Published in final edited form as:
*Cancer*. 2015 December 15; 121(24): 4398–4406. doi:10.1002/cncr.29669.

# Case-Linked Analysis of Clinical Trial Enrollment Among Adolescents and Young Adults at a National Cancer Institute-Designated Comprehensive Cancer Center

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## Abstract

**BACKGROUND—**Poor accrual to cancer clinical trials may contribute to the lower improvement in survival observed for adolescents and young adults (AYAs) (those aged 15–39 years) with cancer. This has been difficult to quantify without reliable mechanisms to link incident cases with study enrollments. Using unique resources available at their National Cancer Institute-designated comprehensive cancer center, the authors compared the percentage of AYAs, children, and older adults enrolled onto cancer clinical trials and determined predictors of enrollment.

**METHODS—**Patients diagnosed with cancer from January 2008 through December 2012 at 1 pediatric and 2 adult University of Southern California hospitals were identified through the California Cancer Registry and individually linked to institutional trial enrollment databases. The availability of clinical trials was assessed.

**RESULTS—**Across the center, the enrollment percentage for AYAs (6%) was equal to that of older adults (6%), but was less than that for children (22%) ($P$<.01). Within the children's hospital, the AYA enrollment percentage was also less than that for children (15% vs 23%, respectively; $P$<.01). On multivariate analysis, diagnosis and site of care were found to be predictive of AYA enrollment onto therapeutic and nontherapeutic studies. Hispanic and Asian/Pacific Islander

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CONFLICT OF INTEREST DISCLOSURES
The authors made no disclosures.


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individuals were more likely to enroll onto nontherapeutic studies compared with non-Hispanic whites, but no racial/ethnic difference was observed for therapeutic studies.

**CONCLUSIONS—**In the current study, the percentages of AYAs and older adults enrolled onto therapeutic trials were low but similar. Diagnosis, site of care, and race/ethnicity appear to be predictive of enrollment. Prospective mechanisms must be instituted to capture reasons for nonenrollment of AYAs and develop corrective interventions.

### Keywords

adolescent; clinical oncology; clinical trial as topic; young adult

## INTRODUCTION

Over a decade ago, data from the National Cancer Institute (NCI) Surveillance, Epidemiology, and End Results (SEER) program first suggested that the rate of improvement in survival for adolescents and young adults (AYAs) (those aged 15–39 years) lagged behind that of both younger and older patients.[1,2] Reasons for this deficit are believed to be multifactorial and may be related to differences in epidemiology, disease biology, pharmacokinetics, insufficient health insurance, psychosocial factors, a lack of provider expertise, and age-specific research.

An additional contributor to this survival disparity is the relative lack of AYA participation in NCI-funded clinical trials.[3–6] Among younger children and subsets of older adults, impressive survival gains have been attributed to the systematic enrollment of patients onto cancer clinical trials.[7] Whether participants derive direct survival benefit is debated, but there is universal agreement that clinical trials inform investigators and improve outcomes for future patients.[8–10] Previous studies have shown that the percentage of AYAs enrolled onto cancer clinical trials is significantly lower compared with children aged <15 years.[3–6,11,12] The issue of low clinical trial enrollment is not necessarily unique to the AYA population as studies have generally demonstrated an age-related decline in clinical trial enrollment.[3,13,14]

Although clinical trial enrollment among AYAs has been the subject of previous studies,[3–6,11–13,15] to the best of our knowledge the majority of these studies had limitations in sample size, racial/ethnic diversity, and/or methods used for estimating accrual percentages. Methodologically, most extrapolate enrollment percentages based on national-level estimates of incidence,[3,4,11,12] or use other indirect measures such as billing and coding data[15] or provider recall of enrollment status.[13] Reports from the NCI estimate the percentage of patients enrolled onto clinical trials using SEER incidence data.[11,12,14,16,17] Many institutions do not have adequate resources with which to document all patients diagnosed and treated but not enrolled onto clinical trials. Even across NCI-designated comprehensive cancer centers, methods for determining the number and demographic characteristics of patients treated but not enrolled onto clinical trials are highly variable.[18] In short, to our knowledge there is no existing mechanism for linking known incident cases of AYA cancer with clinical trial enrollment on a large scale. This fundamental inability to measure the denominator (ie, the total number of patients diagnosed) prohibits an accurate determination of the percentage of AYAs who enroll onto clinical trials.[19]

