

Futility of Lung Cancer Treatments (in the elderly)

And What Actuaries Can Do About it

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Topics

- **Background**

- National statistics

- NSCLC treatment studies

 - ❖ Early stage (LACE by Age, JBR.10)

 - ❖ Advanced stage (including brain metastases)

- What can actuaries do?

- Conclusion

Helpful Definitions

- Lung cancer stages
 - ❖ Early stages: IA, IB, IIA, IIB, IIIA
 - ❖ Advanced stages: IIIB, IV
- Prospective & retrospective studies
- Study trial phases: 1, 2, 3, 4
- Small cell lung cancer (SCLC) vs. non-small-cell lung cancer (NSCLC)

Lung Cancer Screening

- US Preventive Services Task Force (USPSTF):
 - ❖ Before Dec. 2013: No for all ages, because
 - ◆ Doesn't improve mortality
 - ◆ Treatments damage quality of life
 - ❖ Dec. 2013: Annually screen high-risk persons
 - ◆ Ages 55-80; and
 - ◆ 30 pack-years current smoker, or
 - ◆ 30 pack-years quit \leq 15 years before

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Lung Cancer Occurrences & Deaths from Lung Cancer by Age

US Census 2000 Population* Multiplied by SEER 1975-2007** Study's Incidence Rates (combines Non-Small-Cell & Small-Cell Lung Cancer)

Age Range	Total Population					White Female				
	(A) US 2000 Population*	Diagnosed with Lung Cancer		Deaths from Lung Cancer		(A) US 2000 Population***	Diagnosed with Lung Cancer		Deaths from Lung Cancer	
		(B) Cancer Rates**note a	(C) = AxB Cases	(D) Death Rates**note b	(E) = AxD Cases		(B) Cancer Rates**note a	(C) = AxB Cases	(D) Death Rates**note b	(E) = AxD Cases
< 01	3,794,901	0.0	-	0.0	-	6,262,128	0.0	-	0.0	-
01-04	15,191,619	0.0	-	0.0	-	6,785,226	0.0	-	0.0	-
05-09	19,919,840	0.0	-	0.0	-	6,960,988	0.0	-	0.0	-
10-14	20,056,779	0.0	-	0.0	-	6,879,090	0.0	-	0.0	-
15-19	19,819,518	0.1	20	0.0	-	6,388,969	0.4	26	0.1	6
20-24	18,257,225	0.3	55	0.1	18	6,655,571	0.6	40	0.2	13
25-29	17,722,067	0.6	106	0.2	35	7,328,058	1.3	95	0.5	37
30-34	19,511,370	1.2	234	0.5	98	8,487,223	3.3	280	2.1	178
35-39	22,179,956	3.2	710	2.1	466	8,634,083	9.9	855	7.4	639
40-44	22,479,229	9.9	2,225	7.9	1,776	7,955,003	25.0	1,989	17.6	1,400
45-49	19,805,793	25.3	5,011	20.2	4,001	7,190,359	43.4	3,121	31.3	2,251
50-54	17,224,359	49.9	8,595	39.8	6,855	5,691,567	82.9	4,718	59.3	3,375
55-59	13,307,234	93.4	12,429	74.7	9,941	4,653,172	155.6	7,240	113.7	5,291
60-64	10,654,272	172.4	18,368	139.8	14,895	4,286,302	249.9	10,711	177.3	7,600
65-69	9,409,940	275.5	25,924	220.9	20,787	4,240,992	330.6	14,021	243.3	10,318
70-74	8,725,574	371.4	32,407	304.3	26,552	3,833,722	371.9	14,258	287.1	11,007
75-79	7,414,559	436.0	32,327	369.5	27,397	2,764,852	341.9	9,453	288.0	7,963
80-84	4,900,234	415.6	20,365	379.4	18,591	2,690,127	236.6	6,365	228.9	6,158
85+	4,259,173	299.6	12,760	300.4	12,795					
Grand Total	274,633,642		171,536		144,207	107,687,432		73,172		56,236

Average (Mean) Age note c	70.6	71.3	71.4	72.3
Life Expectancy (in years) note d		0.7		0.9
Life Expectancy (in months; = Years x 12)		8.4		10.8
Median Age Range	70-74	70-74	70-74	70-74

SEER - NSC Cancer of the Lung & Bronchus

Historical Survival

5-Year Relative and Period % Survival by Race, Sex, Diagnosis Year, Age and Stage at Diagnosis

