Supplementary Material

Supplementary Table 1 Comparison of characteristics between included and excluded cases with source of missing data shown in bold.

	Excluded (%)	*Included (%)*	*p-value*
No. of cases	167,814	34,380	
Missing survival data	20,569	-	
Year of diagnosis			<0.001
2004-2011	136,346 (81.2)	24,680 (71.8)	
2012-2013	31,468 (18.8)	9,700 (28.2)	
Age			0.002
< 65y	67,012 (39.9)	13,414 (39)	
≥ 65y	100,802 (60.1)	20,966 (61)	
Gender			<0.001
Male	81,426 (48.5)	17,043 (49.6)	
Female	86,388 (51.5)	17,337 (50.4)	
Race			<0.001
White	150,967 (90)	31,055 (90.3)	
Black	12,700 (7.6)	2,639 (7.7)	
Other	4,147 (2.5)	686 (2)	
Hispanic origin			0.90
Non-Hispanic	148,339 (97.6)	33,547 (97.6)	
Hispanic	3,662 (2.4)	833 (2.4)	
Missing	15,813	-	
Charlson/Deyo score			<0.001
0	96,024 (57.2)	18,319 (53.3)	
1	48,774 (29.1)	10,690 (31.1)	
≥ 2	23,016 (13.7)	5,371 (15.6)	
Sequence number			<0.001
0	148,339 (88.4)	33,547 (97.6)	
1	18,972 (11.3)	740 (2.2)	
≥ 2	503 (0.3)	93 (0.3)	
AJCC V8 TNM stage			<0.001
IA	380 (2.8)	1,367 (4)	
IB	119 (0.9)	537 (1.6)	
IIA	48 (0.4)	158 (0.5)	
IIB	257 (1.9)	950 (2.8)	
IIIA	445 (3.3)	1,704 (5)	
IIIB	212 (1.6)	991 (2.9)	
IIIC	60 (0.4)	235 (0.7)	
IVA	8,656 (64.8)	21,354 (62.1)	
IVB	3,172 (23.8)	7,084 (20.6)	
Missing	154,465	-	
Treatment			<0.001
No surgery, no chemo, no radiation	33,639 (20.6)	7,238 (21.1)	
No surgery, no chemo, radiation done	8,573 (5.2)	1,750 (5.1)	
No surgery, chemo done, no radiation	49,145 (30)	11,141 (32.4)	
No surgery, chemo done, radiation done	69,508 (42.5)	10,951 (31.9)	
Surgery done, no chemo, no radiation	698 (0.4)	972 (2.8)	

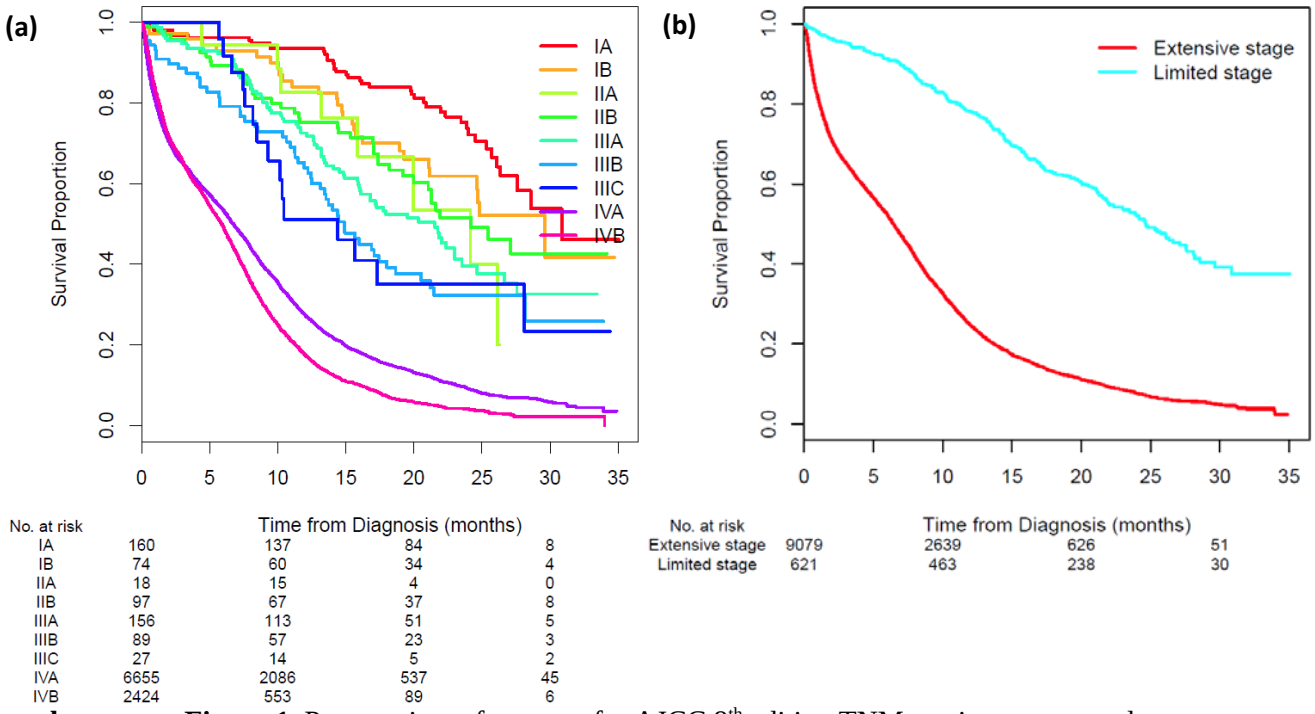
Surgery done, no chemo, radiation done	126 (0.1)	72 (0.2)	
Surgery done, chemo done, no radiation	863 (0.5)	1,165 (3.4)	
Surgery done, chemo done, radiation done	1,096 (0.7)	1,091 (3.2)	
Missing	4,166	-	
Primary site			<0.001
C340	16,995 (10.1)	3,209 (9.3)	
C341	73,408 (43.7)	15,171 (44.1)	
C342	6,566 (3.9)	1,336 (3.9)	
C343	32,198 (19.2)	6,882 (20)	
C348	3,485 (2.1)	685 (2)	
C349	35,162 (21)	7,097 (20.6)	
Laterality			<0.001
Not a paired site	16,995 (10.1)	3,209 (9.3)	
Only one side involved	138,880 (82.8)	28,463 (82.8)	
Bilateral involvement	1,987 (1.2)	778 (2.3)	
Paired site but lateral origin unknown; midline tumor	9,952 (5.9)	1,930 (5.6)	
Grade			<0.001
Well differentiated	286 (0.2)	96 (0.3)	
Moderately differentiated	715 (0.4)	218 (0.6)	
Poorly differentiated	15,310 (9.1)	3,694 (10.7)	
Undifferentiated	39,530 (23.6)	6,494 (18.9)	
Cell type not determined, not stated or not applicable	111,973 (66.7)	23,878 (69.5)	