The Los Angeles Cancer Surveillance Program (CSP) is the population-based cancer registry for Los Angeles County and is administered by the University of Southern California (USC) Keck School of Medicine and Norris Comprehensive Cancer Center (hereafter referred to as USC). This resource provides an opportunity, not otherwise feasible with deidentified national-level data, to determine clinical trial enrollment through direct linkage of patients enrolled onto clinical trials, as documented on an institutional level, with incident cancers captured by cancer registries at the county and state levels. Furthermore, USC is a high-volume academic medical center that serves a patient population characterized by substantial racial, ethnic, and socioeconomic diversity. With these resources, we examined clinical trial enrollment among children, AYAs, and older adults diagnosed and treated at USC over a recent 5-year interval. We discovered a significant enrollment deficit for AYAs compared with children but equivalent enrollment compared with older adults, and determined demographic factors predictive of enrollment in this age group.

## MATERIALS AND METHODS

### Data Source

The CSP has collected demographic, disease, and treatment information concerning incident cases of cancer in Los Angeles County since 1972. The CSP is part of the California Cancer Registry and is the second largest registry of the NCI SEER program. California law requires hospitals and other treatment facilities to report incident cases of cancer within 6 months of diagnosis. This system of mandated reporting is estimated to result in the capture of >98% of all pathologically diagnosed cases.

At USC, cancer care is provided across 4 hospitals: a free-standing children's hospital (Children's Hospital Los Angeles [CHLA]), an adult cancer hospital (USC Norris Cancer Hospital), an adult subspecialty hospital (Keck Hospital of USC), and a public hospital (Los Angeles County + USC Medical Center). CHLA limits cancer treatment for newly diagnosed patients to those aged birth to 21 years and is the only site that enrolls children onto Children's Oncology Group (COG)-sponsored studies. The USC Norris Cancer Hospital and Keck Hospital of USC are adjacent adult facilities that provide medical and surgical oncology services, respectively, to the same patient population, and were combined for this analysis as 1 site of care. The public hospital offers cancer care for all age groups, but rarely treats children aged <15 years.

Duplicate patient entries in the registry were assigned a single site of care based on where patients received treatment. Clinical trial enrollments across the center are entered into databases maintained by clinical trials offices at CHLA and the USC Norris Cancer Hospital, which capture demographic information regarding all patients enrolled on a study, including the name of and type of study (or studies) each patient enrolled onto and the date(s) of enrollment. The current study was approved by the CHLA and USC institutional review boards.

### Study Cohort and Measures

Eligible patients were aged birth to 80 years; newly diagnosed with an invasive malignancy between January 1, 2008 and December 31, 2012; and diagnosed and/or treated at a USC institution. This time frame was selected as the most recent 5-year period offering complete and consistent data from both the state registry and institutional databases. Patients with in situ malignancies, a history of a previous invasive malignancy, or a diagnosis made at the time of autopsy were excluded. The registry only captures new incident cases and not recurrences. Eligible patients identified by the CSP were linked to patients registered in the clinical trials databases to determine whether clinical trial enrollment occurred. For CHLA, enrollments were manually linked using medical record numbers and dates of birth. For patients enrolled at the other sites, enrollments were automatically linked with data-matching software by complete names and birthdates. Patients were divided into 3 age groups: pediatric (aged < 15 years), AYA (aged 15–39 years), and older adult (aged > 39 years). Demographic data for all AYA patients diagnosed in Los Angeles County between 2008 and 2012 were also ascertained.

The primary outcome of interest was the percentage of patients enrolled onto a therapeutic clinical trial. A therapeutic trial was defined as a phase 2, phase 3, or pilot trial for newly diagnosed disease in which overall or recurrence-free survival was a primary or secondary outcome. Enrollments onto trials for recurrent or refractory disease and phase 1 trials were excluded. The secondary outcome of interest was the percentage of patients enrolled onto a nontherapeutic study within 1 year of diagnosis. Nontherapeutic studies were defined as epidemiologic studies, biologic studies involving the banking or testing of tumor tissue or other specimens, and psychosocial and other supportive care studies. Therapeutic and nontherapeutic studies were included irrespective of study sponsor (ie, NCI cooperative group studies, institutional and investigator-initiated studies including pilot studies, and studies sponsored by the pharmaceutical industry).

The enrollment percentage for therapeutic clinical trials was obtained by dividing the number of patients enrolled onto a therapeutic clinical trial, as documented by the institutional clinical trials offices, by the total number of patients diagnosed at a USC institution, as captured by the CSP registry. The enrollment percentage for nontherapeutic studies was similarly obtained. Patients enrolled onto >1 nontherapeutic study were counted only once in the numerator.

