Supplementary

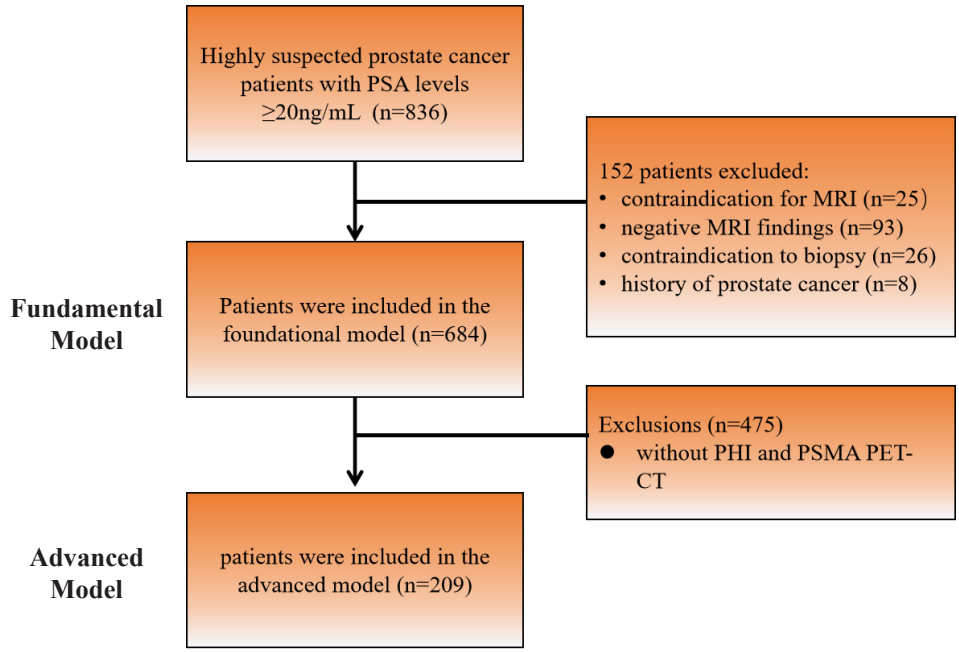

Figure S1 A flow chart of patient enrollment. CT, computed tomography; PET, positron emission tomography; PHI, prostate health index; PSA, prostate-specific antigen; PSMA, prostate-specific membrane antigen.

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Table S1 Patients' characteristics of the training cohort and validation cohort in foundational model

Parameters	All patients (n=684)	Training set (n=478)	Validation set (n=206)	P value
Age, years	71.00 (66.00–76.00)	71.00 (66.00–76.00)	71.00 (66.00–76.00)	0.8
BMI,kg/m^2	24.22 (22.32–26.41)	24.22 (22.47–26.59)	24.09 (22.02–26.03)	0.2
PSA, ng/mL	56.79 (30.95–145.37)	56.48 (30.50–143.90)	62.59 (31.14–147.44)	0.4
PV, mL	60.85 (41.45–82.67)	60.54 (41.55–80.07)	61.16 (41.25–84.85)	0.4
PSAD, ng/mL^2	1.14 (0.57–2.65)	1.13 (0.57–2.64)	1.16 (0.55–2.67)	0.7
PSAVR, %	9.41 (4.88–18.77)	9.38 (4.78–18.82)	9.45 (5.04–18.53)	0.8
PI-RADS score				0.6
3	86 (12.6)	61 (12.8)	25 (12.1)	
4	136 (19.9)	97 (20.3)	39 (18.9)	
5	462 (67.5)	320 (66.9)	142 (68.9)	
Localization of suspicious lesion				0.2
PZ	317 (46.3)	214 (44.8)	103 (50.0)	
TZ	57 (8.3)	41 (8.6)	16 (7.8)	
PZ + TZ	270 (39.5)	193 (40.4)	77 (37.4)	
Others	40 (5.8)	30 (6.3)	10 (4.9)	
ISUP				0.8
1	37 (5.4)	27 (5.6)	10 (4.9)	
2	28 (4.1)	23 (4.8)	5 (2.4)	
3	53 (7.7)	40 (8.4)	13 (6.3)	
4	234 (34.2)	152 (31.8)	82 (39.8)	
5	248 (36.3)	177 (37.0)	71 (34.5)	
DRE	587 (85.8)	407 (85.1)	180 (87.4)	0.4
AUR	188 (27.5)	126 (26.4)	62 (30.1)	0.3
Diabetes	135 (19.7)	98 (20.5)	37 (18.0)	0.4
Hypertension	277 (40.5)	192 (40.2)	85 (41.3)	0.8

Data are presented as median (IQR) or n (%). The P values were calculated using the Chi-squared (categorical variables) and Mann-Whitney *U* (continuous variables) tests. *, P values <0.05. BMI, body mass index; IQR, interquartile range; PI-RADS, Prostate Imaging Reporting and Data System; PSA, prostate-specific antigen; PSAD, prostate-specific antigen density; PZ, peripheral zone; TZ, transition zone; Others, lesions beyond the peripheral and transition zones; ISUP, International Society of Urological Pathology; DRE, digital rectal examination; AUR, acute urinary retention.