Year of Diagnosis	All Races			Whites			Blacks		
	Both	Males	Females	Both	Males	Females	Both	Males	Females
1975-1977 ^a	14.2%	12.8%	18.0%	14.4%	12.9%	18.1%	12.6%	11.5%	16.3%
1978-1980 ^a	15.0%	13.4%	18.8%	15.2%	13.6%	18.9%	13.2%	10.9%	20.0%
1981-1983 ^a	15.5%	13.6%	19.5%	15.9%	13.9%	19.9%	12.6%	11.3%	16.1%
1984-1986 ^a	15.2%	13.2%	18.8%	15.5%	13.4%	19.3%	12.6%	11.8%	14.6%
1987-1989 ^a	15.3%	14.0%	17.6%	15.7%	14.2%	18.2%	12.3%	12.0%	12.7%
1990-1992 ^a	15.8%	13.9%	18.6%	16.3%	14.5%	19.0%	11.6%	10.1%	14.4%
1993-1995 ^a	16.5%	14.3%	19.5%	16.9%	14.6%	20.0%	14.0%	12.4%	16.8%
1996-1998 ^b	16.9%	14.8%	19.5%	17.2%	15.0%	19.9%	13.8%	11.9%	16.8%
1999-2006 ^a	18.2% ^d	15.6% ^d	21.2% ^d	18.8% ^d	16.1% ^d	21.7% ^d	14.1% ^d	12.4%	16.4%

SEER - NSC Cancer of the Lung & Bronchus at Diagnosis – **Stage Distribution**

Stage Distribution (%) 1999-2006 ^c , Case Counts and Percentages									
Stage at	All Races			Whites			Blacks		
Diagnosis	Both Sexes	Males	Females	Both Sexes	Males	Females	Both Sexes	Males	Females
Number of cases	227,406	124,192	103,214	188,126	101,120	87,006	24,436	14,297	10,139
Percent	100%	100%	100%	100%	100%	100%	100%	100%	100%
Localized	16%	15%	18%	17%	15%	19%	13%	12%	15%
Regional	22%	23%	22%	22%	23%	22%	22%	23%	22%
Distant	54%	55%	52%	52%	54%	51%	59%	60%	57%
Unstaged	8%	8%	8%	8%	8%	9%	6%	6%	6%

- Localized = Stages IA and IB
- Regional = Stages IIA, IIB, and IIIA
- Distant = Stages IIIB and IV

SEER - NSC Cancer of the Lung & Bronchus – 5-Year Survival by Age

5-Year Relative Survival (Percent) 1999-2006^c by Age at Diagnosis

Age at Diagnosis	All Races			Whites			Blacks		
	Both	Males	Females	Both	Males	Females	Both	Males	Females
Ages <45	26.2%	24.3%	28.1%	28.6%	26.9%	30.2%	17.8%	15.8%	20.0%
Ages 45-54	20.5%	16.5%	25.6%	21.8%	17.2%	27.3%	14.9%	12.9%	17.7%
Ages 55-64	19.9%	16.9%	24.1%	20.7%	17.5%	24.9%	14.9%	12.9%	18.2%
Ages 65-74	17.5%	14.7%	21.0%	17.9%	15.0%	21.3%	13.0%	11.4%	15.1%
Ages 75+	12.3%	10.7%	13.8%	12.7%	11.0%	14.2%	9.3%	8.5%	10.1%
Ages <65	20.6%	17.3%	24.9%	21.6%	18.0%	26.0%	15.1%	13.1%	18.2%
Ages 65+	15.2%	13.1%	17.6%	15.5%	13.3%	17.9%	11.6%	10.4%	13.0%

SEER - NSC Cancer of the Lung & Bronchus –

5-Year Survival by Stage

Stage at Diagnosis	All Races			Whites			Blacks		
	Both Sexes	Males	Females	Both Sexes	Males	Females	Both Sexes	Males	Females
All Stages	17.4%	14.8%	20.3%	17.8%	15.2%	20.8%	13.5%	12.0%	15.7%
Localized	54.5%	49.5%	59.2%	55.2%	50.2%	59.7%	46.6%	42.5%	50.9%
Regional	25.7%	23.1%	28.9%	25.9%	23.2%	29.1%	22.0%	20.7%	23.9%
Distant	3.7%	3.1%	4.5%	3.6%	3.0%	4.4%	3.3%	2.9%	3.7%
Unstaged	8.8%	7.8%	9.8%	8.4%	7.3%	9.5%	10.8%	10.1%	11.8%