The availability of therapeutic clinical trials was also assessed. Phase 2 and 3 therapeutic studies open at any USC institution that accrued at least 1 patient during the study period were counted and assigned a diagnostic category. The number of therapeutic trials open at any time during the study period and at any institution across the center was tallied by diagnosis.

### Statistical Analysis

The chi-square test was used to evaluate the distribution of disease and demographic factors across the 3 institutions and to assess age group differences in clinical trial enrollment. Logistic regression analysis was used to examine the effect of demographic, disease, and treatment factors on clinical trial participation. Separate multivariate models for trial enrollment in each study type (therapeutic and nontherapeutic) were built using stepwise model selection. Variables that attained a *P* value <.05 were considered to be statistically significant. All *P* values refer to 2-sided tests. All computations were completed with SAS statistical software (version 9.3; SAS Institute Inc, Cary, NC).

## RESULTS

### Patient Characteristics

In total, 1699 AYAs (those aged 15–39 years) were diagnosed among the institutions within the cancer center during the 5-year study period. AYAs diagnosed at the children's hospital were younger, with a slight male predominance (Table 1). The most common diagnosis among AYAs at the children's hospital was acute leukemia (32%), whereas extracranial germ cell tumor was most common at both the adult cancer and public hospitals (14% and 15%, respectively). At the children's and public hospitals, the majority of patients were Hispanic (63% and 74%, respectively) compared with the adult cancer hospital, in which non-Hispanic white patients (50%; $P < .01$) represented the largest racial/ethnic group.

The AYA population at USC accounted for approximately 15% of all AYAs diagnosed in Los Angeles County during the study period (Table 1). AYAs not seen at USC could have been treated at a variety of institutions across Los Angeles County, including other academic and community-based institutions and private practices. Compared with USC, a slightly higher percentage of the county population was female. Among the 10 most frequent AYA diagnoses in Los Angeles County, slightly higher percentages of patients with extracranial germ cell tumors, sarcoma, and acute leukemia were treated at USC, whereas slightly higher percentages of patients with breast and thyroid carcinoma and melanoma were treated elsewhere.

### Enrollment Percentages

Enrollment percentages for AYAs compared with pediatric patients (those aged < 15 years) and older adult patients (those aged > 39 years) were analyzed by study type (therapeutic and nontherapeutic). As shown in Table 2, pediatric patients had significantly higher enrollment onto both study categories compared with AYAs or older adults. Greater than one-half of pediatric patients (54%) enrolled onto any study type compared with 20% of AYAs and 17% of older adults ($P < .01$). The percentages of AYAs and adults enrolled onto therapeutic clinical trials were equal (6%). Within the children's hospital, there was still a deficit in enrollment noted among AYAs compared with pediatric patients (15% vs 23%; $P < .01$).

Combining data across all sites, the characteristics of AYAs who were enrolled versus those not enrolled onto cancer studies are shown in Table 3. For therapeutic studies, a higher percentage of patients aged 15 to 19 years were enrolled onto therapeutic clinical trials compared with the other 5-year age intervals, whereas no significant differences were noted between males and females or among racial/ethnic groups. The children's hospital enrolled a significantly higher percentage of AYAs onto therapeutic studies (15%) compared with the adult cancer hospital (3%) and public hospital (5%) ($P < .01$). Breast cancer (19%) and acute leukemia (15%) were the diagnoses with the highest percentages of patients enrolled.

For nontherapeutic studies, a higher percentage of patients aged 15 to 19 years were enrolled onto nontherapeutic studies compared with the other 5-year age intervals. A higher percentage of females were enrolled compared with males (21% vs 12%; $P < .01$). Higher percentages of Hispanics (19%) and Asian/Pacific Islanders (17%) and a lower percentage of African Americans (7%) were enrolled compared with non-Hispanic whites (11%) ($P < .01$). The enrollment percentage for nontherapeutic studies varied greatly by institution (46% at the children's hospital, 9%at the adult cancer hospital, and 14% at the public hospital; $P < .01$). Similar to therapeutic studies, the highest enrollment percentages occurred among patients with breast cancer (57%) and acute leukemia (26%).

