

## PD-L1 expression in malignant pleural effusion samples and its correlation with oncogene mutations in non-small cell lung cancer

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**Background:** Programmed death ligand 1 (PD-L1) tumor proportion score (TPS) is currently widely used for selection of immune therapies in non-small cell lung cancer (NSCLC). Most of samples for PD-L1 expression were obtained from tumor tissue. However, the feasible of malignant pleural effusion (MPE) cytological samples for PD-L1 detection is poorly reported. And the correlation between oncogene mutations and PD-L1 expression based on high-throughput sequencing is rarely studied.

**Methods:** NSCLC MPE cytological samples and partially paired tumor tissue from our institution analyzed for PD-L1 immunohistochemistry (IHC) using the clone SP263 pharmDx kit and evaluated genomic aberrations in all patients using next generation sequencing (NGS).

**Results:** One hundred and twenty-three MPE cell blocks and 29 paired tumor tissue were successfully tested for PD-L1 expression. PD-L1 TPS of  $\geq$ 50% were seen in 18.7% (23/123) of all samples. The accordance of PD-L1 expression in tumor tissue and MPE samples was 86.2% (50% as cut-off value). PD-L1 TPS  $\geq$ 50% tumors were significantly associated with *EGFR* wild-type (P=0.007), but, no correlation between other genes and PD-L1 expression. A trend of longer overall survival (OS) was observed in patients with PD-L1 TPS <50% than those TPS  $\geq$ 50% (20.0 *vs.* 13.8 months, P=0.057). No difference of tumor mutational burden (TMB) was observed between patients with PD-L1  $\geq$ 50% and <50% (8.2/MB and 7.7/MB, P=0.47).

**Conclusions:** Our results suggest that cytological material is feasible for PD-L1 IHC analysis. Gene alterations could partially contribute to select the samples that with different PD-L1 expression. No correlation between the PD-L1 expression and TMB.

**Keywords:** Tumor proportion score (TPS); malignant pleural effusion (MPE); programmed death ligand 1 (PD-L1); oncogene mutations

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## Introduction

Patients of advanced non-small cell lung cancer (NSCLC) harbored *EGFR*, *ALK* and *ROS1* improved the overall survival (OS) and quality of life after the molecular targeted therapy (1-6). However, the survival in patients with wild-type of gene alternations was not improved recently. The anti-programmed death 1 (PD-1) and programmed death ligand 1 (PD-L1) immune checkpoint inhibitors, have

been approved for systemic therapy in advanced NSCLC for remarkable efficacy compared with chemotherapy, especially in patients with PD-L1 tumor proportion scores (TPSs) of  $\geq$ 50% (7-9). However, many questions are not well answered currently (10). PD-L1 detection was mostly based on tumor tissue in previous studies. It is not well known that whether the cytological samples could be used for PD-L1 detection. The relationship between *EGFR/ALK* 

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mutations and PD-L1 expression was clearly investigated, while, the data based on high-throughput sequencing was scarce.

In present study, 123 malignant pleural effusion (MPE) samples were retrospectively analyzed for PD-L1 expression. Meanwhile, all of the samples were detected gene alterations with next generation sequencing (NGS) containing 416 genes. We aim to expound the feasibility of MPE samples for PD-L1 detection and investigate the correlation between oncogene mutations and PD-L1 expression.

## Methods

## Sample selection

Patients were enrolled in the study between Aug 2015 and Dec 2016. Eligible patients were aged at least 18 years and had advanced, non-squamous NSCLC with pleural effusion. All of the pleural effusion samples were confirmed as malignant by cytological smears. At the time of enrollment, the patients had not received targeted inhibitors. Patient exclusion criteria included squamous cell lung cancer, small cell lung cancer, or other metastatic malignancies tumor to the lung. Diagnosis of the tumors was performed by institutional pathologists with the accordance of the 2015 WHO classification. The study was approved by Zhejiang Cancer Hospital Ethics Committee (IRB2014-03-032). Written informed consent was obtained from all participants.

## Preparation of cell block and tumor PD-L1 analysis

About 50-mL fluid specimens were centrifuged at 2,500-3,000 rpm for 5 min. Cell sediments were then harvested, fixed with 3 times the volume of 10% neutralbuffered formalin for 60 min, wrapped in filter paper, and processed in an automatic tissue processor. The samples were embedded in paraffin and sectioned at a thickness of 4-5 mm.

Ventana independently stained all cases using PD-L1 IHC assay platforms. At Ventana, sections were stained with anti-PD-L1 (SP263, Roche) rabbit monoclonal primary antibody and a matched rabbit immunoglobulin G-negative control with an OptiView DAB IHC Detection Kit on the BenchMark ULTRA automated staining platform. Three pathologists were independently evaluated all PD-L1 immunostained slides.

## NGS analysis

Cell blocks were obtained and shipped to the central testing laboratory by required conditions. The tests were performed in Nanjing Geneseeq Technology Inc., China. Briefly, DNA was extracted from formalin-fixed, paraffin-embedded (FFPE) samples. Purified DNA was qualified by Nanodrop2000 (Thermo Fisher Scientific) and quantified by Qubit 3.0 using the dsDNA HS Assay Kit (Life Technologies) according to the manufacturer's recommendations. Sequencing libraries were prepared using the KAPA Hyper Prep kit (KAPA Biosystems) with an optimized manufacturer's protocol. Customized xGen lockdown probes (Integrated DNA Technologies) targeting 416 cancer-relevant genes were used for hybridization enrichment (Table S1). The capture reaction was performed with the NimbleGen SeqCap EZ Hybridization and Wash Kit (Roche) and Dynabeads M-270 (Life Technologies) with optimized manufacturers' protocols. Genomic fusions were identified by FACTERA with default parameters. Copy number variations (CNVs) were detected using ADTEx (http://adtex.sourceforge.net) with default parameters. Somatic CNVs were identified using paired normal/tumor samples for each exon.

TMB was defined as the number of somatic, coding, base substitution, and indel mutations per megabase of genome examined. For our panel TMB calculation, all base substitutions, including non-synonymous and synonymous alterations, and indels in the coding region of targeted genes were considered with the exception of known hotspot mutations in oncogenic driver genes and truncations in tumor suppressors. Synonymous mutations were counted in order to reduce sampling noise and known driver mutations were excluded as they are over-represented in the panel, as previously described (11).

