

**Supplementary Table 1.** Demographic and other patients' characteristics

<b>Variable</b>	<b>N</b>	<b>%</b>
Age, years	59.58	5.38
Survival status		
Censor	2314	65.66%
Cancer	385	10.59%
Non-cancer death	936	25.75%
Emphysema		
Yes	1,546	42.5%
No	2,089	57.5%
Gender		
Female	1,769	48.7%
Male	1,866	51.3%
Smoking		
Current	2,188	60.2%
Former	1,447	39.8%
Race		
White	3,424	94.2%
Non-white	211	5.8%
BMI	28.79	5.47

**Supplementary Table 2.** Pulmonary circulatory system parameters computed from LDCT chest CT scans in our cohort (n=3635)

<b>Parameter (Liter)</b>	<b>Smoking status</b>		<b>Sex</b>		<b>Overall</b>
	<b>Current (n=2,188)</b>	<b>Former (n=1,447)</b>	<b>Male (n=1,866)</b>	<b>Female (n=1,769)</b>	
Heart volume	0.536 (0.126)	0.570 (0.137)	0.617 (0.128)	0.478 (0.092)	0.549 (0.131)
Total artery volume	0.188 (0.042)	0.191 (0.041)	0.215 (0.035)	0.161 (0.028)	0.189 (0.041)
Total vein volume	0.174 (0.037)	0.178 (0.039)	0.192 (0.038)	0.159 (0.030)	0.176 (0.038)
Extra artery volume	0.092 (0.022)	0.097 (0.023)	0.107 (0.021)	0.080 (0.017)	0.094 (0.023)
Extra vein volume	0.084 (0.021)	0.090 (0.023)	0.093 (0.023)	0.079 (0.018)	0.086 (0.022)
Intra artery volume	0.095 (0.023)	0.094 (0.022)	0.109 (0.019)	0.081 (0.016)	0.095 (0.022)
Intra vein volume	0.091 (0.021)	0.088 (0.021)	0.099 (0.021)	0.080 (0.017)	0.089 (0.021)

Extra – extrapulmonary, Intra – intrapulmonary

**Supplementary Table 3.** Participant characteristics and their association with future lung cancer diagnosis

Characteristics (non-reference level)	Univariate/standalone		Multivariable/joint*	
	Hazard Ratio	p-value	Hazard Ratio	p-value
Sex (Female)	0.85	0.12	---	---
Age	1.50	<.001	1.46	<.001
Smoking Status (current smoker)	1.65	<.001	1.75	<.001
Race (White)	0.93	0.74	---	---
BMI	0.85	<.001	---	---
Emphysema (present)	2.53	<.001	2.20	<.001

\*excluded variables had p-value>0.05.

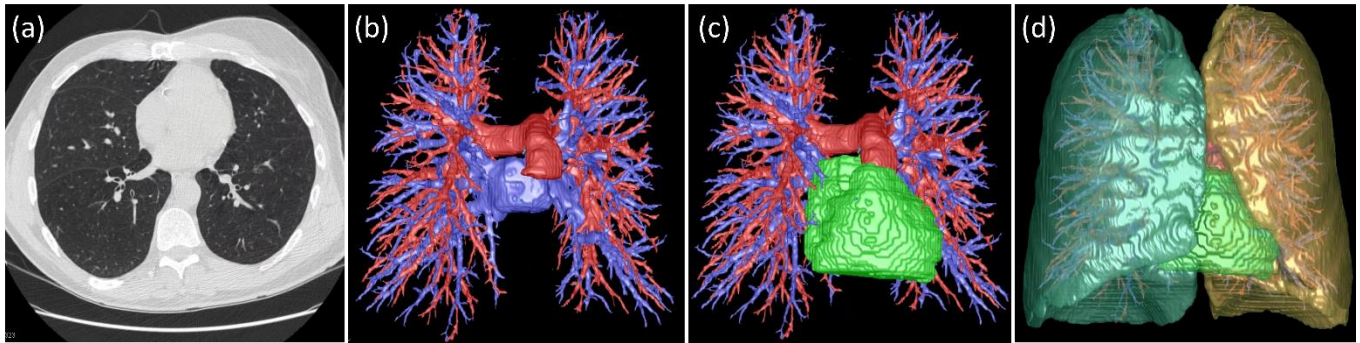
**Supplementary Table 4.** CT-computed PCM parameters and their association with future lung cancer