Multivariate analysis of factors potentially related to enrollment onto therapeutic and nontherapeutic studies is summarized in Table 4. Patients who were Hispanic and Asian/Pacific Islander were significantly more likely than non-Hispanic white patients to enroll onto nontherapeutic studies, but race/ethnicity was not found to be a significant predictor of enrollment onto therapeutic studies. For site of care, AYAs treated at the adult cancer and public hospitals were significantly less likely to be enrolled than those treated at the children's hospital in both study categories. For diagnosis, AYAs with breast cancer or leukemia were far more likely to be enrolled onto both therapeutic and nontherapeutic studies.

Because site of care and age are confounded with younger AYAs treated at the children's hospital and older AYAs treated at the adult institutions, we performed a subanalysis limited to a total of 326 patients aged 15 to 21 years (Table 5). Site of care remained a significant predictor of enrollment among AYAs aged 15 to 21 years. Those diagnosed at the adult cancer hospital or public hospital were less likely to enroll onto nontherapeutic studies compared with those diagnosed at the children's hospital (odds ratio [OR], 0.15 [95% confidence interval (95% CI), 0.05–0.45; $P < .01$] and OR, 0.04 [95% CI, 0.01–0.11; $P < .01$], respectively). For therapeutic studies, AYAs aged 15 to 21 years who were diagnosed at the public hospital were less likely to enroll compared with those diagnosed at the children's hospital (OR, 0.26; 95% CI, 0.10–0.71 [$P < .01$]), but the difference between the adult cancer hospital and the children's hospital was not statistically significant, most likely due to small sample size.

Site of care and trial availability are also confounded because COG trials are only open at the children's hospital. As summarized in Table 6, we examined diagnosis-specific enrollment by site of care. At the children's hospital, a much higher percentage of AYAs with sarcoma or acute leukemia were enrolled compared with the adult hospitals, whereas patients with breast cancer were enrolled only at the adult hospitals.

During the 5-year study period, among therapeutic clinical trials incorporating at least part of the AYA age range (15–39 years), there were a total of 14 trials open for breast carcinoma, 11 for acute leukemia, and 10 for lymphoma versus 2 trials open for extracranial germ cell tumors. Furthermore, the children's hospital had 50 therapeutic clinical trials open and the adult institutions had 96 open trials. At the children's hospital, 43 of 50 therapeutic trials (86%) encompassed at least part of the AYA age range compared with 92 of 96 therapeutic trials (96%) at the adult institutions. At the children's hospital, 30 of 50 trials (60%) were for one of the 10 most common diagnoses in the AYA population compared with 42 of 96 trials (44%) at the adult institutions. In total, only 11 of 146 trials (8%) encompassed the entire AYA age range. Of the 10 most common AYA diagnoses, 8 had therapeutic clinical trials open within the institution (none for thyroid carcinoma or melanoma). Comparatively, clinical trials were open for all 10 of the most common diagnoses in children and for 9 of the 10 most common diagnoses in older adults.

Of 96 therapeutic studies available in the adult setting, 26 (27%) were sponsored by pharmaceutical companies versus none at the children's hospital. Due to limitations in data coding, we were unable to evaluate for the effect of study sponsorship on enrollment.

## DISCUSSION

In the current study, we have described what we believe to be the largest and most accurate study published to date characterizing patterns of AYA enrollment onto cancer clinical trials at an academic medical center. Using the resources of the USC CSP, enrollment percentages were calculated through direct linkage of population-level registry data to patient-level clinical trial enrollment data. In comparison with previous studies that were either much smaller or involved SEER-based estimates of accrual percentage, the data in the current study reflect actual clinical trial enrollment status for each case. Although 22% of newly diagnosed children were enrolled onto phase 2 or phase 3 therapeutic clinical trials, just 6% of AYAs (those aged 15–39 years) and 6% of older adults were enrolled ($P<.01$). In limiting the analysis to the children's hospital, enrollment onto therapeutic clinical trials was still significantly lower for AYAs compared with younger patients (15% vs 23%; $P<.01$). The pattern of enrollment was similar for nontherapeutic studies, with 47% of children enrolled compared with 17% of AYAs and 13% of older adults ($P<.01$). We have expanded on previous studies by including a comparison of AYAs with older adults and examining enrollment onto nontherapeutic studies. Furthermore, the large and diverse patient population of the study center allowed for an analysis of the impact of race and ethnicity on enrollment. We found that Hispanic and Asian/Pacific Islander patients were more likely than non-Hispanic white patients to enroll onto nontherapeutic studies, a novel finding that to the best of our knowledge has not been reported previously.