Supplementary Table 2 Comparison of prognostic performance of three models in testing dataset.

Model	*C-index*	*Average AUC*
Nomogram	0.722 ± 0.004	0.789
8th AJCC TNM stage	0.550 ± 0.003	0.634
Limited/extensive staging	0.539 ± 0.002	0.598

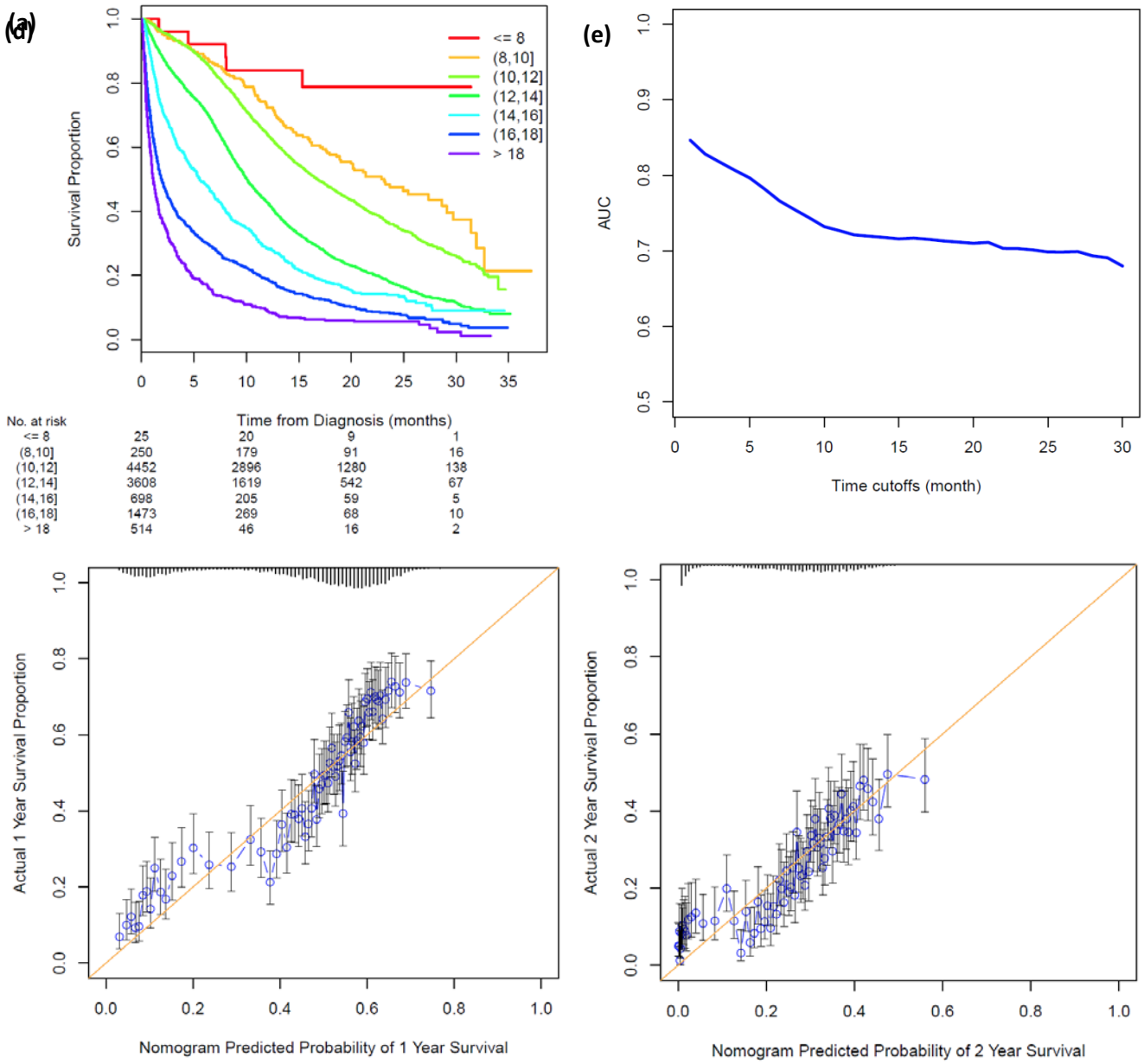
Supplementary Table 3 Comparison of treatment selection among 8th AJCC TNM stages in training set.