## Statistical methods

Fisher's exact test was used to compare categorical variables. All P values reported are two-sided, and tests were conducted at the 0.05 significance level. The relationship between different groups was analyzed with chi-square tests. Progression-free survival (PFS) with targeted therapy was defined as the time from initiation targeted treatment to documented progression or death from any cause. PFS was plotted by the Kaplan-Meier method. All analyses were performed using SPSS<sup>®</sup> version 18.0 (SPSS Inc., Chicago, IL, USA). The last follow-up date was May 31, 2018.

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Table 1 Clinicopathological characteristics of study pa	articipants
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Variable	Number (%)
Variable	Number (%)
Gender	
Male	65 (52.8)
Female	58 (47.2)
Age (years)	
≥65	46 (37.4)
<65	77 (62.6)
Smoking history	
Yes	51 (41.5)
No	72 (58.5)
Performance status	
0–1	106 (86.2)
2	17 (13.8)
Metastatic status	
M1a	73 (59.3)
M1b	50 (40.7)
Histology	
Adenocarcinoma	119 (96.7)
Non-adenocarcinoma	4 (3.3)
History of chemotherapy	
Yes	37 (30.1)
No	86 (69.9)

The median follow-up time was 20.2 months (range, 3.0–29.5 months). No patients were lost to follow-up.

## Results

#### Baseline clinical and pathologic characteristics

Of the 123 patients analyzed, 65 were male and 58 of female with median age of 59 years old (range, 33 to 81 years old). Most of patients were with histology of adenocarcinoma (119 of 123). Fifty-one patients had smoking history and 72 were never smokers. The details of clinical and pathologic characteristics in present study were listed in *Table 1*.

## PD-L1 expression in MPE samples and paired tumor tissues

Totally, 48 (39.0%) were with PD-L1 negative, followed by

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1–5% (n=28), and PD-L1 TPSs of 5–49% (n=24). Twentythree were with proportion of PD-L1 TPS of  $\geq$ 50%. PD-L1 TPS  $\geq$ 50% was seen significantly more frequently in smokers as compared to never smokers (P=0.01) and males (P=0.025). While not associated with patient tumor stage (P=0.53), age (P=0.85) and performance status (P=0.33) (*Table S2*).

Twenty-nine patients were obtained the paired tumor tissue and with PD-L1 IHC detection (*Figure 1*). Among the 29 samples, 14 had PD-L1 TPS  $\geq$ 1% in tumor tissue, and 11 in paired MPE samples, with agreement statistics of 69.0% (20/29) (*Table 2*). When 50% as cut off value, the accordance between MPE samples and tumor tissue was 86.2% (25/29) (*Table 3*). The details of comparison between MPE samples and tumor tissue was presented in *Tables 2-4*.

## NGS results

All results of the comparative analyses are presented in *Figure 2*. Overall, *EGFR* mutations were with most frequent (55.3%), followed with *TP53* mutation (51.2%). Sixteen patients were found to harbor *KRAS* mutations, *ALK* rearrangement were observed in 11 patients. There was no *ROS1* rearrangement, MET amplification and exon 14 skipping among the 123 samples.

# Association between PD-L1 expression and oncogene aberrations

Of the 68 patients with *EGFR* mutations, 10.3% of PD-L1 TPS  $\geq$ 50%, while, the percentage of PD-L1 TPS  $\geq$ 50% was 29.1% *EGFR* wild-type (P=0.007). Of 11 patients with *ALK* rearrangement, 9 had PD-L1 TPS  $\leq$ 50%, as compared with only two tumors with PD-L1 TPS  $\geq$ 50% (P=0.72). More patients with PD-L1 TPS  $\geq$ 50% in *KRAS* mutations than wild-type samples (25.0% vs. 17.8%, P=0.73) (*Table 5* and *Figure S1*). The median TMB in samples with PD-L1  $\geq$ 50% and <50% was 8.2/MB and 7.7/MB, respectively (P=0.47).

## PD-L1 expression and clinical treatment

Forty-seven patients with *EGFR* mutations received EGFR-TKIs treatment. The median PFS was 10.2 months (95% CI: 9.1–11.7 months). A trend of longer PFS was observed in patients with PD-L1 TPS  $\geq$ 50% (11.7 *vs.* 9.7 months, P=0.17). Forty-four patients received first-line platinumbased chemotherapy, including 25 with pemetrexed and 19



**Figure 1** PD-L1 expression in MPE samples (A,C) and paired tumor tissue (B,D) (A and B: TPS =0%; C and D: TPS =100%; IHC, ×400). PD-L1, programmed death ligand 1; MPE, malignant pleural effusion; TPS, tumor proportion score; IHC, immunohistochemistry.

**Table 2** PD-L1 expression in tumor tissue and paired MPE samples(a cut-off value of 1%)

MDE	Tumor	Total	
	Positive	Negative	TOTAL
Positive	8	3	11 (37.9)
Negative	6	12	18 (62.1)
Total	14 (48.3)	15 (51.7)	29

PD-L1, programmed death ligand 1; MPE, malignant pleural effusion.

Table 3 PD-L1 expression in tumor tissue and paired MPEsamples (a cut-off value of 50%)

MDE	Tumor	Total	
	Positive	Negative	TOLAI
Positive	5	1	6 (20.7)
Negative	3	20	23 (79.3)
Total	8 (27.6)	21 (72.4)	29

PD-L1, programmed death ligand 1; MPE, malignant pleural effusion.

 Table 4 PD-L1 expression in tumor tissue and paired MPE samples (a cut-off value of 10%)

MDE	Tumor	Total	
	Positive	Negative	TOLAI
Positive	8	1	9 (31.0)
Negative	4	16	20 (69.0)
Total	12 (41.4)	17 (58.6)	29

PD-L1, programmed death ligand 1; MPE, malignant pleural effusion.

of other regimens. No PFS difference was found between different regimens (7.0 vs. 6.5 months, P=0.97).