On multivariate analysis of factors associated with the enrollment of AYAs onto cancer studies, we found that site of care was predictive. AYAs seen at the children's hospital were significantly more likely to enroll compared with AYAs seen at either of the primarily adult institutions. The exact reasons for this are unclear but are likely complex. It has been proposed that the successful enrollment of AYAs onto clinical oncology trials is a multifaceted process involving trial availability on a national level, accessibility on an institutional level, presentation on a provider level, and acceptance on a patient level.[20] During the period of the current study, COG trials were accessible to AYAs at the children's hospital but not those cared for at the adult institutions. Furthermore, although our adult institutions saw 10 times the number of patients with cancer compared with the children's hospital, they had only twice as many trials open, which suggests a deficit in the number of open trials in relation to patient volume. In seeking to understand actionable barriers to AYA clinical trial enrollment, the relative contributions of trial availability and accessibility as well as physician attitudes and practices, availability of research support, and patient perceptions of clinical trials are worthy of further study and best addressed prospectively.

Diagnosis was significantly associated with AYA enrollment onto both therapeutic and nontherapeutic studies. Although extracranial germ cell tumor was the most common diagnosis in our AYA population, AYAs with breast cancer, acute leukemia, and lymphoma were significantly more likely to enroll onto therapeutic clinical trials, a finding that mirrored the number of trials open for each diagnosis during the study period. These findings suggest that, in diseases in which important research questions related to survival or toxicity remain, a lack of open therapeutic trials may contribute to lower proportional enrollment of AYAs. Conversely, for certain tumors with excellent outcomes and no pressing need for studies aimed at further refining therapy (eg, low-stage testicular cancer), the resources needed for a large-scale clinical trial may be difficult to justify.

Race/ethnicity emerged as a factor that was significantly associated with patient enrollment onto nontherapeutic clinical trials. AYAs of Hispanic descent and Asian/Pacific Islanders were more likely than non-Hispanic whites to enroll onto nontherapeutic studies. National-level data have suggested that Hispanics and other minorities are underrepresented on clinical trials and are less likely to enroll compared with white individuals.[14] The absence of an effect of race/ethnicity on enrollment onto therapeutic studies may be related to a lack of power from the overall small number of therapeutic enrollments at the adult centers. Cultural differences in the patient-physician relationship may possibly influence the likelihood of enrollment and is another area worthy of further study.

Previous studies examining clinical trial enrollment among AYAs have only been able to derive estimates of enrollment percentages based on national-level incidence data[3,4,11,12] or billing and coding data.[16] The majority of these studies have evaluated enrollment solely onto government-sponsored therapeutic trials.[11,12,14,16,17] Unlike these earlier studies, a major strength of the current study is that cancer registry data were directly linked with enrollment data. We were also able to examine enrollment by study type (therapeutic and nontherapeutic) and irrespective of funding source. Despite these strengths, the current study is limited to the experience at a single academic center and therefore the findings may not be generalizable to the entire AYA population because many AYAs with cancer are treated outside of academic centers.[21] However, the study location likely represents the setting in which patients are most likely to have an opportunity for clinical trial enrollment compared with nonacademic centers and private practices. It is possible that enrollment was underestimated because some patients who underwent diagnostic biopsy or surgery at USC never intended to receive ongoing treatment at the center. Unfortunately, we could not fully assess the impact of trial availability because these data are not yet prospectively documented for all patients treated across the center. With additional resources, the routine capture of reasons for nonenrollment would yield a more robust analysis of the impact of trial availability and other patient-level and provider-level factors on enrollment.

On a national and international level, greater collaboration among the oncology disciplines is necessary for the development of AYA-focused clinical trials.[22] This has emerged as an NCI priority with the recent launching of the National Clinical Trials Network (NCTN), which brings the COG and 4 adult cooperative groups into a more unified structure built around collaboration and resource-sharing.[19] Beyond merely changing age eligibility limits and gaining cross-group enrollment onto existing trials, the NCTN creates opportunities for designing and developing intergroup studies that are genuinely scientifically integrated through the incorporation of both pediatric and medical oncology expertise. A current example of a study highly relevant to AYAs is ARST1321, which was codeveloped by COG and NRG Oncology investigators and is evaluating pazopanib for the treatment of non-rhabdomyosarcoma soft tissue sarcoma and is open to patients aged ≥2 years.[23] ARST1321 and several other collaborative studies (such as AEWS1031 and AEWS1221 for Ewing sarcoma and A031102 for refractory and recurrent germ cell tumors) are available through the NCI Cancer Trials Support Unit and can be activated by institutions affiliated with any NCTN cooperative group. This more streamlined NCTN infrastructure may permit the implementation of strategies to increase the participation of AYAs in clinical trials such as ARST1321.

