Regression, 2006 and 2012-2013 National Cancer Institute Patterns of Care Study (N=3,135)[+]

Characteristic	Odds Ratio	95% Confidence Interval
Patient Characteristics		
Year		
2006	Ref.	
2012-2013	0.75	(0.55,1.02)
Cancer Type		
Non-Hodgkin Lymphoma	Ref.	
Hodgkin Lymphoma	1.44	(0.89,2.32)
Acute Lymphoblastic Leukemia	**11.93**	**(5.61,25.39)**
Sarcoma	**3.20**	**(1.65,6.23)**
American Joint Commission on Cancer Stage		
I	Ref.	
II	1.65	(0.88,3.11)
III	1.71	(0.89,3.31)
IV	1.79	(1.00,3.22)
0/Unknown/Unstaged	0.73	(0.35,1.55)
Age at Diagnosis, Years		
15-19	Ref.	
20-24	**0.62**	**(0.42,0.92)**
25-29	**0.47**	**(0.29,0.76)**
30-34	**0.28**	**(0.16,0.49)**
35-39	**0.29**	**(0.17,0.49)**
Race/Ethnicity		
Non-Hispanic White	Ref.	
Non-Hispanic Black	**0.65**	**(0.43,0.98)**
Hispanic	0.77	(0.52,1.14)
Other [*]	0.65	(0.42,1.00)
Sex		
Male	Ref.	
Female	0.91	(0.67,1.24)
Marital Status		
Married	Ref.	
Other	0.83	(0.56,1.23)
Comorbidities		

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Characteristic	Odds Ratio	95% Confidence Interval
No	Ref.	
Yes	0.97	(0.72,1.31)
Insurance		
Private	Ref.	
Public	0.92	(0.64,1.31)
No-Insurance/Unknown	0.57	(0.26,1.28)
Census Tract Median Family Income ($, Thousands)		
<55	1.43	(0.94,2.17)
55-<75	0.97	(0.70,1.35)
>=75	Ref.	
Provider Characteristics		
Physician Specialty		
Pediatric Hematology/Oncology only	Ref.	
Adult Hematology/Oncology Only	**0.31**	**(0.11,0.85)**
Pediatric Oncology + Other	0.99	(0.35, 2.85)
Adult Hematology/Oncology +Other/Unknown	**0.19**	**(0.07, 0.54)**
Treating Hospital Bed Size		
<200	Ref.	
200-299	1.08	(0.63,1.85)
300-399	**1.78**	**(1.06,2.98)**
>=400	1.34	(0.86,2.08)
Unknown + Outpatient/Physician Office	1.64	(0.70,3.82)
Residency Training Program		
Yes	Ref.	
No/Unknown	0.67	(0.44,1.03)

*Includes Asian/Pacific Islander; American Indian/Alaskan Native; Bold indicates P<0.05;

+Multivariable models include all patient and provider characteristics listed.

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Table 4:

Association Between Patient/Demographic Characteristics and Enrollment on a Clinical Trial, Multivariable Logistic Regression, Stratified by Year of Diagnosis, National Cancer Institute Patterns of Care Study (N=3,135)[+]

Characteristic	Year of Diagnosis, 2006		Year of Diagnosis, 2012-2013	
Patient				
	Odds Ratio	**95% CI**	**Odds Ratio**	**95% CI**
Cancer Type				
Non-Hodgkin Lymphoma	Ref.		Ref.	
Hodgkin Lymphoma	1.79	(0.84,3.87)	1.18	(0.61,2.26)
Acute Lymphoblastic Leukemia	**10.96**	**(3.83,31.35)**	**13.31**	**(4.81,36.81)**
Sarcoma	**4.55**	**(2.03,10.16)**	**2.93**	**(1.21,7.08)**
American Joint Commission on Cancer Stage				
I	Ref.		Ref.	
II	2.23	(0.91,5.49)	1.24	(0.50,3.08)
III	2.40	(0.89,6.49)	1.31	(0.54,3.19)
IV	2.25	(0.83,6.12)	1.43	(0.67,3.05)
0/Unknown/Unstaged	0.79	(0.28,2.22)	0.58	(0.21,1.63)
Age at Diagnosis, Years				
15-19	Ref.		Ref.	
20-24	**0.49**	**(0.25,0.96)**	0.69	(0.42,1.13)
25-29	**0.21**	**(0.08,0.55)**	0.63	(0.35,1.11)
30-34	**0.28**	**(0.11,0.67)**	**0.21**	**(0.11,0.42)**
35-39	**0.21**	**(0.08,0.54)**	**0.32**	**(0.17,0.61)**
Race/Ethnicity				
Non-Hispanic White	Ref.		Ref.	
Non-Hispanic Black	0.63	(0.31,1.29)	0.66	(0.41,1.09)
Hispanic	0.89	(0.47,1.72)	0.69	(0.43,1.13)
Other[*]	0.82	(0.36,1.87)	0.55	(0.32,0.95)
Sex				
Male	Ref.		Ref.	
Female	0.73	(0.43,1.24)	1.07	(0.72,1.57)
Marital Status				
Married	Ref.		Ref.	
Other	0.59	(0.31,1.16)	0.97	(0.61,1.56)
Comorbidities				
No	Ref.		Ref.	

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Characteristic	Year of Diagnosis, 2006		Year of Diagnosis, 2012-2013	
Patient				
	Odds Ratio	**95% CI**	**Odds Ratio**	**95% CI**
Yes	0.99	(0.58,1.69)	0.90	(0.63,1.30)
Insurance				
Private	Ref.		Ref.	
Public	0.99	(0.53,1.88)	0.91	(0.59,1.39)
No-Insurance/Unknown	**0.29**	**(0.10,0.82)**	1.13	(0.44,2.92)
Census Tract Median Family Income ($, Thousands)				
<55	1.56	(0.73,3.37)	1.40	(0.85,2.33)
55-<75	0.79	(0.47,1.32)	1.04	(0.68,1.59)
>=75	Ref.		Ref.	
Provider				
Physician Specialty				
Pediatric Hematology/Oncology only	Ref.		Ref.	
Adult Hematology/Oncology Only	**0.16**	**(0.05,0.49)**	0.36	(0.10,1.32)
Pediatric Hematology/Oncology + Other	0.54	(0.18,1.64)	1.13	(0.31,4.10)
Adult Hematology/Oncology +Other/Unknown	0.14	(0.05,0.42)	0.18	(0.05,0.65)
Treating Hospital Bed Size				
<200	Ref.		Ref.	
200-299	1.66	(0.60,4.60)	0.79	(0.43,1.46)
300-399	2.60	(1.09,6.19)	1.43	(0.73,2.81)
>=400	2.09	(0.89,4.90)	1.00	(0.61,1.66)
Unknown + Outpatient/Physician Office	3.50	(0.90,13.63)	0.70	(0.21,2.31)
Residency Training Program				
Yes	Ref.		Ref.	
No/Unknown	0.90	(0.47,1.73)	**0.57**	**(0.33,0.98)**

*Includes Asian/Pacific Islander; American Indian/Alaskan Native; Bold indicated P<0.05

+Multivariable models include all patient and provider characteristics listed.