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Table S2 Patients' characteristics of advanced model (n=209)

Parameters	All patients (n=209)	csPCA (n=144)	Non-csPCa (n=65)	P value
Age, years	71.00 (66.00–76.00)	71.00 (66.00–77.00)	70.00 (64.50–74.00)	0.05
BMI, kg/m^2	24.21 (22.07–26.63)	24.09 (21.99–26.28)	24.22 (22.19–28.30)	0.3
PSA, ng/mL	41.68 (27.86–91.40)	57.73 (32.31–128.75)	27.63 (22.86–34.40)	<0.001*
PV, mL	61.18 (40.75–80.00)	59.45 (38.67–76.24)	69.71 (51.96–98.30)	0.016*
PSAD, ng/mL^2	0.91 (0.42–1.68)	1.27 (0.62–2.42)	0.41 (0.29–0.60)	<0.001*
PSAVR, %	12.30 (6.01–25.63)	10.12 (5.30–18.84)	21.66 (10.99–38.82)	<0.001*
PHI	172.72 (82.30–295.75)	236.10 (162.10–342.16)	55.73 (38.95–96.07)	<0.001*
PSMA PET/CT SUVmax	13.10 (6.87–23.40)	18.10 (11.17–27.16)	5.02 (2.98–8.04)	<0.001*
PI-RADS score				<0.001*
3	40 (19.1)	7 (4.9)	33 (50.8)	
4	50 (23.9)	27 (18.8)	23 (35.4)	
5	119 (57.0)	110 (76.3)	9 (13.8)	
Localization of suspicious lesion				0.01*
PZ	115 (55.0)	70 (48.6)	45 (69.2)	
TZ	20 (9.6)	12 (8.3)	8 (12.3)	
PZ + TZ	59 (28.2)	56 (38.9)	3 (4.6)	
Others	15 (7.2)	6 (4.2)	9 (13.9)	
ISUP				<0.001*
1	21 (10.0)	0 (0)	21 (32.3)	
2	9 (4.3)	9 (6.3)	0 (0)	
3	14 (6.7)	14 (9.7)	0 (0)	
4	65 (31.1)	65 (45.1)	0 (0)	
5	56 (26.8)	56 (38.9)	0 (0)	
DRE	174 (83.3)	126 (87.5)	48 (73.8)	0.01*
AUR	67 (32.1)	30 (20.8)	37 (56.9)	<0.001*
Diabetes	41 (19.6)	32 (22.2)	9 (13.8)	0.16
Hypertension	84 (40.2)	66 (45.8)	18 (27.7)	0.01*

Data are presented as median (IQR) or n (%). The P values were calculated using the Chi-squared (categorical variables) and Mann-Whitney *U* (continuous variables) tests. *, P values <0.05. CsPCa, clinically significant prostate cancer; BMI, body mass index; IQR, interquartile range; PI-RADS, Prostate Imaging Reporting and Data System; PSA, prostate-specific antigen; PSAD, prostate-specific antigen density; PSAVR, prostate-specific antigen variation ratio; PZ, peripheral zone; TZ, transition zone; Others, lesions beyond the peripheral and transition zones; ISUP, International Society of Urological Pathology; DRE, digital rectal examination; AUR, acute urinary retention.

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Table S3 Patients' characteristics of the training cohort and validation cohort in advanced model