The findings of the current study are relevant for having accurately measured the enrollment percentage for AYAs, established its feasibility as a metric with which to track the effect of strategies designed to improve enrollment, and identified predictors of enrollment and areas for further study.

## Acknowledgments

FUNDING SUPPORT

Support for this research was provided by the Dear Jack Foundation (to Dr. Collins) and the David Stroud Postgraduate Fellowship Fund (to Dr. Collins). The cancer incidence data used in this study were supported by the California Department of Public Health as part of the cancer reporting program mandated by California Health and Safety Code Section 103885; the National Cancer Institute’s Surveillance, Epidemiology, and End Results program under HHSN261201000140C awarded to the Cancer Prevention Institute of California, HHSN261201000035C awarded to the University of Southern California, and HHSN261201000034C awarded to the Public Health Institute; and the Centers for Disease Control and Prevention’s National Program of Cancer Registries, under agreement U58DP003862-01 awarded to the California Department of Public Health. The ideas and opinions expressed herein are those of the authors and endorsement by the State of California, Department of Public Health, the National Cancer Institute, and the Centers for Disease Control and Prevention or their contractors and subcontractors is not intended nor should be inferred.

We thank Aavesh Naykodi, MS, Asma Faruki, Lakshmi Damerla, Richard Sposto, PhD, Andrea Sipin, and Yaping Wang for their assistance in completing this project.

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## TABLE 1.

Characteristics of Newly Diagnosed AYAs (Aged 15–39 Years) Seen at the USC Norris Comprehensive Cancer Center by Institution (n=1699) Versus Los Angeles County SEER incidence (n=11,358): 2008–2012

| | Children's Hospital | Adult Cancer Hospital | Public Hospital (Adults and Children) | Los Angeles County |
|---|---|---|---|---|
| No. | 191 | 320 | 1188 | 11,358 |
| Median age (range), y | 16 (15–22) | 31 (15–39) | 31 (15–39) | 33 (15–39) |
| Sex | | | | |
| Male | 114 (60%) | 158 (49%) | 588 (49%) | 4538 (40%) |
| Female | 77 (40%) | 162 (51%) | 600 (51%) | 6820 (60%) |
| Race/ethnicity | | | | |
| White, non-Hispanic | 38 (20%) | 160 (50%) | 155 (13%) | 3675 (32%) |
| African American | 10 (5%) | 15 (5%) | 55 (5%) | 856 (8%) |
| Hispanic | 121 (63%) | 86 (27%) | 881 (74%) | 5175 (46%) |
| Asian/Pacific Islander | 22 (12%) | 59 (18%) | 97 (8%) | 1382 (12%) |
| Other | - | - | - | 270 (2%) |
| Diagnosis | | | | |
| Extracranial germ cell tumor (no. male/no. female) | 17 (9%) (14/3) | 46 (14%) (42/1) | 181 (15%) (165/16) | 1170 (10%) (1048/122) |
| Lymphoma | 30 (16%) | 24 (7%) | 132 (11%) | 1210 (11%) |
| Sarcoma | 26 (13%) | 34 (11%) | 105 (9%) | 671 (6%) |
| Acute leukemia | 61 (32%) | 22 (7%) | 71 (6%) | 499 (4%) |
| Breast carcinoma | 0 | 31 (10%) | 109 (9%) | 1587 (14%) |
| Thyroid carcinoma | 10 (5%) | 29 (9%) | 75 (6%) | 1597 (14%) |
| Cervical carcinoma | 0 | 10 (3%) | 94 (8%) | 574 (5%) |
| CNS malignancies | 26 (14%) | 15 (5%) | 54 (5%) | 784 (7%) |
| Colorectal carcinoma | 0 | 14 (4%) | 55 (5%) | 496 (4%) |
| Melanoma | 0 | 12 (4%) | 13 (1%) | 604 (5%) |
| Other | 21 (11%) | 83 (26%) | 299 (25%) | 2166 (19%) |

Abbreviations: AYAs, adolescents and young adults; CNS, central nervous system; SEER, Surveillance, Epidemiology, and End Results; USC, University of Southern California.