The median OS of all patients was 18.4 months (95% CI: 14.9–21.8 months). A trend of longer OS was observed in patients with PD-L1 TPS <50% than those TPS  $\geq$ 50% (20.0 *vs.* 13.8 months, P=0.057) (*Figure 3*). No survival difference was observed in *EGFR/ALK* positive patients with PD-L1 TPS <50% than those TPS  $\geq$ 50% (21.0 *vs.* 20.5 months, P=0.21); However, a shorter survival was existed in *EGFR/ALK* negative patients with PD-L1 TPS <50% than those





		0	6	1	
Gene	Mutation	Wild-type	PD-L1 TPS ≥50% in mutation	PD-L1 TPS ≥50% in wild-type	Р
EGFR	68	55	10.3% (7/68)	29.1% (16/55)	0.007
ALK	11	112	18.2% (2/11)	18.8% (21/112)	0.72
KRAS	16	107	25.0% (4/16)	17.8% (19/107)	0.73
TP53	63	60	20.6% (13/63)	16.7% (10/60)	0.57
KRAS/TP53	7	116	28.6% (2/7)	18.1% (21/116)	0.49
RET	3	120	33.3% (1/3)	18.3% (22/120)	0.93
BRAF	9	114	44.4% (4/9)	16.7% (19/114)	0.11
ERBB2	7	116	0.0% (0/7)	19.8% (23/116)	0.42
PIK3CA	9	114	0.0% (0/9)	20.2% (23/114)	0.29
STK11	6	117	16.7% (1/6)	18.8% (22/117)	0.68

Table 5 Correlation between common oncogene mutations or rearrangement and PD-L1 over-expression

PD-L1, programmed death ligand 1; TPS, tumor proportion score.



**Figure 3** Overall survivals comparison in patients with different PD-L1 expression. PD-L1, programmed death ligand 1.

TPS ≥50% (15.5 *vs.* 12.7 months, P=0.025).

## Discussion

A high accordance of PD-L1 expression was found between tumor tissue and cytological samples in present study. Further, we investigated the relationship between gene alternations and PD-L1 expression based on highthroughput sequencing. Our results demonstrated PD-L1 expression was associated with some oncogene aberrations.

Two platforms are currently applied in clinical practice for PD-L1 IHC detection, including DAKO

and VENTANA (12-14). Patients with PD-L1 TPS of  $\geq$ 50% were reported to benefit more from pembrolizumab treatment than chemotherapy in KEYNOTE024 study (7). And the PD-L1 TPS of  $\geq$ 50% were reported in 20% to 30% of advanced NSCLC (7-9). The difference percentage may contribute to different antibodies in different trials. The Blueprint PD-L1 IHC Assay Comparison Project revealed that three antibodies (22C3, 28-8, SP263) were closely aligned on tumor cell staining, but different from SP142 (15). In present study, The PD-L1 TPS of  $\geq$ 50% were found in 18.7% patients, which was a similar percentage compared with previous studies (16-18). And a high correlation between staining on cytological cell block material and histological specimens was observed. Our results indicated the feasibility of MPE samples for PD-L1 detection.

PD-L1 TPS of  $\geq$ 50% in *EGFR* mutation patients were reported with 11% in Gainor *et al.* study (18). However, lung cancer patients harboring *EGFR* mutations are associated with lower response to PD-1/PD-L1 inhibitors (usually lower than 5% in previous studies). Low rates of concurrent PD-L1 expression and CD8<sup>+</sup> tumor-infiltrating lymphocytes (TILs) may underlie these results. In present study, 10.3% *EGFR*-mutated samples were with PD-L1 TPS of  $\geq$ 50%, in contrast, 29.1% of patients with *EGFR* wild type were with PD-L1 TPS of  $\geq$ 50% which consistence with previous study. In another study, Dong *et al.* found that TP53 mutation significantly activated T-effector and interferon- $\gamma$  signature. And *TP53/KRAS* comutated subgroup manifested exclusive increased expression of *PD-L1* mutation burden (19). The reason may due to these two genes altered a group of genes involved in cell cycle regulating, DNA replication and damage repair, which results to a favorable efficacy to immune treatment. However, it is not clear for the correlation between *TP53/ KRAS* and *PD-L1* expression in Dong *et al.* study. In present study, no significant different was found between *TP53/ KRAS* mutation. The small number patients may cause the bias.

As a retrospective nature, our study has several limitations. First, only 29 patients were with paired tumor tissue, hence, the accordance between tumor tissue and MPE sample could not fully validated in present study. Second, only the antibody of SP263 was used to examine the PD-L1 expression, which would be preferred for using another antibody to validate the results. In addition, although the 25% of TPS was recommended as cut-off value for durvalumab study (20). However, in the MYSTIC study, the data showed no more benefit for durvalumab than chemotherapy (21). Hence, 50% may be a preferable cut-off value regardless different antibody. For the purpose of comparison with other antibody, the 50% TPS was used in present study. Thirdly, no PD-1/PD-L1 inhibitors are approved in China, our data could not be examined in clinics. In additions, NGS in present study was not based on whole exome sequencing, the results based on 416 genes may not well represent the real TMB level, the relationship between PD-L1 and TMB needs to be investigated in future study. Last but not least, only 123 patients were collected in present study, hence, the correlation between rare oncogene mutations and PD-L1 expression was not fully investigate and the results might be affected.

In summary, our data suggests that MPE samples is feasible for PD-L1 IHC analysis. The PD-L1 levels of MPE cell blocks were comparable with paired tumor tissues, however, heterogeneity was found between these two media. Gene alterations based on NGS of MPE samples could contribute to select the samples that with different PD-L1 expression.

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## Footnote

Conflicts of Interest: All authors have completed the ICMJE

uniform disclosure form (available at http://dx.doi. org/10.21037/jtd.2020.02.06). The authors have no conflicts of interest to declare.

*Ethical Statement:* The authors are accountable for all aspects of the work in ensuring that questions related to the accuracy or integrity of any part of the work are appropriately investigated and resolved. The study was approved by Zhejiang Cancer Hospital Ethics Committee (IRB2014-03-032). Written informed consent was obtained from all participants.

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**Figure S1** Top 50 genes in patients with PD-L1 TPS <50% (A) and with PD-L1 TPS  $\geq$ 50% (B). PD-L1, programmed death ligand 1; TPS, tumor proportion score.