Parameter	Univariate/standalone		Multivariable/ joint	
	Hazard Ratio	p-value	Hazard Ratio	p-value
Intrapulmonary artery volume* ,+	0.89	0.023	1.59	<.001
Extrapulmonary artery volume *	1.06	0.32	1.21	0.006
Intrapulmonary vein volume*	0.63	<.001	0.41	<.001
Extrapulmonary vein volume * ,+	0.84	0.001	---	---
Heart volume*	0.88	0.014	---	---

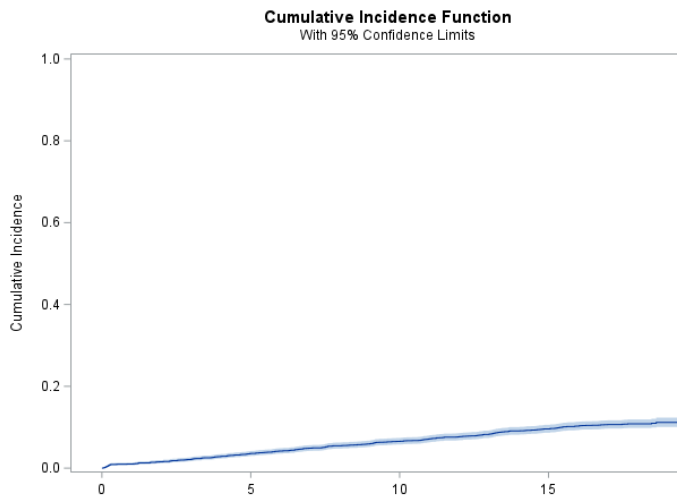
\* Continuous variables were log-transformed for the statistical analysis

**Supplementary Table 5.** Risk strata based on the predictions by the composite model

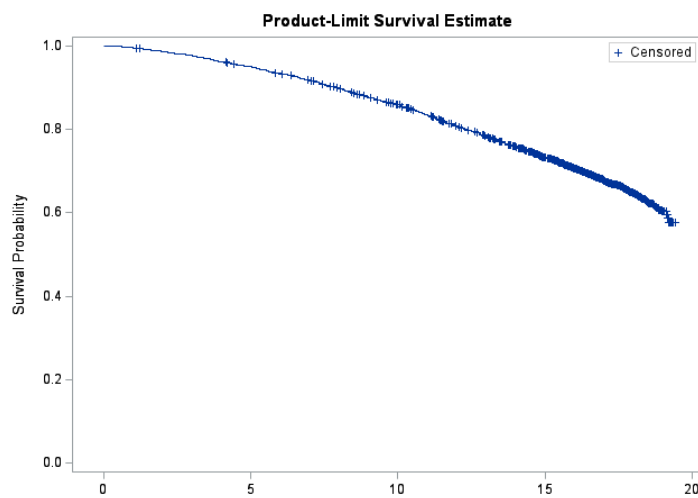
Model's risk strata	Lung Cancers	Deaths	Total patients	15-year risk estimate	95% CI
Low risk	78	318	1,816	3.6%	(0.028, 0.045)
Intermediate	186	468	1,452	11.8%	(0.102, 0.136)
High Risk	121	150	367	30.6%	(0.259, 0.353)
Total	385	936	3,635		



**Supplementary Figure 1.** Automated segmentation of pulmonary circulatory system (PCS) structures on LDCT scans. (a) a LDCT scan, (b) segmented arteries (blue) and vein (red), (c) heart (green), and (d) right/left lungs.