**TABLE 2.**

Comparison of Cancer Study Enrollment Between Pediatric (Aged < 15 Years), AYA (Aged 15–39 Years), and Adult (Aged > 39 Years) Patients

| | Pediatric | AYA | Adult | *P* |
|---|---|---|---|---|
| No. | 793 | 1699 | 9311 | |
| Any cancer study | 426 (54%) | 342 (20%) | 1561 (17%) | <.01 |
| Therapeutic | 174 (22%) | 104 (6%) | 518 (6%) | <.01 |
| Nontherapeutic | 371 (47%) | 287 (17%) | 1215 (13%) | <.01 |

Abbreviation: AYA, adolescents and young adults.

## TABLE 3.

Characteristics of Newly Diagnosed AYAs (Aged 15–39 Years) Enrolled Versus Those Not Enrolled onto Therapeutic and Nontherapeutic Cancer Studies (Across All Institutions)

| | Therapeutic | | | Nontherapeutic | | |
|---|---|---|---|---|---|---|
| | **Enrolled** | **Not Enrolled** | ***P*** | **Enrolled** | **Not Enrolled** | ***P*** |
| Age, y | | | | | | |
| 15–19 | 31 (12%) | 237 (88%) | <.01 | 90 (34%) | 178 (66%) | <.01 |
| 20–24 | 10 (4%) | 241 (96%) | | 14 (6%) | 237 (94%) | |
| 25–29 | 16 (5%) | 290 (95%) | | 30 (10%) | 276 (90%) | |
| 30–34 | 14 (4%) | 357 (96%) | | 69 (19%) | 302 (81%) | |
| 35–39 | 33 (7%) | 470 (93%) | | 84 (17%) | 419 (83%) | |
| Sex | | | | | | |
| Male | 48 (6%) | 812 (94%) | .35 | 107 (12%) | 753 (88%) | <.01 |
| Female | 56 (7%) | 783 (93%) | | 180 (21%) | 659 (79%) | |
| Race/ethnicity | | | | | | |
| White, non-Hispanic | 13 (4%) | 340 (96%) | .06 | 38 (11%) | 315 (89%) | <.01 |
| African American | 2 (3%) | 78 (97%) | | 6 (7%) | 74 (93%) | |
| Hispanic | 77 (7%) | 1011 (93%) | | 212 (19%) | 876 (81%) | |
| Asian/Pacific Islander | 12 (7%) | 166 (93%) | | 31 (17%) | 147 (83%) | |
| Hospital | | | | | | |
| Children's hospital | 29 (15%) | 162 (85%) | <.01 | 87 (46%) | 104 (54%) | <.01 |
| Adult cancer hospital | 10 (3%) | 310 (97%) | | 30 (9%) | 290 (91%) | |
| Public hospital | 65 (5%) | 1123 (95%) | | 170 (14%) | 1018 (86%) | |
| Diagnosis | | | | | | |
| Extracranial germ cell tumor | 7 (3%) | 237 (97%) | <.01 | 12 (5%) | 232 (95%) | <.01 |
| Lymphoma | 15 (8%) | 171 (92%) | | 12 (6%) | 174 (94%) | |
| Sarcoma | 9 (5%) | 156 (95%) | | 17 (10%) | 148 (90%) | |
| Acute leukemia | 23 (15%) | 131 (85%) | | 41 (26%) | 113 (73%) | |
| Breast carcinoma | 26 (19%) | 114 (81%) | | 80 (57%) | 60 (43%) | |
| Other | 24 (3%) | 786 (97%) | | 125 (15%) | 685 (85%) | |

Abbreviation: AYAs, adolescents and young adults.

**TABLE 4.**

Multivariate Analysis of Factors[a] Associated With Enrollment of AYAs (Aged 15–39 Years) onto Therapeutic and Nontherapeutic Cancer Studies

| | Therapeutic | | Nontherapeutic | |
|---|---|---|---|---|
| | **OR (95% CI)** | ***P*** | **OR (95% CI)** | ***P*** |
| Race/ethnicity[b] | | | | |
| White, non-Hispanic | - | NS | Referent | <.01 |
| African American | - | | 0.38 (0.14–1.02) | |
| Hispanic | - | | 1.75 (1.12–2.72) | |
| Asian/Pacific Islander | - | | 1.80 (1.01–3.21) | |
| Hospital | | | | |
| Children's hospital | Referent | <.01 | Referent | <.01 |
| Adult cancer hospital | 0.19 (0.08–0.41) | | 0.06 (0.04–0.11) | |
| Public hospital | 0.34 (0.20–0.59) | | 0.10 (0.06–0.15) | |
| Diagnosis | | | | |
| Extracranial germ cell tumor | Referent | <.01 | Referent | <.01 |
| Lymphoma | 2.54 (1.01–6.42) | | 0.98 (0.41–2.34) | |
| Sarcoma | 1.72 (0.62–4.76) | | 1.75 (0.77–3.98) | |
| Acute leukemia | 3.86 (1.56–9.56) | | 3.03 (1.43–6.39) | |
| Breast carcinoma | 9.01 (3.77–21.56) | | 44.37 (21.71–90.69) | |
| Other | 1.04 (0.44–2.45) | | 4.37 (2.29–8.33) | |

