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How Radiation Oncologists Evaluate and Incorporate Life Expectancy Estimates Into the Treatment of Palliative Cancer Patients: A Survey-Based Study

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Abstract

Purpose—We surveyed how radiation oncologists think about and incorporate a palliative cancer patient's life expectancy (LE) into their treatment recommendations.

Methods and Materials—A 41-item survey was e-mailed to 113 radiation oncology attending physicians and residents at radiation oncology centers within the Boston area. Physicians estimated how frequently they assessed the LE of their palliative cancer patients and rated the importance of 18 factors in formulating LE estimates. For 3 common palliative case scenarios, physicians estimated LE and reported whether they had an LE threshold below which they would modify their treatment recommendation. LE estimates were considered accurate when within the 95% confidence interval of median survival estimates from an established prognostic model.

Results—Among 92 respondents (81%), the majority were male (62%), from an academic practice (75%), and an attending physician (70%). Physicians reported assessing LE in 91% of their evaluations and most frequently rated performance status (92%), overall metastatic burden (90%), presence of central nervous system metastases (75%), and primary cancer site (73%) as “very important” in assessing LE. Across the 3 cases, most (88%–97%) had LE thresholds that would alter treatment recommendations. Overall, physicians' LE estimates were 22% accurate with 67% over the range predicted by the prognostic model.

Conclusions—Physicians often incorporate LE estimates into palliative cancer care and identify important prognostic factors. Most have LE thresholds that guide their treatment

recommendations. However, physicians overestimated patient survival times in most cases. Future studies focused on improving LE assessment are needed.

Introduction

Among cancer patients with metastatic disease, accurate assessment of a patient's life expectancy (LE) is important for determining a patient's likelihood of benefitting from palliative radiation therapy and, if appropriate, recommending a dose-fractionation schedule that balances patient LE with long-term efficacy and side effects (1, 2). Indeed, in an international survey of radiation oncologists, the factor most frequently influencing a dose-fractionation prescription was patient prognosis (3).

Unfortunately, physicians often inaccurately predict the LE of terminally ill patients (4, 5) and tend to overestimate their survival times (6, 7). Such LE overestimates may contribute to patients receiving a proportionally long palliative radiation therapy treatment course during a limited remaining life span. Gripp et al reported that among 27 palliative cancer patients who received radiation therapy within the last 30 days of life at the University Hospital Dusseldorf, half spent >60% of their remaining life span on therapy (8). A larger, contemporary, US-population-based study reported that among 202,299 patients who succumbed to lung, breast, prostate, colorectal, or pancreas cancer, only 7.6% received radiation therapy in the last month of life. However, 17.8% of those who received radiation therapy spent >10 of their final 30 days of life being treated (9).

Recognizing that patient LE is critical in informing appropriate palliative cancer care, national oncology and palliative care guidelines require oncologists to incorporate estimates of patient LE in palliative oncology care decision making (10). However, there are few data among radiation oncologists informing (1) the frequency with which LE estimates are incorporated into palliative oncology care; (2) how LE is assessed; (3) whether LE influences radiation therapy decisions; (4) physician accuracy in estimating LE; and (5) frequency of training in LE assessment. We performed a survey-based study of radiation oncologists to understand LE utilization within radiation oncology based on these 5 factors and to identify potential ways to improve LE assessment as part of palliative oncology care.

Methods and Materials

Survey and participants

After receiving approval from the Dana-Farber/Harvard Cancer Center institutional review board, we emailed an anonymous, electronic survey to 113 radiation oncology attending physicians and residents at 10 Boston-area institutions. Eligible radiation oncology centers included Beth Israel Deaconess Medical Center, Boston Medical Center, Brigham and Women's Hospital/Dana-Farber Cancer Institute, Emerson Hospital, Massachusetts General Hospital, Milford Regional Medical Center, Newton-Wellesley Hospital, North Shore Medical Center, Saint Anne's Hospital, and South Shore Hospital. Three requests for participation were sent over the course of 5 weeks. Survey respondents received a \$10 gift card.