Table S1 List of 416 cancer-related	Table S1 (continued)	Table S1 (continued)	Table S1 (continued)	Table S1 (continued)	Table S1 (continued)
target genes with NGS detection	CREB1	FGFR2	MEN1	PRKCI	TMPRSS2
ABCB1 (MDR1)	CREBBP	FGFR3	MET	PRSS1	TNFAIP3
ABCC2 (MRP2)	CBKI	FGFRA	MGMT	PTCH1	TNERSE114
ADH1B				DIEN	
AFF1	CSFTR	FH		PTEN	
AFF4	CTCF	FLCN	MLH1	PTK2	TNFRSF19
AIP	CTLA4	FLI1	MLH3	PTPN11	TNFSF11
AKT1	CTNNB1	FLT1 (VEGFR1)	MLLT1	PTPRD	TOP1
ΑΚΤ2	CXCR4	FLT3	MLLT10	QKI	TOP2A
AKT3	CYLD	FLT4	MLLT3	RAC1	TP53
AK15	CYP19A1	GATA1	MLLT4	RAD50	ТРМЗ
ALDH2	CYP2A6	GATA2	MPL	RAD51	TPM4
ALK	CVP2B6*6	GATA3	MRE114	RAD51C	TPMT*2
AMER1	0/02010*2		MOLIO		
APC	CYP2C1912	GAIA4	MSH2	RADSID	
AR	CYP2C9*3	GATA6	MSH3	RAF1	TPMT*4
ARAF	CYP2D6*3	GNA11	MSH6	RARA	TPMT*5
ARID1A	CYP2D6*4	GNAQ	MTHFR	RB1	TPMT*6
ARID2	CYP2D6*5	GNAS	MTOR	RECQL4	TPMT*7
	CYP2D6*6	GOLGA5	МИТҮН	RET	TPMT*10
ARIDOB	CYP2D6*7	GOPC	MYC	RHOA	TRIM24
ASXL1	CYP2D6*11	GRIN2A	MYCI	RICTOR	TRIM27
ATF1				DNF146	
ATIC	CYP2D612	GRIM3	MYCN	RINF 146	
ATM	CYP2D6*14	GSTM1	MYD88	RNF43	TSC1
ATR	CYP3A4*4	GSTP1	NAT1	ROS1	TSC2
ATRX	CYP3A5*1	GSTT1	NBN	RPTOR	TSHR
ALIRKA	CYP3A5*3	HDAC2	NCOA4	RRM1	TTF1
	DAXX	HGF	NF1	RTEL1	TUBB3
AURKB	DCTN1	HIP1	NF2	RUNX1	TYMS
AXIN2					
AXL					
BAIAP2L1	DDR2	HNF1A	NKX2-1	SDC4	VEGFA
BAK1	DENND1A	HNF1B	NOTCH1	SDHA	VHL
BAP1	DHFR	HRAS	NOTCH2	SDHAF2	WAS
BARD1	DICER1	HSD3B1	NPM1	SDHB	WISP3
	DNMT3A	IDH1	NQO1	SDHC	WRN
BCL2	DPYD	IDH2	NR4A3	SDHD	WT1
BCL2L11 (BIM)	DUSP2	IGE1B	NBAS	SEPTO	ХРА
BIRC3					
BLM	EGFR	IGF2	NSDI	SERP2	
BMPR1A	EML4	IKBKE	NTRK1	SETBP1	XRCC1
BRAF	EP300	IKZF1	PAK3	SETD2	YAP1
	EPAS1	IK7E3	PALB2	SF3B1	ZNF2
BRCA1		11(21)			
BRCA1	EPCAM	IL7R	PALLD	SGK1	ZNF217
BRCA1 BRCA2	EPCAM EPHA2	IL7R INPP4B	PALLD PARK2	SGK1 SH2D1A	ZNF217 ZNF444
BRCA1 BRCA2 BRD4	EPCAM EPHA2 EPHA3	IL7R INPP4B INPP5D	PALLD PARK2 PARP1	SGK1 SH2D1A SHOX	ZNF217 ZNF444 ZNF703
BRCA1 BRCA2 BRD4 BRIP1	EPCAM EPHA2 EPHA3 EPS15	IL7R INPP4B INPP5D IRF2	PALLD PARK2 PARP1 PARP2	SGK1 SH2D1A SHOX SLC34A2	ZNF217 ZNF444 ZNF703 NGS, next generation sequencing,
BRCA1 BRCA2 BRD4 BRIP1 BTG2	EPCAM EPHA2 EPHA3 EPS15	ILTR INPP4B INPP5D IRF2	PALLD PARK2 PARP1 PARP2 PAX5	SGK1 SH2D1A SHOX SLC34A2 SLC34A2	ZNF217 ZNF444 ZNF703 NGS, next generation sequencing.
BRCA1 BRCA2 BRD4 BRIP1 BTG2 BTK	EPCAM EPHA2 EPHA3 EPS15 ERBB2 (HER2)	IL7R INPP4B INPP5D IRF2 JAK1	PALLD PARK2 PARP1 PARP2 PAX5	SGK1 SH2D1A SHOX SLC34A2 SLC7A8	ZNF217 ZNF444 ZNF703 NGS, next generation sequencing.
BRCA1 BRCA2 BRD4 BRIP1 BTG2 BTK BUB1B	EPCAM EPHA2 EPHA3 EPS15 ERBB2 (HER2) ERBB3	ILTR INPP4B INPP5D IRF2 JAK1 JAK2	PALLD PARK2 PARP1 PARP2 PAX5 PBRM1	SGK1 SH2D1A SHOX SLC34A2 SLC7A8 SLX4	ZNF217 ZNF444 ZNF703 NGS, next generation sequencing.
BRCA1 BRCA2 BRD4 BRIP1 BTG2 BTK BUB1B c11orf30	EPCAM EPHA2 EPHA3 EPS15 ERBB2 (HER2) ERBB3 ERBB4	ILTR INPP4B INPP5D IRF2 JAK1 JAK2 JAK3	PALLD PARK2 PARP1 PARP2 PAX5 PBRM1 PCDH11Y	SGK1 SH2D1A SHOX SLC34A2 SLC7A8 SLX4 SMAD2	ZNF217 ZNF444 ZNF703 NGS, next generation sequencing.
BRCA1 BRCA2 BRD4 BRIP1 BTG2 BTK BUB1B c11orf30 CBL	EPCAM EPHA2 EPHA3 EPS15 ERBB2 (HER2) ERBB3 ERBB4 ERC1	ILTR INPP4B INPP5D IRF2 JAK1 JAK2 JAK3 JUN	PALLD PARK2 PARP1 PARP2 PAX5 PBRM1 PCDH11Y PDCD1 (PD1)	SGK1 SH2D1A SHOX SLC34A2 SLC7A8 SLX4 SMAD2 SMAD3	ZNF217 ZNF444 ZNF703 NGS, next generation sequencing.
BRCA1 BRCA2 BRD4 BRIP1 BTG2 BTK BUB1B c11orf30 CBL CBL	EPCAM EPHA2 EPHA3 EPS15 ERBB2 (HER2) ERBB3 ERBB4 ERC1 ERCC1	ILTR INPP4B INPP5D IRF2 JAK1 JAK2 JAK3 JUN KDM5A	PALLD PARK2 PARP1 PARP2 PAX5 PBRM1 PCDH11Y PDCD1 (PD1) PDCD1LG2 (PD-L2)	SGK1 SH2D1A SHOX SLC34A2 SLC7A8 SLX4 SMAD2 SMAD3 SMAD4	ZNF217 ZNF444 ZNF703 NGS, next generation sequencing.
BRCA1 BRCA2 BRD4 BRIP1 BTG2 BTK BUB1B c11orf30 CBL CBLB	EPCAM EPHA2 EPHA3 EPS15 ERBB2 (HER2) ERBB3 ERBB4 ERC1 ERCC1 ERCC2	ILTR INPP4B INPP5D IRF2 JAK1 JAK2 JAK3 JUN KDM5A KDM6A	PALLD PARK2 PARP1 PARP2 PAX5 PBRM1 PCDH11Y PDCD1 (PD1) PDCD1LG2 (PD-L2) PDE11A	SGK1 SH2D1A SHOX SLC34A2 SLC7A8 SLX4 SMAD2 SMAD3 SMAD4 SMAD7	ZNF217 ZNF444 ZNF703 NGS, next generation sequencing.