Treatment	*Stage I*	*Stage II*	*Stage III*	*Stage IV*
No surgery, no chemo, no radiation	54 (3.2)	38 (3.8)	264 (9.9)	4,669 (24.1)
No surgery, no chemo, radiation done	23 (1.4)	11 (1.1)	45 (1.7)	1,151 (5.9)
No surgery, chemo done, no radiation	50 (3)	68 (6.8)	402 (15.1)	7,148 (36.9)
No surgery, chemo done, radiation done	128 (7.7)	194 (19.5)	1,341 (50.5)	6,238 (32.2)
Surgery done, no chemo, no radiation	526 (31.5)	169 (17)	126 (4.7)	35 (0.2)
Surgery done, no chemo, radiation done	20 (1.2)	15 (1.5)	17 (0.6)	12 (0.1)
Surgery done, chemo done, no radiation	561 (33.6)	236 (23.8)	152 (5.7)	51 (0.3)
Surgery done, chemo done, radiation done	308 (18.4)	262 (26.4)	311 (11.7)	55 (0.3)



Supplementary Figure 1. Prognostic performance for AJCC 8th edition TNM staging system and limited/extensive staging system. (a) K-M plot grouped by AJCC 8th edition TNM stages. (b) K-M plot grouped by limited/extensive stages.

Score	*#patients*	*#events*	*Median survival (mos)*	*HR*	*p-value*
≤ 8	25	5	NA (NA-NA)	-	-
(8,10]	250	118	23.16 (18.92-29.11)	≤ 8 vs (2,8]: 2.53 (1.03-6.2)	0.04
(10,12]	4452	2577	16.79 (16.13-17.54)	(10,12] vs (8,10]: 1.37 (1.14-1.64)	< 0.001
(12,14]	3608	2694	10.05 (9.72-10.41)	(12,14] vs (10,12]: 1.82 (1.72-1.92)	< 0.001
(14,16]	698	544	5.55 (4.76-6.70)	(14,16] vs (12,14]: 1.5 (1.37-1.64)	< 0.001
(16,18]	1473	1192	1.94 (1.71-2.20)	(16,18] vs (14,16]: 1.52 (1.37-1.68)	< 0.001
> 18	514	457	1.12 (0.99-1.35)	> 18 vs (16,18]: 1.41 (1.26-1.57)	< 0.001



Supplementary Figure 2 Sensitivity analysis of bias introduced by missing data. Excluded data with diagnostic time ranging from year 2012 to 2013 were used. Missed variables were imputed using mode in the training cohort. **(a)** Risk scores of testing set cases were calculated according to the model in Figure 1 and grouped into 8 subgroups. K-M plot was depicted for each group. **(b)** Summary of groups in (a). Hazard Ratio (HR) was calculated using Coxph regression model between each two adjacent lines. P-value was calculated using Wald test. **(c)** Area under the curve (AUC) was calculated for the proposed nomogram for every month from the 1st to the 30th month. **(d, e)** Calibration curves compare predicted and actual survival proportions at 1 year (d) and 2 years (e), separately. Distributions of predicted survival probabilities are plotted at the top. Error bars represent 95% confidence intervals.