Abbreviations: 95% CI, 95% confidence interval; AYAs, adolescents and young adults; NS, not significant; OR, odds ratio.

[a]Age (as categorical variable, 5-year intervals), sex, race/ethnicity, hospital, and diagnosis.

[b]Race/ethnicity was not found to be significantly associated with enrollment onto a therapeutic clinical trial.

## TABLE 5.

Multivariate Analysis of Factors[a] Associated With Enrollment of AYAs Restricted to Those Aged 15 to 21 Years onto Therapeutic and Nontherapeutic Cancer Studies

| | Therapeutic | | Nontherapeutic | |
|---|---|---|---|---|
| | **OR (95% CI)** | ***P*** | **OR (95% CI)** | ***P*** |
| Hospital | | | | |
| Children's hospital | Referent | <.01 | Referent | <.01 |
| Adult cancer hospital | 0.22 (0.03–1.74) | | 0.15 (0.05–0.45) | |
| Public hospital | 0.26 (0.10–0.72) | | 0.04 (0.01–0.11) | |
| Diagnosis[b] | | | | |
| Extracranial germ cell tumor | Referent | .05 | - | - |
| Lymphoma | 1.12 (0.23–5.53) | | - | |
| Sarcoma | 2.84 (0.69–11.76) | | - | |
| Acute leukemia | 2.38 (0.62–9.06) | | - | |
| Other | 0.71 (0.15–3.18) | | - | |

Abbreviations: 95% CI, 95% confidence interval; AYAs, adolescents and young adults; OR, odds ratio.

[a]Age (as categorical variable, 5-year intervals), sex, race/ethnicity, hospital, and diagnosis (breast carcinoma excluded).

[b]Diagnosis was not found to be significantly associated with enrollment onto a nontherapeutic clinical trial.

## TABLE 6.

Enrollment of AYAs (Aged 15–39 Years) onto Therapeutic and Nontherapeutic Cancer Studies by Diagnosis by Site of Care[a]

| | Therapeutic | | | Non-Therapeutic | | |
|---|---|---|---|---|---|---|
| | Enrolled | Not Enrolled | *P* | Enrolled | Not Enrolled | *P* |
| Children's hospital | | | | | | |
| Extracranial germ cell tumor | 0 (0) | 17 (100%) | <0.01 | 7 (41.2%) | 10 (58.8%) | 0.05 |
| Lymphoma | 3 (10.0%) | 27 (90.0%) | | 10 (33.3%) | 20 (66.7%) | |
| Sarcoma | 8 (30.8%) | 18 (69.2%) | | 14 (53.9%) | 12 (46.1%) | |
| Acute leukemia | 14 (22.9%) | 47 (77.1%) | | 36 (59.0%) | 25 (41.0%) | |
| Breast carcinoma | - | - | | - | - | |
| Other | 4 (7.0%) | 53 (93.0%) | | 20 (35.1%) | 37 (64.9%) | |
| Adult hospitals (combined) | | | | | | |
| Extracranial germ cell tumor | 7 (3.1%) | 220 (96.9%) | <0.01 | 5 (2.2%) | 222 (97.8%) | <0.01 |
| Lymphoma | 12 (7.7%) | 144 (92.3%) | | 2 (1.3%) | 154 (98.7%) | |
| Sarcoma | 1 (0.7%) | 138 (99.3%) | | 3 (2.2%) | 136 (97.8%) | |
| Acute leukemia | 9 (9.7%) | 84 (90.3%) | | 5 (5.4%) | 88 (94.6%) | |
| Breast carcinoma | 26 (18.6%) | 114 (81.4%) | | 80 (57.1%) | 60 (42.9%) | |
| Other | 20 (2.7%) | 733 (97.3%) | | 105 (13.9%) | 648 (86.1%) | |

Abbreviation: AYAs, adolescents and young adults.

[a]Adult cancer hospitals and public hospitals were combined as adult hospitals.