BRCA1 BRCA2 BRD4 BRIP1 BTG2 BTK BUB1B c11orf30 CBL CBLB CCND1	EPCAM EPHA2 EPHA3 EPS15 ERBB2 (HER2) ERBB3 ERBB4 ERC1 ERCC1 ERCC2 ERCC2	ILTR INPP4B INPP5D IRF2 JAK1 JAK2 JAK3 JUN KDM5A KDM6A KDR (VEGFR2)	PALLD PARK2 PARP1 PARP2 PAX5 PBRM1 PCDH11Y PDCD1 (PD1) PDCD1LG2 (PD-L2) PDE11A PDGFRA	SGK1 SH2D1A SHOX SLC34A2 SLC7A8 SLX4 SMAD2 SMAD3 SMAD4 SMAD7 SMARCA4	ZNF217 ZNF444 ZNF703 NGS, next generation sequencing.
BRCA1 BRCA2 BRD4 BRIP1 BTG2 BTK BUB1B c11orf30 CBL CBLB CCND1 CCNE1	EPCAM EPHA2 EPHA3 EPS15 ERBB2 (HER2) ERBB3 ERBB4 ERC1 ERCC1 ERCC2 ERCC2 ERCC3 ERCC3	ILTR ILTR INPP4B INPP5D IRF2 JAK1 JAK2 JAK3 JUN KDM5A KDM6A KDM6A KDR (VEGFR2) KIE5B	PALLD PARK2 PARP1 PARP2 PAX5 PBRM1 PCDH11Y PDCD1LG2 (PD-L2) PDE11A PDGFRA PDGFRB	SGK1 SH2D1A SHOX SLC34A2 SLC7A8 SLX4 SMAD2 SMAD3 SMAD4 SMAD7 SMARCA4 SMARCB1	ZNF217 ZNF444 ZNF703 NGS, next generation sequencing.
BRCA1 BRCA2 BRD4 BRIP1 BTG2 BTK BUB1B c11orf30 CBL CBLB CCND1 CCNE1 CD274 (PD-L1)	EPCAM EPHA2 EPHA3 EPS15 ERBB2 (HER2) ERBB3 ERBB4 ERC1 ERCC1 ERCC2 ERCC2 ERCC3 ERCC4 ERCC4 ERCC5	ILTR ILTR INPP4B INPP5D IRF2 JAK1 JAK2 JAK2 JAK3 JUN KDM5A KDM6A KDR (VEGFR2) KIF5B KIT	PALLD         PARK2         PARP1         PARP2         PAX5         PBRM1         PCDH11Y         PDCD1 (PD1)         PDCD1LG2 (PD-L2)         PDE11A         PDGFRB         PDK1	SGK1 SH2D1A SHOX SLC34A2 SLC7A8 SLX4 SMAD2 SMAD3 SMAD4 SMAD7 SMARCA4 SMARCB1 SMO	ZNF217 ZNF444 ZNF703 NGS, next generation sequencing.
BRCA1 BRCA2 BRD4 BRIP1 BTG2 BTK BUB1B c11orf30 CBL CBLB CCND1 CCND1 CCNE1 CD274 (PD-L1) CD74	EPCAM EPHA2 EPHA3 EPS15 ERBB2 (HER2) ERBB3 ERBB4 ERC1 ERCC1 ERCC2 ERCC3 ERCC3 ERCC4 ERCC5	ILI 7R IL 7R INPP4B INPP5D IRF2 JAK1 JAK2 JAK2 JAK3 JUN KDM5A KDM6A KDM6A KDR (VEGFR2) KIF5B KIT	PALLD         PARK2         PARP1         PARP2         PAX5         PBRM1         PCDH11Y         PDCD1 (PD1)         PDCD1LG2 (PD-L2)         PDE11A         PDGFRA         PDGFRB         PDK1	SGK1         SH2D1A         SHOX         SLC34A2         SLC7A8         SLX4         SMAD2         SMAD3         SMAD7         SMARCA4         SMARCB1         SMO	ZNF217 ZNF444 ZNF703 NGS, next generation sequencing.
BRCA1         BRCA2         BRD4         BRIP1         BTG2         BTK         BUB1B         c11orf30         CBL         CBLB         CCND1         CCNE1         CD274 (PD-L1)         CDA	EPCAM EPHA2 EPHA3 EPS15 ERBB2 (HER2) ERBB3 ERBB4 ERC1 ERCC1 ERCC2 ERCC2 ERCC3 ERCC3 ERCC4 ERCC5 ERG	ILI 7R ILI 7R INPP4B INPP5D IRF2 JAK1 JAK2 JAK2 JAK3 JUN KDM5A KDM6A KDM6A KDR (VEGFR2) KIF5B KIT KITLG	PALLD         PARK2         PARP1         PARP2         PAX5         PBRM1         PCDH11Y         PDCD1 (PD1)         PDCD1LG2 (PD-L2)         PDE11A         PDGFRB         PDK1         PGR	SGK1         SH2D1A         SHOX         SLC34A2         SLC7A8         SLX4         SMAD2         SMAD3         SMAD7         SMARCA4         SMARCB1         SOX2	ZNF217 ZNF444 ZNF703 NGS, next generation sequencing.
BRCA1 BRCA2 BRD4 BRIP1 BTG2 BTK BUB1B c11orf30 CBL CBLB CCND1 CCNE1 CCNE1 CD274 (PD-L1) CD74 CDA CDA	EPCAM EPHA2 EPHA3 EPS15 ERBB2 (HER2) ERBB3 ERBB4 ERC1 ERCC1 ERCC1 ERCC2 ERCC3 ERCC3 ERCC4 ERCC5 ERG	IL27R         INPP4B         INPP5D         IRF2         JAK1         JAK2         JAK3         JUN         KDM5A         KDM6A         KIF5B         KIT         KITLG         KLC1	PALLD PARK2 PARP1 PARP2 PAX5 PBRM1 PCDH11Y PDCD1 (PD1) PDCD1LG2 (PD-L2) PDE11A PDGFRA PDGFRB PDK1 PGR	SGK1         SH2D1A         SHOX         SLC34A2         SLC7A8         SLX4         SMAD2         SMAD3         SMAD4         SMAC81         SMARC81         SOX2         SPOP	ZNF217 ZNF444 ZNF703 NGS, next generation sequencing.
BRCA1         BRCA2         BRD4         BRIP1         BTG2         BTK         BUB1B         c11orf30         CBL         CBLB         CCND1         CCNE1         CD274 (PD-L1)         CD74         CDC73         CDH1	EPCAM EPHA2 EPHA3 EPS15 ERBB2 (HER2) ERBB3 ERBB4 ERC1 ERCC1 ERCC2 ERCC2 ERCC3 ERCC3 ERCC4 ERCC4 ERCC5 ERG ESR1 ETV1	IL27R         INPP4B         INPP5D         IRF2         JAK1         JAK2         JAK3         JUN         KDM5A         KDM6A         KIT         KITLG         KLLN	PALLD         PARK2         PARP1         PARP2         PAX5         PBRM1         PCDH11Y         PDCD1 (PD1)         PDCD1LG2 (PD-L2)         PDGFRA         PDGFRB         PDK1         PGR         PHOX2B         PIK3C3	SGK1         SH2D1A         SHOX         SLC34A2         SLC7A8         SLX4         SMAD2         SMAD3         SMAD4         SMARCA4         SMARCB1         SOX2         SPOP         SPRY4	ZNF217 ZNF444 ZNF703 NGS, next generation sequencing.