Estimated New Cancer Cases and Deaths by Sex, US, 2012*

	Estimated New Cases			Estimated Deaths		
	Both Sexes	Male	Female	Both Sexes	Male	Female
All Sites	1,638,910	848,170	790,740	577,190	301,820	275,370
Oral cavity & pharynx	40,250	28,540	11,710	7,850	5,440	2,410
Tongue	12,770	9,040	3,730	2,050	1,360	690
Mouth	11,620	7,030	4,590	1,790	1,070	720
Pharynx	13,510	10,790	2,720	2,330	1,730	600
Other oral cavity	2,350	1,680	670	1,680	1,280	400
Digestive system	284,680	156,760	127,920	142,510	80,560	61,950
Esophagus	17,460	13,950	3,510	15,070	12,040	3,030
Stomach	21,320	13,020	8,300	10,540	6,190	4,350
Small intestine	8,070	4,380	3,690	1,150	610	540
Colon [†]	103,170	49,920	53,250	51,690	26,470	25,220
Rectum	40,290	23,500	16,790			
Anus, anal canal, & anorectum	6,230	2,250	3,980	780	300	480
Liver & intrahepatic bile duct	28,720	21,370	7,350	20,550	13,980	6,570
Gallbladder & other biliary	9,810	4,480	5,330	3,200	1,240	1,960
Pancreas	43,920	22,090	21,830	37,390	18,850	18,540
Other digestive organs	5,690	1,800	3,890	2,140	880	1,260
Respiratory system	244,180	130,270	113,910	164,770	91,110	73,660
Larynx	12,360	9,840	2,520	3,650	2,880	770
Lung & bronchus	226,160	116,470	109,690	160,340	87,750	72,590
Other respiratory organs	5,660	3,960	1,700	780	480	300
Bones & joints	2,890	1,600	1,290	1,410	790	620
Soft tissue (including heart)	11,280	6,110	5,170	3,900	2,050	1,850
Skin (excluding basal & squamous)	81,240	46,890	34,350	12,190	8,210	3,980
Melanoma-skin	76,250	44,250	32,000	9,180	6,060	3,120
Other nonepithelial skin	4,990	2,640	2,350	3,010	2,150	860
Breast	229,060	2,190	226,870	39,920	410	39,510
Genital system	340,650	251,900	88,750	58,360	28,840	29,520
Uterine cervix	12,170		12,170	4,220		4,220
Uterine corpus	47,130		47,130	8,010		8,010
Ovary	22,280		22,280	15,500		15,500
Vulva	4,490		4,490	950		950
Vagina & other genital, female	2,680		2,680	840		840
Prostate	241,740	241,740		28,170	28,170	
Testis	8,590	8,590		360	360	
Penis & other genital, male	1,570	1,570		310	310	
Urinary system	141,140	97,610	43,530	29,330	19,670	9,660
Urinary bladder	73,510	55,600	17,910	14,880	10,510	4,370
Kidney & renal pelvis	64,770	40,250	24,520	13,570	8,650	4,920
Ureter & other urinary organs	2,860	1,760	1,100	880	510	370
Eye & orbit	2,610	1,310	1,300	270	120	150
Brain & other nervous system	22,910	12,630	10,280	13,700	7,720	5,980
Endocrine system	58,980	14,600	44,380	2,700	1,240	1,460
Thyroid	56,460	13,250	43,210	1,780	780	1,000
Other endocrine	2,520	1,350	1,170	920	460	460
Lymphoma	79,190	43,120	36,070	20,130	10,990	9,140
Hodgkin lymphoma	9,060	4,960	4,100	1,190	670	520
Non-Hodgkin lymphoma	70,130	38,160	31,970	18,940	10,320	8,620
Myeloma	21,700	12,190	9,510	10,710	6,020	4,690
Leukemia	47,150	26,830	20,320	23,540	13,500	10,040
Acute lymphocytic leukemia	6,050	3,450	2,600	1,440	820	620
Chronic lymphocytic leukemia	16,060	9,490	6,570	4,580	2,730	1,850
Acute myeloid leukemia	13,780	7,350	6,430	10,200	5,790	4,410
Chronic myeloid leukemia	5,430	3,210	2,220	610	370	240
Other leukemia [‡]	5,830	3,330	2,500	6,710	3,790	2,920
Other & unspecified primary sites [§]	31,000	15,620	15,380	45,900	25,150	20,750

*Rounded to the nearest 10; estimated new cases exclude basal and squamous cell skin cancers and in situ carcinomas except urinary bladder. About 63,300 carcinoma in situ of the female breast and 55,560 melanoma in situ will be newly diagnosed in 2012. †Estimated deaths for colon and rectal cancers are combined. ‡More deaths than cases may reflect lack of specificity in recording underlying cause of death on death certificates or an undercount in the case estimate.

Source: Estimated new cases are based on 1995-2008 incidence rates from 47 states and the District of Columbia as reported by the North American Association of Central Cancer Registries (NAACCR), representing about 95% of the US population. Estimated deaths are based on US Mortality Data, 1994 to 2008, National Center for Health Statistics, Centers for Disease Control and Prevention.

Cancer Cost Projections

Source: National Cancer Institute, costprojections.cancer.gov

Cost in US 2010 Billions			
Cancer Type	2010	2020 Projection	
	Base	Low	High
Breast	\$16.50	\$18.91	\$20.69
Colorectal	\$14.14	\$14.35	\$17.83
Lung	\$12.12	\$12.14	\$15.23
Lymphoma	\$12.14	\$15.00	\$15.71
Prostate	\$11.85	\$15.32	\$16.43
Leukemia	\$5.44	\$6.66	\$7.24
Ovary	\$5.12	\$4.49	\$6.27
Brain	\$4.47	\$5.38	\$5.79
Bladder	\$3.98	\$4.41	\$4.98
Kidney	\$3.80	\$6.07	\$5.30
Head/Neck	\$3.64	\$3.79	\$4.40
Uterus	\$2.62	\$2.84	\$3.04
Melanoma	\$2.36	\$3.76	\$3.18
Pancreas	\$2.27	\$2.81	\$3.16
Stomach	\$1.82	\$1.81	\$2.40
Cervix	\$1.55	\$1.20	\$1.55
Esophagus	\$1.33	\$1.70	\$2.04
All sites	\$124.57	\$147.57	\$165.21