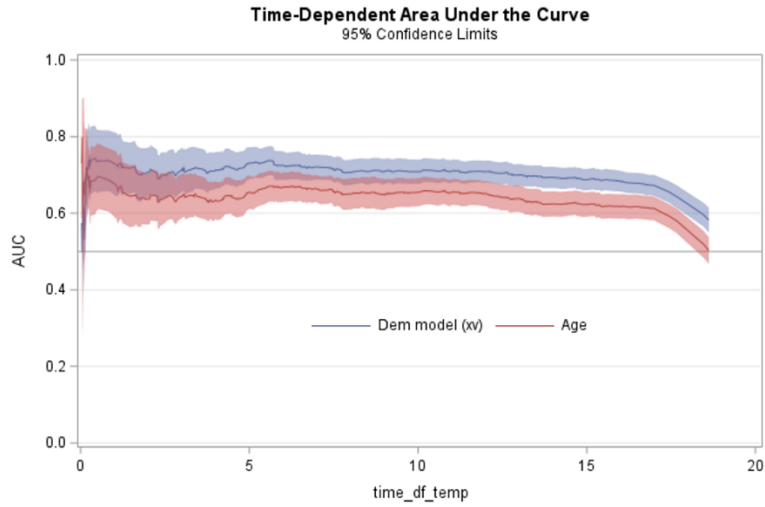


(a)

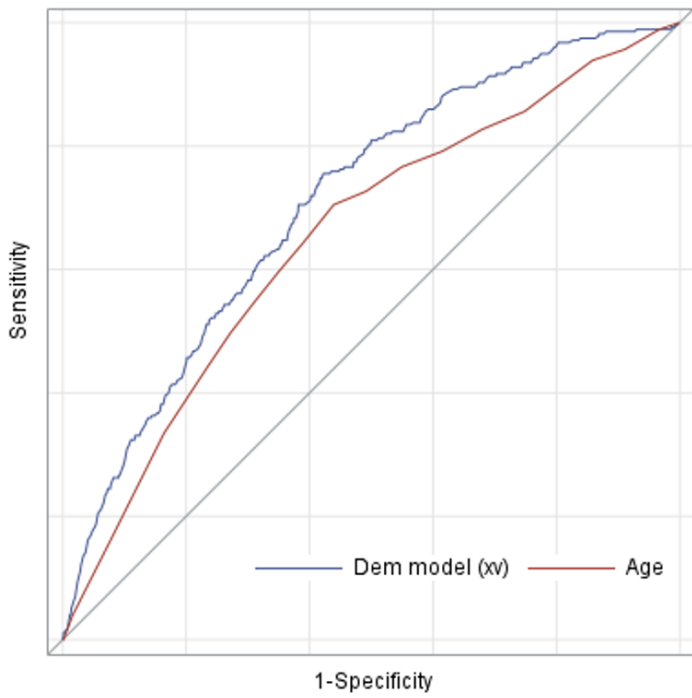


(b)

**Supplementary Figure 2.** Cumulative incidence function (a) for lung cancer with a competing event of death and the overall survival probability (b) up to 19 years after baseline CT scan (based on 3635 participants with 385 lung cancers and 936 deaths)