BRCA1 BRCA2 BRD4 BRIP1 BTG2 BTK BUB1B c11orf30 CBL CBLB CCND1 CCNE1 CD274 (PD-L1) CD74 CDA CDA CDC73 CDH1 CDK10	EPCAM EPHA2 EPHA3 EPS15 ERBB2 (HER2) ERBB3 ERBB4 ERC1 ERCC1 ERCC1 ERCC2 ERCC3 ERCC3 ERCC3 ERCC3 ERCC3 ERCC4 ERCC4 ERCC5 ERC	IL27R         INPP4B         INPP5D         IRF2         JAK1         JAK2         JAK3         JUN         KDM5A         KDM6A         KIT         KITLG         KLC1         KMT2A	PALLD         PARK2         PARP1         PARP2         PAX5         PBRM1         PCDH11Y         PDCD1 (PD1)         PDCD1LG2 (PD-L2)         PDF11A         PDGFRA         PDGFRB         PDK1         PGR         PHOX2B         PIK3C3         PIK3CA	SGK1         SH2D1A         SHOX         SLC34A2         SLC7A8         SLX4         SMAD2         SMAD3         SMAD4         SMAC81         SMARC81         SOX2         SPOP         SPRY4         SRC	ZNF217 ZNF444 ZNF703 NGS, next generation sequencing.
BRCA1 BRCA2 BRD4 BRIP1 BTG2 BTK BUB1B c11orf30 CBL CBLB CCND1 CCNE1 CCNE1 CD274 (PD-L1) CD74 CD74 CDA CDC73 CDH1 CDK10 CDK12	EPCAM EPHA2 EPHA3 EPS15 ERBB2 (HER2) ERBB3 ERBB4 ERC1 ERCC1 ERCC1 ERCC2 ERCC3 ERCC3 ERCC4 ERCC4 ERCC5 ERG ESR1 ETV1 ETV4 ETV4	IL27R         INPP4B         INPP5D         IRF2         JAK1         JAK2         JAK3         JUN         KDM5A         KDM6A         KIT         KITLG         KLC1         KLN         KMT2A	PALLD         PARK2         PARP1         PARP2         PAX5         PBRM1         PCDH11Y         PDCD1 (PD1)         PDCD1LG2 (PD-L2)         PDF11A         PDGFRA         PDGFRB         PDK1         PGR         PHX28         PIK3C3         PIK3R1	SGK1         SH2D1A         SHOX         SLC34A2         SLC7A8         SLX4         SMAD2         SMAD3         SMAD4         SMACA4         SMARCB1         SOX2         SPOP         SPRY4         SRC         SRY	ZNF217 ZNF444 ZNF703 NGS, next generation sequencing.
BRCA1 BRCA2 BRD4 BRIP1 BTG2 BTK BUB1B c11orf30 CBL CBLB CCND1 CCNE1 CCNE1 CD274 (PD-L1) CD74 CDA CDA CDC73 CDH1 CDK10 CDK12	EPCAM EPHA2 EPHA3 EPS15 ERBB2 (HER2) ERBB3 ERBB4 ERC1 ERCC1 ERCC1 ERCC2 ERCC3 ERCC3 ERCC3 ERCC4 ERCC5 ERC ERC ERC ERC EXT ETV1 ETV1 ETV4 ETV6 ETV6	ILI 7R ILI 7R INPP4B INPP5D IRF2 JAK1 JAK2 JAK2 JAK3 JUN KDM5A KDM5A KDM6A KDM6A KDR (VEGFR2) KIF5B KIT KITLG KLC1 KLLN KMT2A KMT2B KRAS	PALLD         PARK2         PARP1         PARP2         PAX5         PBRM1         PCDH11Y         PDCD1 (PD1)         PDCD1LG2 (PD-L2)         PDE11A         PDGFRA         PDK1         PGR         PHOX2B         PIK3C3         PIK3R1         PIK3R2	SGK1         SH2D1A         SHOX         SLC34A2         SLC7A8         SLX4         SMAD2         SMAD3         SMAD4         SMAC4         SMARC44         SMO         SOX2         SPOP         SPRY4         SRC         SRY         STAG2	ZNF217 ZNF444 ZNF703 NGS, next generation sequencing.
BRCA1         BRCA2         BRD4         BRIP1         BTG2         BTK         BUB1B         c11orf30         CBL         CBLB         CCND1         CD274 (PD-L1)         CD74         CDA         CDK10         CDK12         CDK4	EPCAM EPHA2 EPHA3 EPS15 ERBB2 (HER2) ERBB3 ERBB4 ERC1 ERCC1 ERCC1 ERCC2 ERCC3 ERCC3 ERCC4 ERCC3 ERCC4 ERCC5 ERG ESR1 ETV1 ETV4 ETV4 ETV6 EWSR1 EXT1	IL27R         INPP4B         INPP5D         IRF2         JAK1         JAK2         JAK3         JUN         KDM5A         KDM6A         KDR (VEGFR2)         KITLG         KLC1         KLN         KMT2A         KRAS         KTN1	PALLD         PARK2         PARP1         PARP2         PAX5         PBRM1         PCDH11Y         PDCD1 (PD1)         PDCD1LG2 (PD-L2)         PDE11A         PDGFRA         PDGFRB         PDK1         PGR         PHOX2B         PIK3C3         PIK3R1         PIK3R2         PKD1	SGK1         SH2D1A         SHOX         SLC34A2         SLC7A8         SLX4         SMAD2         SMAD3         SMAD4         SMAD7         SMARC81         SMO         SOX2         SPOP         SPRY4         SRC         STAG2         STAG2	ZNF217 ZNF444 ZNF703 NGS, next generation sequencing.