My Mother's vs. National Costs

TABLE 2
Nancy Wolf's Medical Bills

Medical Service	Billed	Paid
Lung surgery & hospitalization	\$78,832	\$25,109
Chemotherapy	\$98,286	\$50,725
Radiation treatment	\$78,015	\$10,491
X-ray, CT, Pet, MRI scans	\$120,710	\$24,280
Home health aides	\$7,989	\$7,879
Hospice	\$27,445	\$16,201
Prescription drugs	\$32,872	\$25,034
Miscellaneous medical services	\$21,992	\$17,716
Total	\$466,141	\$177,435

National Costs (2012)

- ♦ \$12.1 billion ÷ 160,000 deaths ~ \$75,000 or
- ♦ \$12.1 billion ÷ 80,000 deaths ~ \$150,000

National Statistics - **Issues**

- Doesn't provide multi-parameter correlations
- Doesn't separate treated vs. untreated
- No data by type of treatment

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- National statistics
- **NSCLC treatment studies**
 - ❖ Early stage (LACE by Age, JBR.10)
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Observations about NSCLC Chemotherapy Studies

- Prospective studies
- Number studied often small
- Median age
- Elderly
- Female % studied
- Early vs. advanced stage survival rates
- Not reproducible (e.g., early stage, placebo median survivor months were BLT (33), ALPI (48), ANITA (44), and JBR.10 (73))
- Time span relatively short (median typically 5-years)

Early Stage Study

LACE by Age

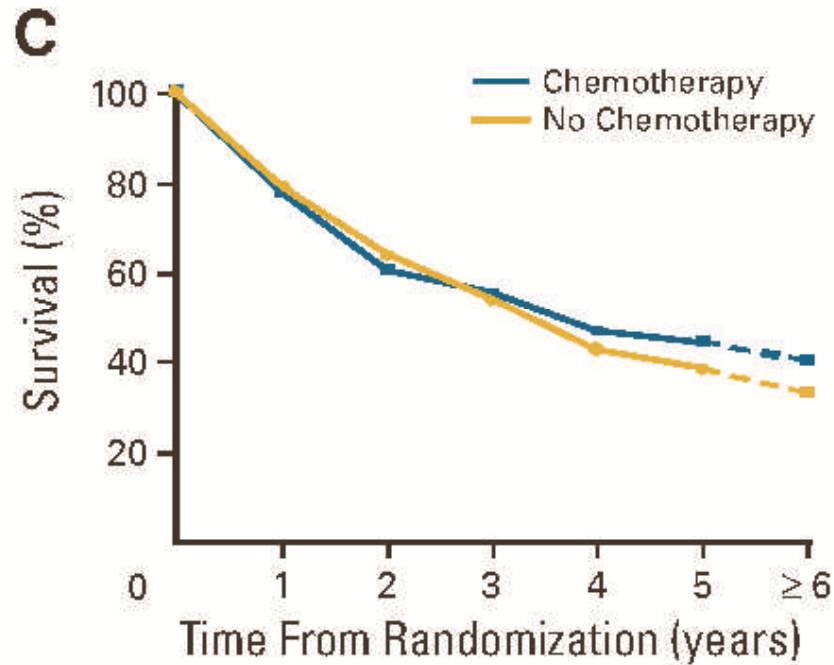
- Combined major cisplatin+ combination chemotherapy studies
- Provided results by age (<65, 65-69, 70+)
- Source: Früh, et al, 2008, *Journal of Clinical Oncology (JCO)*, 28:21, 3573-3581

LACE by Age – Issues

- 9% age 70+
- 20% females
- 78 females age 70+ of 4,600 in LACE study
- Stage I patients – chemotherapy does not help
- Highly toxic (50%+ severe or disabling toxicity; ~1%-3% died from chemotherapy)