Parameters	All patients (n=209)	Training set (n=147)	Validation set (n=62)	P value
Age, years	71.00 (66.00–76.00)	71.00 (66.00–76.00)	70.00 (65.75–75.00)	0.8
BMI, kg/m^2	24.21 (22.07–26.63)	23.84 (21.95–26.40)	24.77 (22.45–26.93)	0.2
PSA, ng/mL	41.68 (27.86–91.40)	39.53 (28.24–89.41)	43.06 (26.21–116.11)	1.0
PV, mL	61.18 (40.75–80.00)	61.18 (40.95–81.51)	61.27 (40.21–77.54)	0.9
PSAD, ng/mL^2	0.91 (0.42–1.68)	0.89 (0.46–1.57)	1.06 (0.40–1.83)	0.8
PSAVR, %	12.30 (6.01–25.63)	12.30 (5.38–23.90)	12.81 (6.39–34.04)	0.4
PHI	172.72 (82.30–295.75)	179.40 (84.23–309.98)	171.06 (69.37–273.45)	0.4
PSMA PET/CT SUVmax	13.10 (6.87–23.40)	13.13 (6.87–24.89)	12.79 (5.73–19.28)	0.4
PI-RADS score				0.2
3	40 (19.1)	31 (21.1)	9 (14.5)	
4	50 (23.9)	36 (24.5)	14 (22.6)	
5	119 (57.0)	80(54.4)	39 (62.9)	
Localization of suspicious lesion				0.6
PZ	115 (55.0)	79 (53.7)	36 (58.1)	
TZ	20 (9.6)	15 (10.2)	5 (8.1)	
PZ + TZ	59 (28.2)	42 (28.6)	17 (27.4)	
Others	15 (7.2)	11 (7.5)	4 (6.4)	
ISUP				0.6
1	21 (10.0)	12 (8.2)	9 (14.5)	
2	9 (4.3)	9 (6.1)	0 (0.0)	
3	14 (6.7)	10 (6.8)	4 (6.5)	
4	65 (31.1)	47 (32.0)	18 (29.0)	
5	56 (26.8)	37 (25.2)	19 (30.6)	
DRE	174 (83.3)	121 (82.3)	53 (85.5)	0.6
AUR	67 (32.1)	45 (30.6)	22 (35.5)	0.5
Diabetes	41 (19.6)	26 (17.7)	15 (24.2)	0.3
Hypertension	84 (40.2)	61 (41.5)	23 (37.1)	0.6

Data are presented as median (IQR) or n (%). The P values were calculated using the Chi-squared (categorical variables) and Mann-Whitney *U* (continuous variables) tests. BMI, body mass index; IQR, interquartile range; PI-RADS, Prostate Imaging Reporting and Data System; PSA, prostate-specific antigen; PSAD, prostate-specific antigen density; PSAVR, prostate-specific antigen variation ratio; PHI, Prostate Health Index; PET, positron emission tomography; PZ, peripheral zone; TZ, transition zone; Others, lesions beyond the peripheral and transition zones; ISUP, International Society of Urological Pathology; DRE, digital rectal examination; AUR, acute urinary retention.

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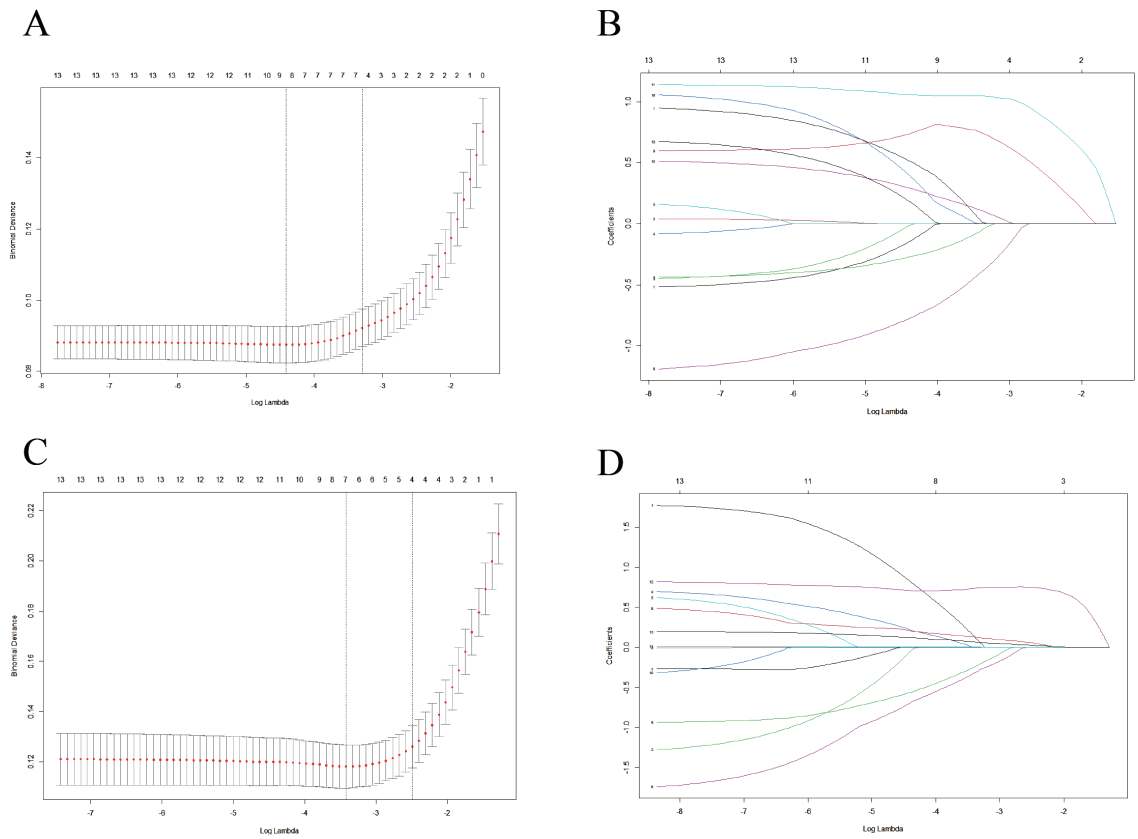