The survey consisted of 41 questions, including 8 demographic and clinical practice questions. As part of their care to palliative cancer patients, physicians estimated the frequency that they assessed patient LE, discussed LE with patients, performed follow-up of patients after treatment completion, and learned when their patients had died. Physicians rated the importance of LE in clinical decision making (5-point scale, “not at all important” to “very important”), the importance of 18 patient-, tumor-, and treatment-related factors for LE assessment (5-point scale, “not at all important” to “very important”), and their confidence with estimating LE (5-point scale, “not at all confident” to “very confident”).

Physicians also reported whether they had received training in LE assessment and whether that training was adequate. Physicians were presented with 3 case scenarios of patients with advanced, incurable cancers seen in consultation for possible palliative radiation therapy (Table 1). Median LEs and 95% confidence intervals (CIs) of each case scenario were based on a validated prognostic model that was derived from a cohort of patients presenting for palliative radiation therapy consultation (11) (see Table 4). In each of these case scenarios, physicians were asked (1) whether they would recommend palliative radiation therapy; (2) their recommended dose-fractionation schedule (if applicable); (3) the patient’s estimated remaining LE (write-in); and (4) a threshold LE (if any) at which they would choose an alternate treatment recommendation. A LE estimate was considered accurate if it fell within the 95% CI of the predicted median survival (MS) using Chow’s number of risk factors prognostic model (11).

The questionnaire was written and initially critiqued by 3 investigators (Y.D.T., M.S.K., T.A.B.). A panel of physicians and researchers with training in medical oncology, radiation oncology, palliative care, survey construction, or a combination thereof piloted the survey sequentially to establish face and content validity, ease of completion, and completion time. After receiving each panel member’s comments, we revised the survey before sending it to the next member. We considered the survey validated when 2 consecutive panel members’ reviews did not alter the survey, which was achieved after 8 members.

Statistical analysis

Descriptive statistics were compiled as proportions, medians, and ranges for categorical variables and as means and standard deviations for continuous variables. Because of the lack of normally distributed data, physician LE estimates, threshold LE estimates, and number of years in practice were summarized using medians and ranges. *t* tests were used to compare continuous variables.

For each case scenario, we asked physicians whether they had a LE threshold below which they would choose an alternate treatment recommendation (see Table 3). For each case, physicians chose one of the following options: (1) their initial recommendation was the same as the alternate treatment recommendation; (2) they would never recommend the alternate treatment; or (3) provide the LE threshold below which they would recommend the alternate treatment. The proportion of physicians who had a LE threshold that would change their initial recommendation to a shorter radiation therapy regimen (cases 1 and 3) or no radiation therapy (case 2) was defined as the number of physicians who reported a LE

threshold (option 3) over the number of physicians whose initial recommendation differed from the alternate treatment suggested (options 2 and 3).

The total number of accurate LE estimates across the 3 cases was a physician's accuracy score (possible score of 0–3). To identify predictors of a high accuracy score, we constructed a stepwise log-linear regression model in both the forward and backward directions using the Akaike Information Criterion. The following covariates were included: gender, physician experience (resident, attending <13 years in practice, attending ≥13 years in practice), practice type (academic, nonacademic), reported length of palliative consultations, proportion of case-mix with palliative intent, whether the physician provided follow-up, how frequently a physician learned when his or her treated patient had died, and previous training in LE assessment. All analyses were conducted using R (version 2.15.2). *P* values <.05 were considered significant, and all tests were 2-sided.

Results

Respondent and clinical practice characteristics

Ninety-two responses were obtained from 113 eligible physicians (81%). The majority of respondents were male (62%) and attendings (70%) who worked at academic institutions (75% of attendings; Table 2). On average, physicians estimated that 29% of their patient consultations regarded the possible use of palliative-intent radiation therapy.

Estimating life expectancy: importance, frequency, factors considered, and confidence

The majority of physicians indicated that patient LE influenced their clinical decision making: 79% and 89% of physicians rated LE as either “very” or “moderately” important when recommending radiation therapy and prescribing a dose-fractionation schedule, respectively. LE estimates were frequently integrated into the evaluation of palliative patients; on average, physicians considered their patient's LE during 91% (SD 18%) of their evaluations and discussed prognosis with 68% (SD 29%) of their patients. Most physicians (65%) assessed patient LE in broad, quantitative categories (eg, <6 months, >6 months) rather than qualitative (eg, poor, good; 19%) or specific numerical estimates (10%). Only 1% did not think about LE, and 4% chose “other.”