BRCA1         BRCA2         BRD4         BRIP1         BTG2         BTK         BUB1B         c11orf30         CBL         CBLB         CCND1         CD274 (PD-L1)         CD74         CDA1         CDC73         CDH1         CDK10         CDK4         CDK6	EPCAM EPHA2 EPHA3 EPS15 ERBB2 (HER2) ERBB3 ERBB4 ERC1 ERCC1 ERCC1 ERCC2 ERCC3 ERCC3 ERCC4 ERCC4 ERCC5 ERG ESR1 ETV1 ETV4 ETV4 ETV6 EWSR1 EXT2	IL27R         INPP4B         INPP5D         IRF2         JAK1         JAK2         JAK3         JUN         KDM5A         KDM6A         KDR (VEGFR2)         KIF5B         KIT         KLC1         KLLN         KMT2A         KRAS         KTN1         LHCGR	PALLD         PARK2         PARP1         PARP2         PAX5         PBRM1         PCDH11Y         PDCD1 (PD1)         PDCD1LG2 (PD-L2)         PDE11A         PDGFRA         PDGFRB         PDK1         PGR         PIK3C3         PIK3R1         PIK3R2         PKD1	SGK1         SH2D1A         SHOX         SLC34A2         SLC7A8         SLX4         SMAD2         SMAD3         SMAD4         SMACA4         SMARCB1         SMO         SOX2         SPOP         SPRY4         SRC         SRY         STAG2         STAG3	ZNF217 ZNF444 ZNF703 NGS, next generation sequencing.
BRCA1         BRCA2         BRD4         BRIP1         BTG2         BTK         BUB1B         c11orf30         CBL         CBLB         CCND1         CD274 (PD-L1)         CD74         CDA         CDK10         CDK12         CDK4         CDK8	EPCAM EPHA2 EPHA3 EPS15 ERBB2 (HER2) ERBB3 ERBB4 ERC1 ERCC1 ERCC2 ERCC3 ERCC3 ERCC3 ERCC4 ERCC4 ERCC5 ERG ESR1 ETV1 ETV1 ETV4 ETV4 ETV6 EXT1 EXT1	IL27R         INPP4B         INPP5D         IRF2         JAK1         JAK2         JAK3         JUN         KDM5A         KDM6A         KDR (VEGFR2)         KIF5B         KIT         KITLG         KLLN         KMT2A         KMT2B         KRAS         KTN1         LHCGR	PALLD         PARK2         PARP1         PARP2         PAX5         PBRM1         PCDH11Y         PDCD1 (PD1)         PDCD1LG2 (PD-L2)         PDE11A         PDGFRA         PDGFRB         PLK1         PGR         PIK3C3         PIK3R1         PIK3R2         PKD1         PIK3R1         PIKU2	SGK1         SH2D1A         SHOX         SLC34A2         SLC7A8         SLX4         SMAD2         SMAD3         SMAD4         SMAD7         SMARC44         SMARC81         SVX2         SPOP         SPRY4         SRC         STAG2         STAT3         STK11	ZNF217 ZNF444 ZNF703 NGS, next generation sequencing.
BRCA1         BRCA2         BRD4         BRIP1         BTG2         BTK         BUB1B         c11orf30         CBL         CBLB         CCND1         CD274 (PD-L1)         CD74         CDA         CDK10         CDK12         CDK4         CDK8         CDKN1A	EPCAM EPHA2 EPHA3 EPS15 ERBB2 (HER2) ERBB3 ERBB4 ERC1 ERCC1 ERCC1 ERCC2 ERCC3 ERCC3 ERCC4 ERCC5 ERG ESR1 ETV1 ETV4 ETV4 ETV4 ETV4 ETV4 ETV6 EWSR1 EXT2 EXT2	IL278         INPP4B         INPP5D         IRF2         JAK1         JAK2         JAK3         JUN         KDM5A         KDM6A         KDR (VEGFR2)         KIF5B         KITLG         KLC1         KMT2A         KMT2B         KRAS         KTN1         LHCGR         LMO1	PALLD         PARK2         PARP1         PARP2         PARP3         PARP1         PARP2         PDCD11P         PDGFRA         PDGFRA         PDGFRA         PDGFRA         PDGFRA         PDGFRA         PDGFRA         PDGFRA         PDGFRA         PIK3C3         PKD1         PKHD1	SGK1         SH2D1A         SHOX         SLC34A2         SLC7A8         SLX4         SMAD2         SMAD3         SMAD4         SMACA4         SMARCB1         SOX2         SPOP         SPRY4         STAG2         STAT3         STK11         STMN1	ZNF217 ZNF444 ZNF703 NGS, next generation sequencing.