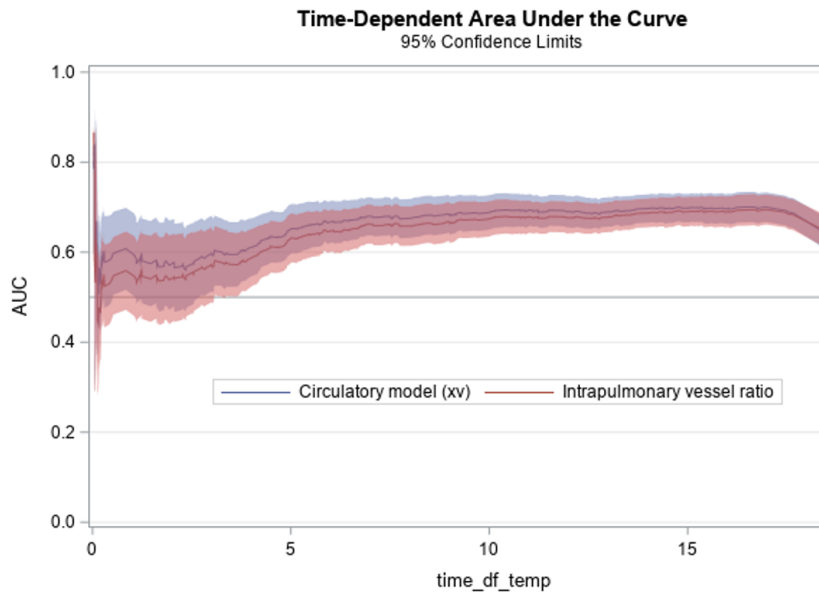


(a)

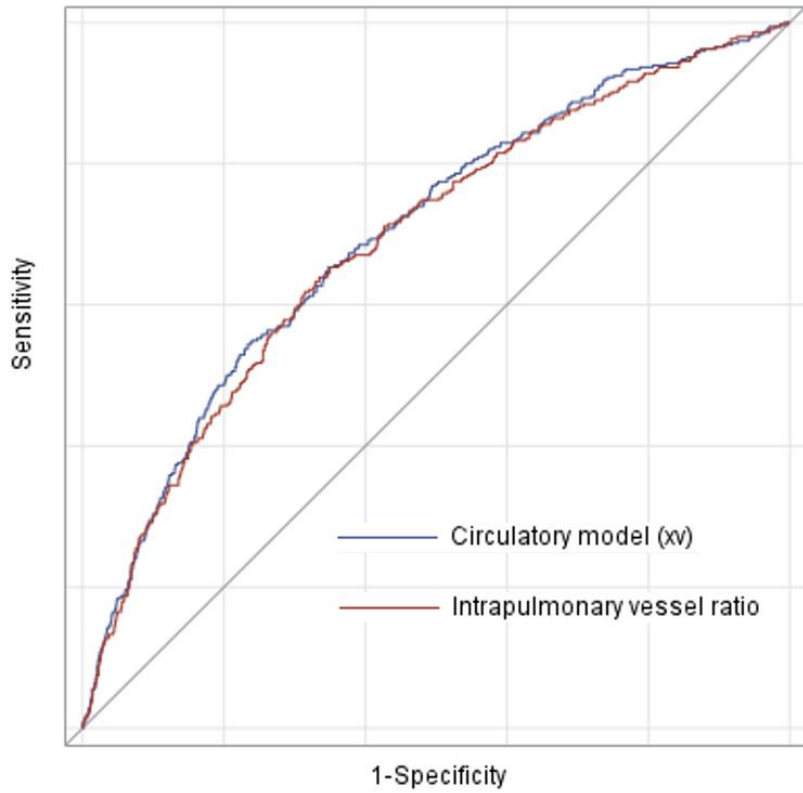


(b)

**Supplementary Figure 3.** Time-dependent AUC curve (left) and the ROC curve at 15 years for age standalone and combined with smoking status and the presence of emphysema (under the five-fold cross-validation adjustment).