Physicians most frequently rated performance status (92%), overall metastatic burden (90%), presence of CNS metastases (75%), and primary cancer site (73%) as “very important” when assessing a patient's LE. In contrast, laboratory values (4%) and prognostic models (7%) were the 2 least frequently rated “very important” factors (Fig. 1). Despite how frequently LE was considered and its impact on clinical decision making, only 2% of physicians felt “very confident” with estimating the LE of their palliative radiation therapy patients; most physicians felt “some-what confident” (53%) or less: “minimally confident” (33%), “somewhat not confident” (10%), “not at all confident” (2%).

Palliative radiation oncology case scenarios

Recommended treatment and dose-fractionation schedules for the 3 cases are summarized in Table 3. Most physicians had LE thresholds that guided treatment recommendations. Among

physicians who had not initially chosen a less aggressive palliative radiation therapy regimen or recommendation, 65 physicians (88%) in case 1 would switch to 5 fractions at a median LE threshold of 6 months (range, 1–12; Table 3). For case 2, 75 physicians (97%) would not offer whole-brain radiation therapy at a median LE of 1 month (range, 0.25–6). Lastly, for case 3, 53 of 57 (93%) who recommended >1 fraction of radiation therapy initially would treat with a single fraction (SF) at a median LE threshold of 6 months (range, 1–12).

Physician LE estimates were broadly distributed for each of the 3 cases (Fig. 2). Overall, their estimates were 22% accurate, with 11% under and 67% over the range predicted by the prognostic model (Table 4). Physicians most frequently overestimated LE in case 2 (98%). Five and 11 respondents had outlying LE estimates of 5 years for cases 1 and 3, respectively.

Methods of improving LE estimates

Twenty-two physicians (25%) received training in LE assessment, and 5 of those 22 (23%) perceived their training as adequate. The majority (80%) reported providing any follow-up to on average 47% (SD 31%) of palliative patients they had treated. Physicians estimated that they learned when their palliative patients had died just over half the time (53%, SD 31%). This estimate was significantly higher among physicians who provided any follow-up compared with those who did not (57% vs 36%; $P<.01$). The majority of physicians (89%) believed that participating in their palliative radiation therapy patients' follow-up would improve their ability to estimate LE. Lastly, stepwise construction of the log-linear model for predictors of a high LE accuracy score yielded the following nonsignificant covariates in the final model: male gender (relative risk 1.51; 95% CI 0.84–2.71; $P=.17$) and providing follow-up (relative risk 1.76; 95% CI 0.79–3.89; $P=.16$).

Discussion

Our survey-based study sheds light on how radiation oncologists evaluate and incorporate LE into the treatment of palliative cancer patients; although radiation oncologists frequently consider patient LE as part of their evaluation and regard LE estimates as a critical component of clinical decision making, physicians are frequently inaccurate in their LE estimations. These results help explain previous observations that radiation therapy is not always appropriately tailored to palliative cancer patient illness trajectories (8) and suggest that LE assessment is an area for quality improvement in palliative cancer care, in accordance with national guidelines (10).

Most physicians were “somewhat” confident or less in their ability to estimate LE. This lack of confidence may in part elucidate why radiation oncologists are less likely to engage in end-of-life (EOL) discussions with their cancer patients (12, 13). Interestingly, 68% of respondents reported discussion of prognosis with their palliative oncology patients, which is higher than prior patient-reported studies (14). This discrepancy may be related to social desirability bias but could also indicate that radiation oncologists' lack of confidence in their prognostic estimates renders their communication too vague to adequately convey prognostic information and/or that they lack sufficient training in EOL communication. This

unfortunately may delay EOL care including palliative care consultation, which has been associated with improved patient-reported quality of life (15) and decreased aggressive EOL care and hospital-associated costs (16).

Our results confirm those of previous studies suggesting that physicians inaccurately estimate LE (5, 8). LE estimates for the 3 hypothetical cases were 22% accurate overall with 67% over the range predicted by a validated prognostic model. In a study by Gripp et al, 3 entities categorized survival estimates (<1, 1–6, >6 months) of patients referred for palliative radiation therapy. They reported higher accuracy rates (55%–63%), although this in part may be secondary to categorization of patients into relatively broad prognostic groups (6). Notably, however, prognosis was still overestimated in 71% to 96% of patients with a short survival (<1 month). This is similar to our observation that 98% of physicians overestimated the LE of a newly diagnosed lung cancer patient with poor performance status and visceral metastases (case 2: predicted MS 2.25 months).