LACE by Age

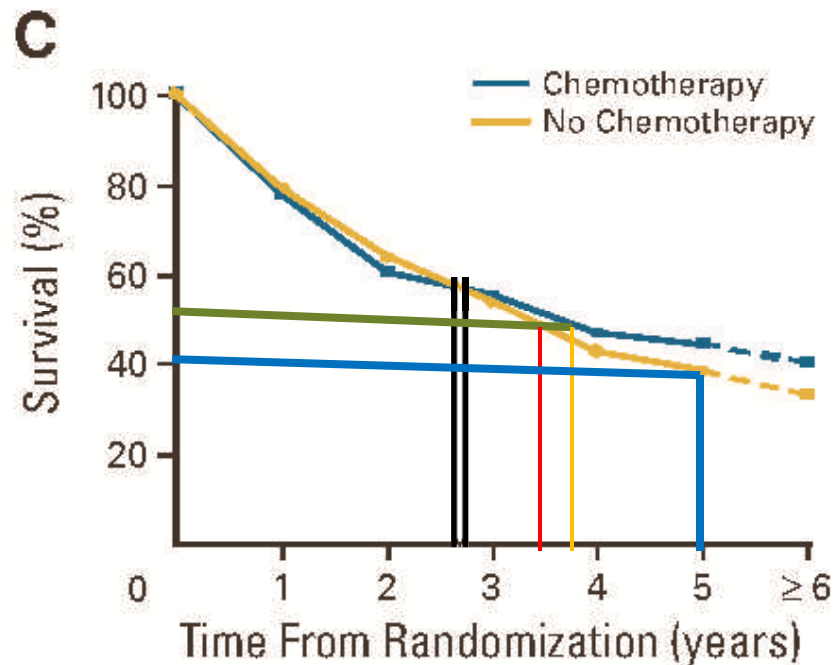
Survival Age \geq Age 70



Deaths/person by period	Years 0-3	Years 4-5	Years ≥ 6
Control	94 / 436	25 / 131	8 / 51
Chemotherapy	92 / 438	19 / 158	7 / 71

LACE by Age

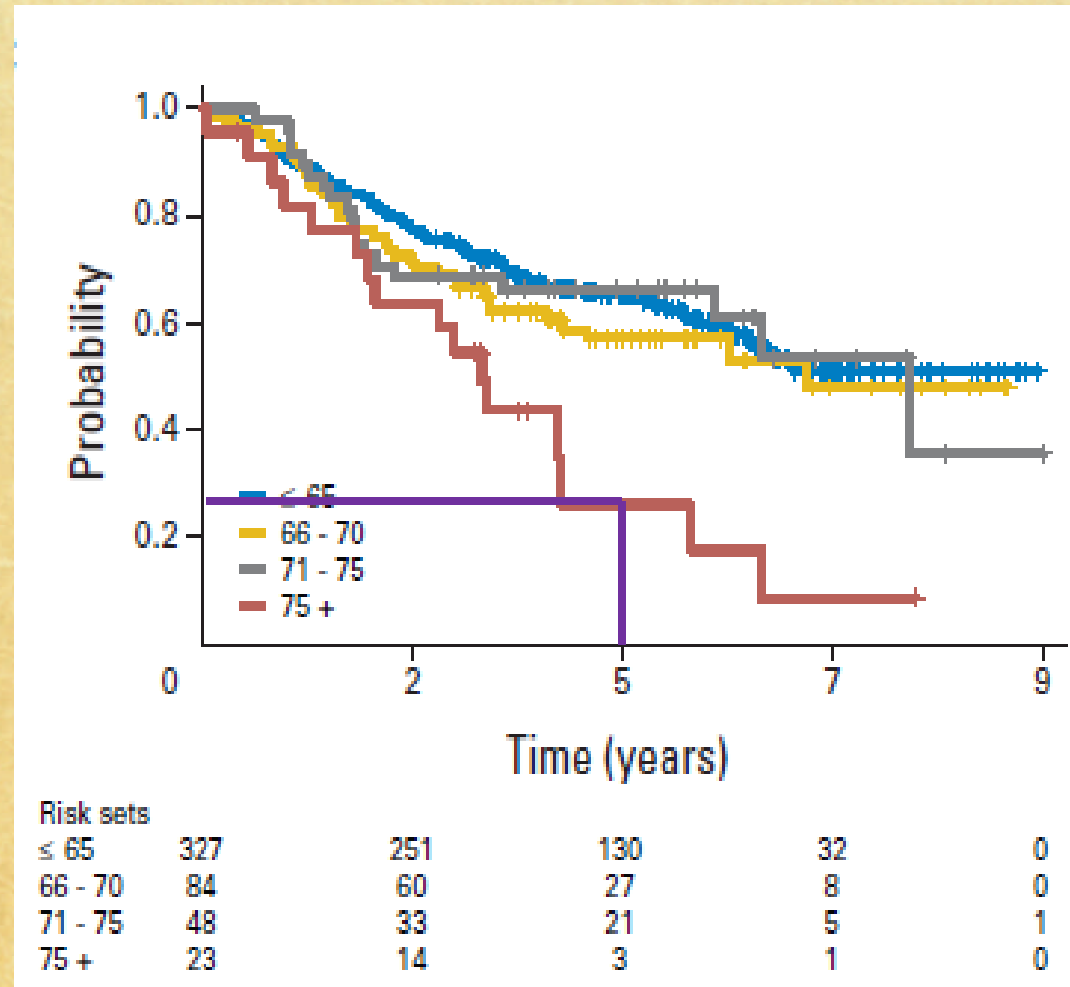
Survival Age \geq Age 70



Deaths/person by period	Years 0-3	Years 4-5	Years \geq 6
Control	94 / 436	25 / 131	8 / 51
Chemotherapy	92 / 438	19 / 158	7 / 71

