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Improvements in life expectancy among childhood cancer survivors: uneven gains and remaining challenges

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Background: Childhood cancer survivors are at risk for shortened lifespan. Projections of life expectancy (LE) by diagnosis can provide benchmarks for assessing improvements over time.

Methods: We developed a simulation model to project risk for common, life-threatening chronic health conditions (CHCs; heart failure, myocardial infarction, valvular disease, stroke, secondary breast cancer, colorectal cancer, glial tumors, sarcomas) and excess mortality among 5-year survivors, based on patient characteristics (sex, age at diagnosis, diagnosis) and treatment exposures (chemotherapy, radiation dose). Risk was estimated using statistical models and Childhood Cancer Survivor Study data. Age-related CHC risks (SEER, NHLBI) and competing mortality (CDC Wonder) were based on national databases. We used model calibration to identify parameter sets that generated outcomes consistent with observed data. Model outcomes included conditional LE and 10-year survival probability at age 40. For comparisons to the general population, we simulated age-, sex-, and diagnosis year-matched individuals who faced only competing mortality rates.

Results: Among a cohort representative of the CCSS (mean diagnosis age, 7.4 yrs), compared to the general population, the gap in LE among survivors diagnosed in the 1970s vs. 1990s decreased from 17 yrs (25%) to 11 yrs (17%). Changes in LE among survivors diagnosed in the 1990s vs. 1970s varied by diagnosis, with leukemia, lymphoma, and CNS tumor survivors estimated to live an additional 8 to 11 yrs (Table). In contrast, considerably smaller gains were estimated for sarcoma and renal tumor survivors (1–3 yrs) and a loss for neuroblastoma (-3 yrs). Among survivors who reached age 40, the probability of surviving an additional 10 years increased from 89% to 92% between 1970s vs. 1990s, with the greatest gains for lymphoma and CNS tumors.

Conclusions: Although temporal changes in pediatric oncology are projected to result in LE gains among survivors, considerable variation is projected across diagnoses. These findings highlight the uneven success of improving treatments for all cancers.

Cohort	Conditional LE, yr			Conditional 10-year survival probability at age 40, %		
	Diagnosed 1970s	Diagnosed 1990s	Δ	Diagnosed 1970s	Diagnosed 1990s	Δ
General population	65 (64–65)	67 (66–67)	2 (1–2)	97 (97–97)	97 (97–98)	0 (0–0)
5-yr survivors	48 (46–49)	55 (53–57)	7 (6–9)	89 (88–90)	92 (91–93)	3 (2–5)
Leukemia	53 (47–56)	61 (55–64)	8 (5–11)	93 (90–95)	94 (91–96)	1 (-1–4)
Lymphoma	39 (38–41)	51 (47–56)	11 (8–15)	84 (81–86)	93 (91–95)	9 (6–12)

CNS tumors	37 (35–40)	46 (41–51)	9 (5–12)	80 (75–85)	86 (82–90)	7 (1–12)
Bone tumors	47 (46–49)	48 (47–50)	1 (-2–3)	92 (89–94)	93 (90–95)	1 (-2–5)
Neuroblastoma	61 (59–63)	58 (57–60)	-3 (-5–0)	92 (89–95)	92 (89–94)	-1 (-5–3)
Renal tumors	59 (57–61)	62 (61–63)	3 (1–5)	92 (89–95)	94 (92–96)	2 (-1–6)
Soft tissue sarcoma	51 (49–52)	53 (51–55)	2 (0–5)	90 (88–93)	91 (87–94)	0 (-4–5)