Our accuracy rates are more consistent with studies in which physicians provided a numerical LE estimate instead of a range. In a study of 343 physicians estimating LE for 468 terminally ill patients at the time of hospice referral, 20% of predictions were accurate, and 63% were overoptimistic (4). An estimate was considered accurate if the ratio of the observed to predicted survival was between 0.67 and 1.33. Despite different definitions and methods of assessing accuracy (ie, hypothetical vs real cases), these and our study highlight that physicians inaccurately estimate LE and often overestimate survival, in particular among patients with shorter LE.

These findings are notable because physicians have LE thresholds that guide treatment recommendations. Across the 3 cases, 88% or more of physicians would alter their recommendation if the patient had a shorter LE than their threshold. Because radiation oncologists generally use long-course radiation therapy for patients in whom they want to maximize durability, recommendations based on LE overestimates may yield longer treatment courses for patients with short life spans. This not only has an impact on patients through needlessly prolonged palliative radiation therapy courses but also contributes to overutilization of resources (17). In some cases, such as the treatment of uncomplicated bone metastases (case 3), patient LE arguably should not influence dose-fractionation prescription. National guidelines (18) and multiple randomized trials (19, 20) have demonstrated equivalent efficacy with short- versus long-course radiation therapy. Despite this, only 34% of respondents initially recommended SF treatment. Although low, this proportion is higher than that observed in other US patterns-of-care studies (3, 21), and notably, almost all remaining physicians would consider SF at a median LE threshold of 6 months. Therefore, although the data suggest otherwise, physicians incorporate LE into the treatment of uncomplicated osseous disease. This limitation of SF to patients with short LE may reflect concern regarding greater retreatment rates among these patients (20).

Unfortunately, little is currently known regarding how to improve accuracy of LE assessments. In our multivariable model predicting accuracy score, only gender and provision of follow-up were included in the final model, and neither was significant. At the same time, training in LE assessment did not predict a high accuracy score within our

cohort. Only a minority of radiation oncologists were formally trained in LE assessment (25%), and even fewer indicated that they had received adequate training (6%). Hence, this study is likely insufficiently powered to assess the potential utility of LE assessment training. Given the recent emergence of data in LE assessment among cancer patients receiving palliative radiation therapy (11, 22), there is a growing evidence base that can be drawn on to guide training. Additional study is required to determine whether training would improve accuracy of predictions and the quality of palliative cancer care.

Although not significant in the multivariable model, provision of follow-up after palliative radiation therapy demonstrated a trend toward improved accuracy. Interestingly, the majority of respondents felt that providing follow-up would improve their ability to estimate LE, and respondents who provided follow-up learned more frequently when a treated patient died. Although these results require additional study, they suggest that physicians may learn from real-time feedback. This is congruent with findings that sequential rather than a single educational intervention provides a learn-work-learn opportunity in which physicians can translate newly learned information into practice and have it reinforced at another session (23). Lastly, physician years of experience was not a final covariate in our multivariable model, a finding that is consistent with previous studies (6).

Physicians in our study possess many of the tools to estimate LE accurately. Performance status, primary cancer type, and overall metastatic burden were the most frequently selected “very important” factors in assessing LE, and each of these factors has been shown to correlate with duration of survival (5, 6, 24). Despite this, however, physicians do not appear to integrate this information correctly into their LE assessments. Prognostic models are designed to simplify this process by weighing the most important factors and providing quantitative estimates of how these factors impact patient LE. Prognostic models developed and validated among advanced or metastatic cancer patients receiving palliative care (25) or seriously ill hospitalized adults (26) are as accurate or more accurate than physician estimates. Furthermore, combining the prognostic model with physician estimates improves predictive accuracy (26), suggesting that the 2 methods may be complementary. However, in our study only 31% of physicians rated prognostic models as “very” or “moderately important” for LE assessment. This finding suggests that prognostic models may be underutilized.