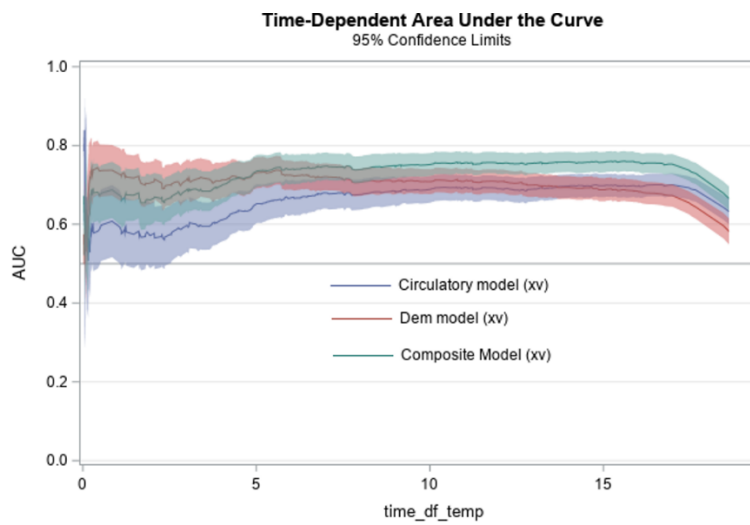


(a)

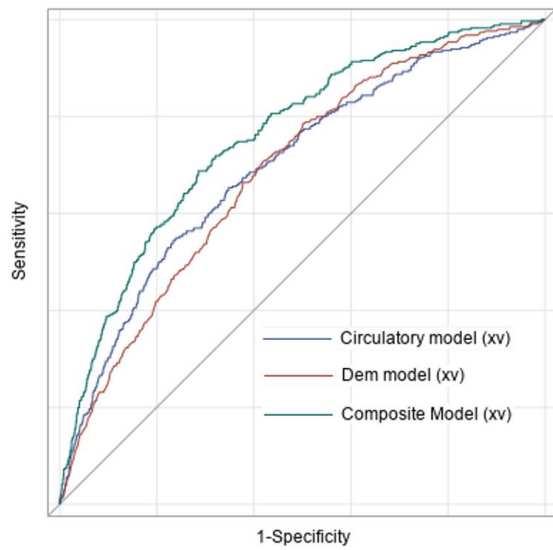


(b)

**Supplementary Figure 4.** Time-dependent AUC curves for the cross-validated prognostic scores of the model based on circulatory characteristics (at 15 years AUC=0.69, 95% CI:0.66-0.72 for intrapulmonary vessel ratio, and 0.70, 95%CI: 0.67-0.73 for the overall circulatory model)

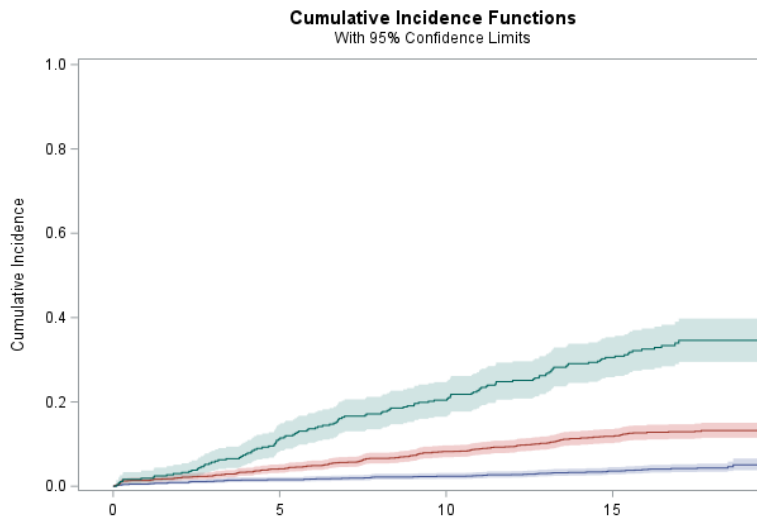


(a)



(b)

**Supplementary Figure 5.** Time-dependent AUC curves for the cross-validated predictive scores of several models (at 15 years AUC=0.69, 95% CI:0.66-0.72 for non-circulatory, and 0.70, 95%CI: 0.67-0.73 for circulatory, and 0.76, 95%CI:0.73-0.79 for the composite model)



**Supplementary Figure 6.** Cumulative incidence of lung cancer (from the first CT) for the risk strata based on the composite model combining predictors from pulmonary circulatory system (PCS) and patient demographics.