Canadian Study: JBR.10 by Age

Source: Pepe, et al; April 2007, JCO, 25:12, 1553-1561, figure 1C



Advanced Stage – Carboplatin/Alimta Survival

Source: **Gervais, et al, Phase II study, Lung, 80(2013), 185-190**

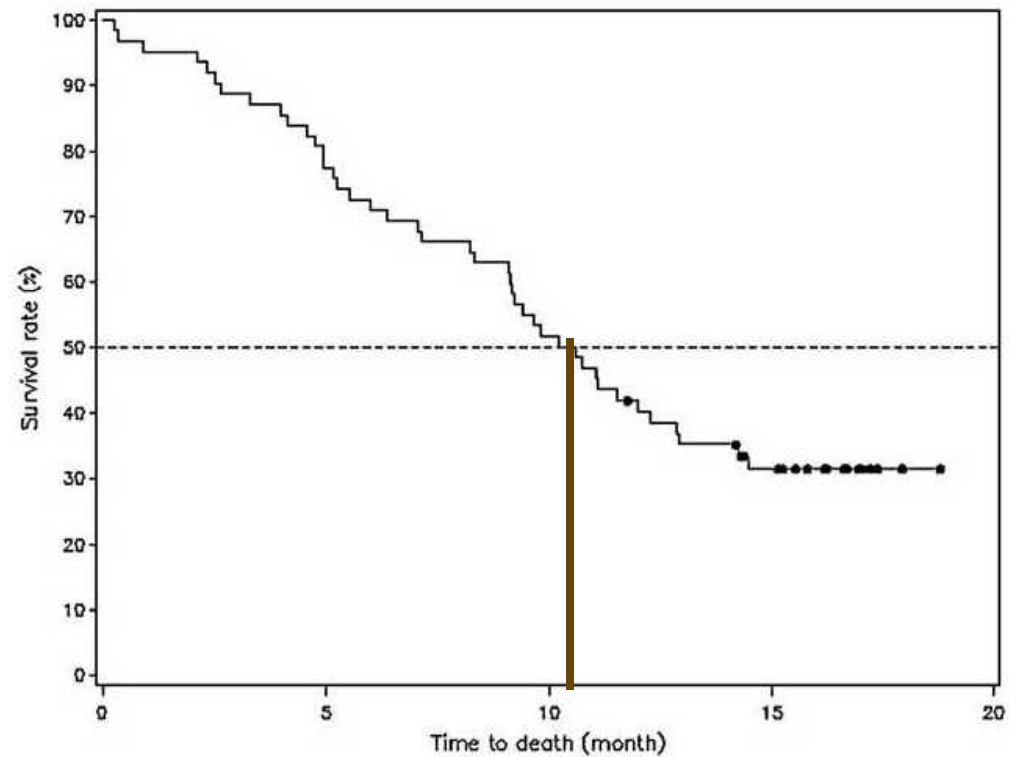


Fig. 3. Overall survival – Kaplan–Meier curve – all treated patients (n = 62-ITT).

Brain Metastases - Prognostic Scores

Recursive Partitioning Analysis (RPA)