Our study has several strengths. Our survey underwent rigorous content and face validation among a group of physicians and survey researchers with experience in palliative care, radiation oncology, medical oncology, and survey development. Furthermore, our response rate was high (81%), and physician respondents had a wide range of clinical experience, from residents-in-training to attendings in their 35th year of practice. Lastly, this study comprehensively assesses how LE is incorporated into clinical decision making within palliative radiation oncology care, which to our knowledge has not been investigated previously.

Limitations to this study include that physicians may inaccurately report their palliative oncology clinical practice (ie, recall and/or response bias). Furthermore, because our survey is drawn from radiation oncologists working at radiation oncology facilities in the Boston

area, our results may not be generalizable to US radiation oncologists. Indeed, 75% of our respondents worked at an academic center and included a higher proportion of women than the national average (27). However, other clinical practice characteristics, such as the proportion who work full versus part time and the proportion of case mix with palliative intent, were similar to those reported in the 2003 American College of Radiology's survey of radiation oncologists (27).

Finally, accuracy of LE estimates was not based on actual patients seen by clinicians but on commonly encountered, hypothetical cases with use of the validated Chow prognostic model (11) to determine accuracy. The accuracy of the Chow prognostic model for actual patient survival has been compared with neither those of physician estimates nor other prognostic models. However there are few, if any, additional prognostic models validated among palliative cancer patients presenting for radiation therapy. Most, if not all other prognostic models are limited to patients with particular symptoms (eg, spinal bone or brain metastases) (24, 28) or a disease site (29).

Conclusion

Radiation oncologists frequently incorporate LE estimates into palliative cancer care and identify important prognostic factors. However, radiation oncologists inaccurately estimate LE and have a tendency to overestimate patient survival times. Prognostic accuracy is important because most radiation oncologists have LE thresholds that guide their palliative radiation therapy treatment recommendations. Therefore, additional research on how to improve LE assessment is needed, including the impact of formal training, prognostic models, or both on the accuracy of LE estimates and by extension, on appropriately tailoring palliative radiation therapy to patients' illness trajectories.

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Summary

We surveyed how radiation oncologists within the Boston area within the Boston area evaluate and incorporate life expectancy (LE) estimates into clinical decision making. Although physicians frequently think about a patient's LE and have LE thresholds that guide treatment recommendations, physicians' LE estimates are largely inaccurate. Studies investigating how to improve LE assessment are needed.

Fig. 1.

Stacked bar chart of physician ratings on the importance of 18 patient-, tumor-, and treatment-related factors when assessing a palliative cancer patient's life expectancy. CA = cancer; Chemo = chemotherapy; CNS = central nervous system; Met = metastasis; RT = radiation therapy.

Fig. 2.

Histogram of physician life expectancy life estimates for each of the 3 cases. Black histogram bars represent physician estimates within the predicted 95% confidence interval (CI) based on the Chow prognostic model (11), whereas the black horizontal bars demonstrate the 95% CI range. The histogram bin width is 1 month. If the values within the bin do not fall within the predicted 95% CI, the bin will not be colored black even if it appears to lie within the horizontal black bar (eg, physician estimated 9 months but 95% CI is 9.25–17.5 months). Note that an outlier for case 3 (180 months) is not shown in the histogram given its effect on scaling.

Table 1

Hypothetical case scenarios

Case	Question stem
1	A 65-year-old, formerly healthy man was diagnosed last year with metastatic prostate cancer to bone. He has progressed despite systemic treatment with bicalutamide and docetaxel and now presents with 2 weeks of mid back pain and 1 week of mild bilateral lower extremity weakness and paresthesias. He remains ambulatory, and there are NO bowel/bladder symptoms (eg, incontinence). He is admitted, and MRI of the spine reveals epidural disease from T6–T10 causing cord compression. Metastatic disease remains confined to the bones. He is not deemed a surgical candidate by neurosurgery. He was started on dexamethasone. ECOG performance status is 1.
2	A 75-year-old woman with a long-standing smoking history presented with slowly progressive dyspnea and was diagnosed with non-small cell lung cancer. Staging workup revealed bone and liver metastases, as well as multiple (>10), subcentimeter brain metastases. She is asymptomatic from her brain metastases. She has not yet received chemotherapy and tested negative for ALK rearrangement and EGFR mutations. She is referred to you as an outpatient by her medical oncologist for consideration of whole brain radiotherapy before initiating chemotherapy. ECOG performance status is 2.
3	A 58-year-old woman was diagnosed with T2N0 ER+/PR+/Her2–breast cancer 5 years ago and underwent breast-conserving therapy and chemotherapy. Three years later, she developed metastatic recurrence in her bones. Despite multiple chemotherapy regimens, her osseous disease has progressed. She does not have disease elsewhere. She now presents with 8/10 pain in her left arm despite optimization of her pain regimen. On imaging, she is noted to have a left distal humeral lytic lesion with NO evidence of impending fracture. She is evaluated by orthopedics, who does not recommend stabilization. She sees you as an outpatient. ECOG performance status is 1.