Figure S2 Variable selection using LASSO binary logistic regression in two models. (A) Coefficient profile plot of Model 1 against the log(lambda) sequence, showing six variables with non-zero coefficients selected by optimal lambda. (B) Partial likelihood deviance curve plotted against log(lambda), with dotted vertical lines indicating one standard error for verification of the optimal parameter (lambda) in the LASSO model. Panels (C,D) depict Model 2. LASSO, least absolute shrinkage and selection operator

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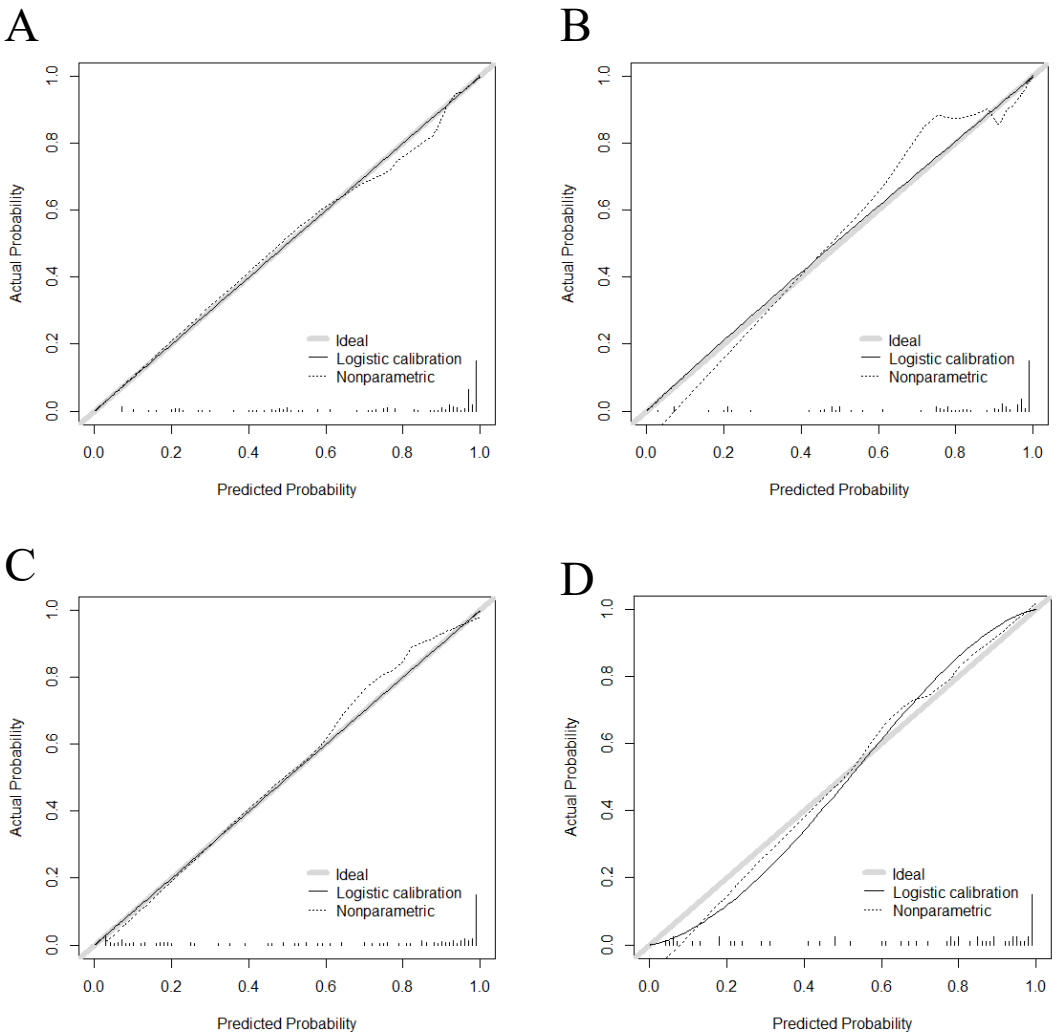

Figure S3 Calibration curves for two nomograms predicting csPCa in both training and validation sets. (A,B) Nomogram 1 predictions in training and validation sets. (C,D) Nomogram 2 predictions in training and validation sets. csPCa, clinically significant prostate cancer.

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