Source: Nieder, et al, *Jour Thoracic Oncology*, 4:11, 2009, 1337-1341

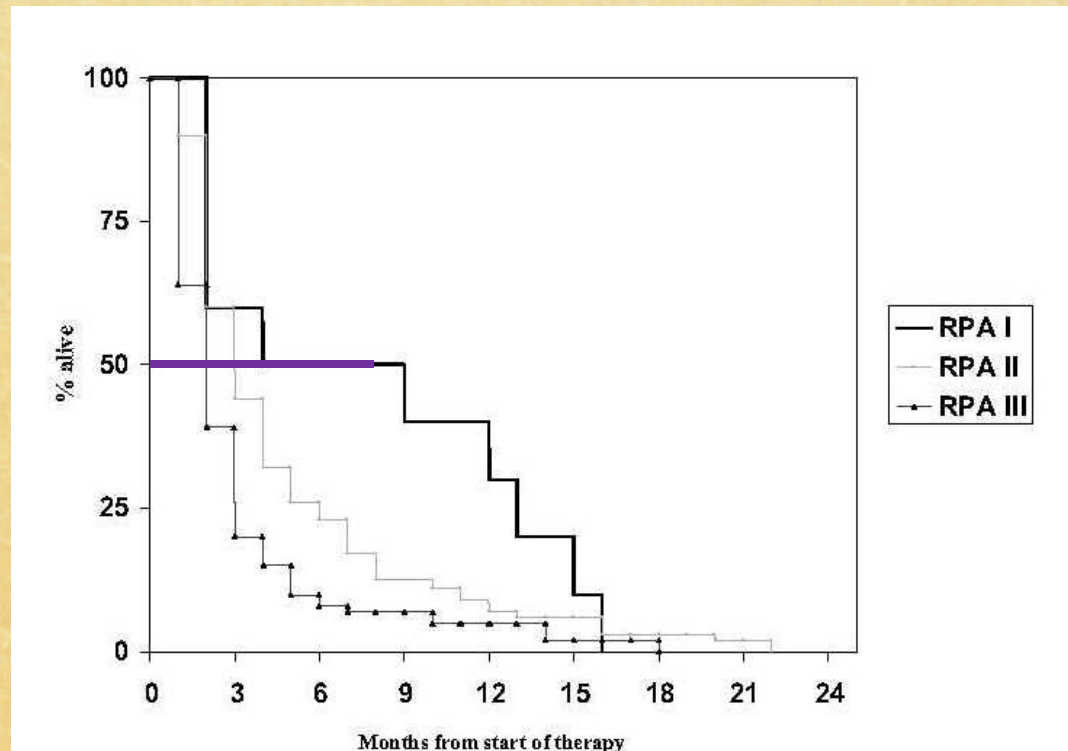


FIGURE 1. Actuarial survival curves according to the recursive partitioning analysis (RPA) score ($p < 0.05$), $n = 10$ in class I, 90 in class II, and 59 in class III.

Brain Metastases - Prognostic Scores

Basic Score for Brain Metastases (BSBM)

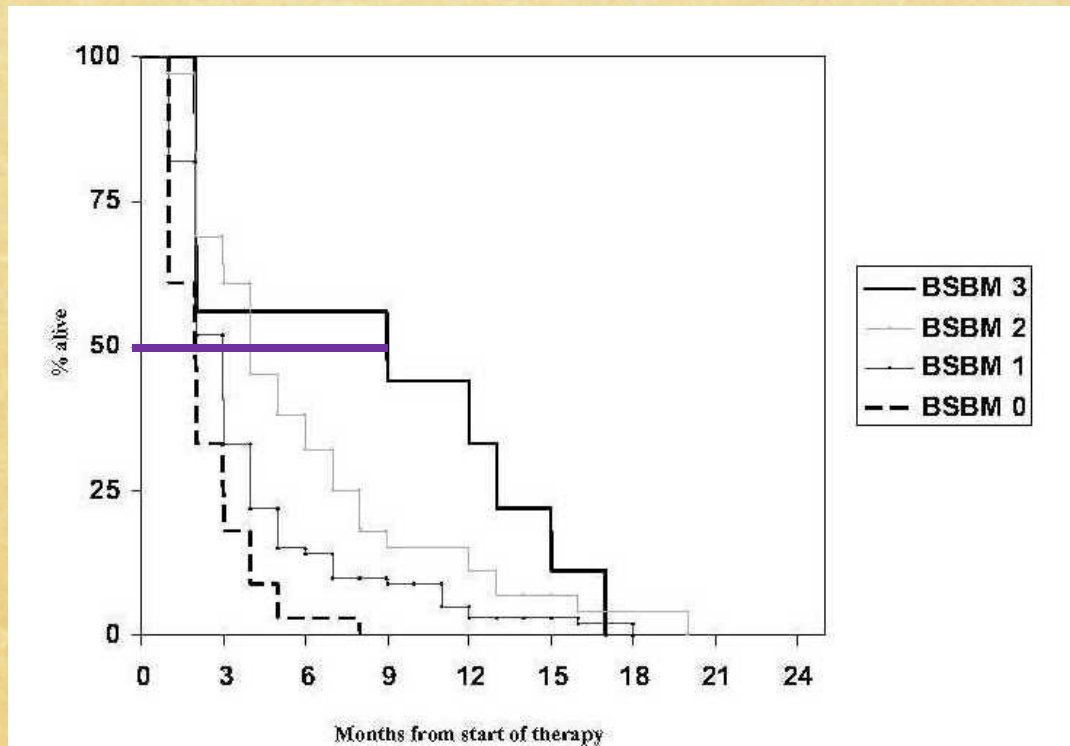


FIGURE 2. Actuarial survival curves according to the basic score for brain metastases (BSBM) score ($p < 0.05$), $n = 9$ in class I, 32 in class II, 61 in class III, and 33 in class IV.

Brain Metastases - Prognostic Scores

Graded Prognostic Assessment (GPA)