Abbreviations: ALK = anaplastic lymphoma kinase; ECOG = Eastern Cooperative Oncology Group; EGFR = epidermal growth factor receptor; MRI = magnetic resonance imaging.

Table 2

Respondent demographic and clinical practice characteristics

Characteristic	N=92
Demographic characteristics, n (%) [*]	
Male	56 (62%)
Female	34 (38%)
Attending	64 (70%)
Resident	28 (30%)
Years postcompletion of clinical training, median (range)	13 (0–35)
Clinical practice characteristics, n (%) [*]	
Among attending physicians only (n=64)	
Academic practice type	47 (75%)
Hybrid practice type [†]	16 (25%)
Workload	
Full time clinical	50 (79%)
Full time research	9 (14%)
Part time	4 (6%)
Among attending physicians and residents (n=92)	
Consultations with palliative intent	
Mean proportion of patient consultations, percent (SD)	29% (19%)
Mean proportion seen in an inpatient setting, percent (SD)	34% (29%)
Mean palliative consultation time, minutes (SD) [‡]	71 minutes (34) [§]

^{*} Missing responses: gender (n=2), years in practice (n=7), practice type (n=1), workload (n=1).

[†] Community practice affiliated with an academic center.

[‡] Not including simulation or treatment planning.

[§] Not significantly different from mean curative consultation time (71 vs 79 minutes; $P=.16$).

Table 3

Clinical case scenarios and treatment recommendations

	Cases		
	1. Prostate cancer with spinal cord compression	2. NSCLC with asymptomatic brain metastases	3. Breast cancer with uncomplicated bone metastasis
RT recommended	91/91 (100%)	77/89 (87%)	89/89 (100%)
Dose and fractionation recommended (if applicable)			
Median dose/fractions (dose range, Gy)	30 Gy/10 fx (8–37.5)	30 Gy/10 fx (20–37.5)	20 Gy/5 fx (7–45)
5 fx used	16/91 (17%)	7/89 (8%)	56/89 (63%)
SF used	2/91 (2%)	0/89 (0%)	30/89 (34%)
Shorter LE would alter recommendation	65/74 (88%)	75/77 (97%)	53/57 (93%)
Alternative treatment	Use 5 fx	No whole-brain RT	Use SF
Median LE threshold, months (range)	6 (1–12)	1 (0.25–6)	6 (1–12)
Median estimated LE, months (range)	12 (4–60)	6 (1–36)	24 (1–180)

Abbreviations: fx = fraction; NSCLC = non-small cell lung cancer; RT = radiation therapy; SF = single fraction.

Table 4

Proportion of physicians with accurate, overestimated, and underestimated LE estimates based on the predicted ranges (95% confidence interval) of survival times from the Chow prognostic model (11)

	Case 1 n=90	Case 2 n=89	Case 3 n=89	Overall
Physician-estimated LE				
Median estimated LE (mo)	12	6	24	
Range (mo)	4–60	1–36	1–180	
Predicted LE based on Chow model (11)				
Median survival (mo)	15	2.25	15	
95% CI (mo)	9.25–17.5	1.5–2.75	9.25–17.5	
Accuracy *	40%	1%	26%	22%
Proportion overestimated *	38%	98%	64%	67%
Proportion underestimated *	22%	1%	10%	11%

Abbreviations: CI = confidence interval; LE = life expectancy; mo = months.

* Accuracy defined as the physician-estimated LE being within the 95% CI of the predicted LE based on the Chow et al (11) number of risk factors prognostic model. Overestimation and underestimation of LE defined as the physician-predicted LE being above or below, respectively, the predicted 95% CI.