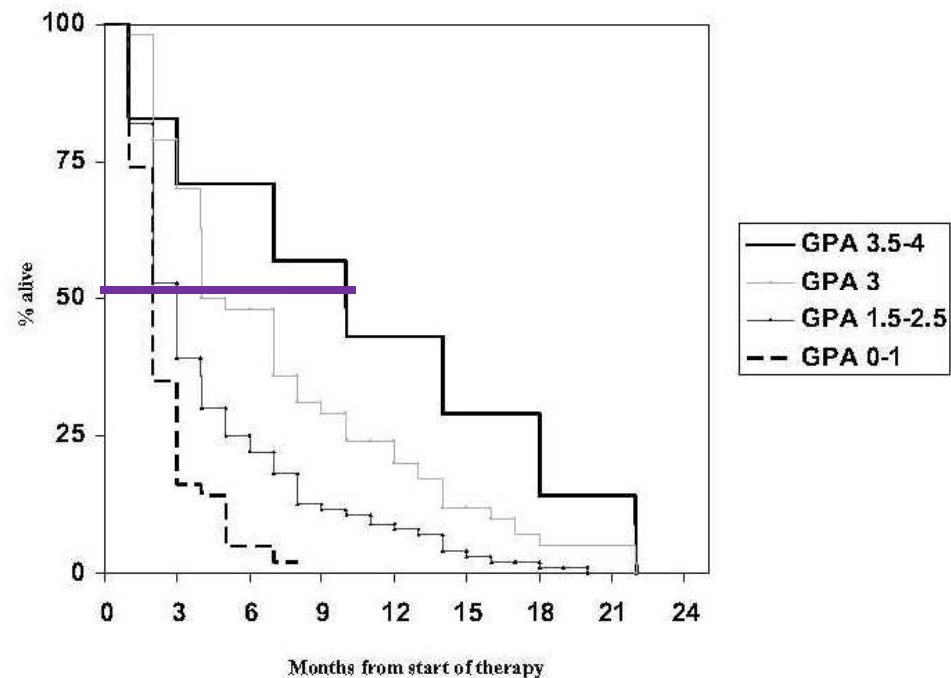


FIGURE 3. Actuarial survival curves according to the graded prognostic assessment (GPA) score ($p < 0.01$), $n = 7$ in class I, 35 in class II, 93 in class III, and 38 in class IV.

Early Palliative Care (EPC)

Source: Temel et al, 2010, NEJM, 363:8, 733-742

- 151 patients (74 standard care (SC); 77 EPC w/ SC available)
- Median age 65
- Female (49% SC, 55% EPC)
- Random assignment
- EPC had better quality of life
- EPC less depressed
- EPC less aggressive end-of-life care
- Median survival : EPC 11.6 months, SC 8.9 months

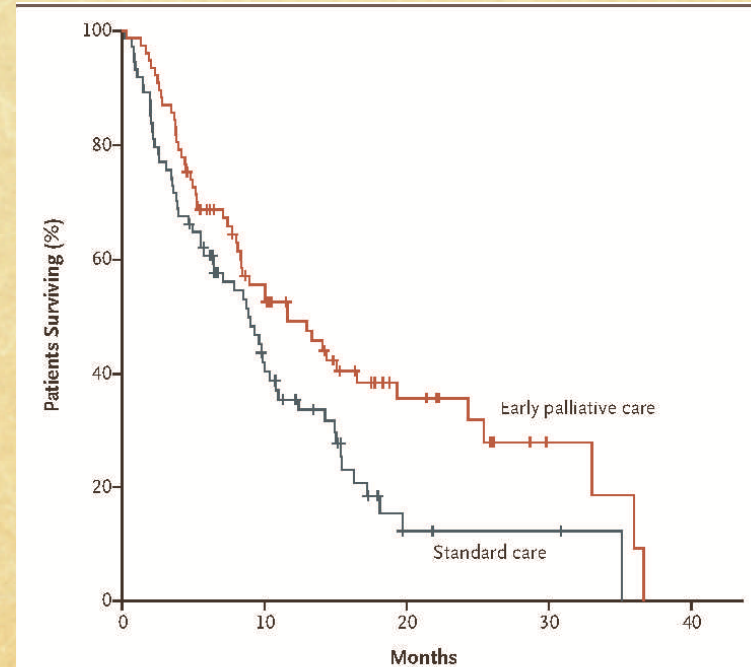


Figure 3. Kaplan–Meier Estimates of Survival According to Study Group.

Survival was calculated from the time of enrollment to the time of death, if it occurred during the study period, or to the time of censoring of data on December 1, 2009. Median estimates of survival were as follows: 9.8 months (95% confidence interval [CI], 7.9 to 11.7) in the entire sample (151 patients), 11.6 months (95% CI, 6.4 to 16.9) in the group assigned to early palliative care (77 patients), and 8.9 months (95% CI, 6.3 to 11.4) in the standard care group (74 patients) ($P=0.02$ with the use of the log-rank test). After adjustment for age, sex, and baseline Eastern Cooperative Oncology Group performance status, the group assignment remained a significant predictor of survival (hazard ratio for death in the standard care group, 1.70; 95% CI, 1.14 to 2.54; $P=0.01$). Tick marks indicate censoring of data.

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- **What can actuaries do?**
- **Conclusion**

What can actuaries do?

- Help develop and participate in national disease studies comparing treatments to
 - ❖ Survivorship
 - ❖ Costs
 - ❖ Parameters: age, gender, race, cancer type & stage, etc.?
 - ❖ Updateable database for changes over time
- Comparisons could be by provider, locality, state/region, nations
- Help patients & providers make informed decisions using evidence-based medicine

Conclusion

- Actuary can help patients make better informed health decisions based on national evidence
- Current lung cancer treatments (for elderly) are costly and futile
- Hope

Questions?

➤ **Article link:**

<http://www.milbank.org/publications/the-milbank-quarterly/featured-articles/article/3944/the-lake-wobegon-effect-are-all-cancer-patients-above-average->

➤ **Contact:**

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