BRCA1         BRCA2         BRD4         BRIP1         BTG2         BTK         BUB1B         c11orf30         CBL         CBLB         CCND1         CD274 (PD-L1)         CD74         CDA         CDK10         CDK12         CDK4         CDK8         CDKN1A         CDKN1B	EPCAM EPHA2 EPHA3 EPS15 ERBB2 (HER2) ERBB3 ERBB4 ERC1 ERCC1 ERCC2 ERCC3 ERCC3 ERCC3 ERCC4 ERCC5 ERG ESR1 ETV1 ETV4 ETV4 ETV6 EVSR1 EXT2 EXT2 EZH2	IL278         INPP4B         INPP5D         IRF2         JAK1         JAK2         JAK3         JUN         KDM5A         KDM6A         KDR (VEGFR2)         KIF5B         KIT         KITLG         KLC1         KMT2A         KMT2B         KRAS         KTN1         LHCGR         LM01         LRG3	PALLD         PARK2         PARP1         PARP2         PAX5         PBRM1         PCDH11Y         PDCD1 (PD1)         PDCD1LG2 (PD-L2)         PDE11A         PDGFRA         PDGFRB         PIK3C3         PIK3C4         PIK3R1         PKD1         PKD1         PKD1         PKD1         PKD1         PKD2         PKHD1         PLAG1	SGK1         SH2D1A         SHOX         SLC34A2         SLC7A8         SLX4         SMAD2         SMAD3         SMAD4         SMAD7         SMARC44         SMARC81         SVX2         SPOP         SPRY4         SRC         STAT3         STK11         STMN1	ZNF217 ZNF444 ZNF703 NGS, next generation sequencing.
BRCA1         BRCA2         BRD4         BRIP1         BTG2         BTK         BUB1B         c11orf30         CBL         CBLB         CCND1         CD274 (PD-L1)         CD74         CD73         CDH1         CDK12         CDK4         CDK6         CDK8         CDKN1A         CDKN1B         CDKN1C	EPCAM EPHA2 EPHA3 EPS15 ERBB2 (HER2) ERBB3 ERBB4 ERC1 ERC1 ERC2 ERC2 ERC2 ERC2 ERC3 ERC4 ERC4 ERC4 ERC5 ERG ESR1 ETV1 ETV4 ETV4 ETV4 ETV4 ETV4 ETV4 ETV4 ETV4	IL278         IL278         INPP4B         INPP5D         IRF2         JAK1         JAK2         JAK3         JUN         KDM5A         KDM6A         KDR (VEGFR2)         KIF5B         KITLG         KLC1         KLN         KMT2A         KRAS         KTN1         LHCGR         LM01         LRIG3         LYN	PALLD         PARK2         PARP1         PARP2         PARP2         PAK5         PBRM1         PCDH11Y         PDCD1 (PD1)         PDCD1LG2 (PD-L2)         PDE11A         PDGFRA         PDGFRB         PDK1         PGR         PIK3C3         PIK3R1         PKD1         PKD1         PLK1         PKD1         PKD2         PKHD1         PLK1	SGK1         SH2D1A         SHOX         SLC34A2         SLC7A8         SLX4         SMAD2         SMAD3         SMAD4         SMAD7         SMACA4         SMARCB1         SMO         SOX2         SPOP         SPRY4         SRC         STAG2         STK11         STMN1         STRN         STT3A	ZNF217 ZNF444 ZNF703 NGS, next generation sequencing.
BRCA1         BRCA2         BRD4         BRIP1         BTG2         BTK         BUB1B         c11orf30         CBL         CBLB         CCND1         CCNE1         CD274 (PD-L1)         CD74         CDC73         CDH1         CDK10         CDK12         CDK4         CDK8         CDKN1A         CDKN1B         CDKN1C	EPCAM         EPHA2         EPHA3         EPS15         ERBB2 (HER2)         ERBB3         ERBB4         ERC1         ERC2         ERC2         ERC2         ERC3         ERC4         ESR1         ESR1         EV1         ETV1         ETV4         ETV6         EWSR1         EXT2         EZR         FANCA	IN2F10         IL7R         INPP4B         INPP5D         IRF2         JAK1         JAK2         JAK3         JUN         KDM5A         KDM6A         KDR (VEGFR2)         KIF5B         KITLG         KLLN         KMT2A         KMT2B         KTN1         LHCGR         LM01         LRIG3         LYN         LZTR1	PALLD         PARK2         PARP1         PARP2         PARP2         PAK5         PBRM1         PCDH11Y         PDCD1 (PD1)         PDCD1LG2 (PD-L2)         PDE11A         PDGFRA         PDGFRB         PDK1         PGR         PIK3C3         PIK3C4         PIK3R1         PKD2         PKD1         PKD2         PKHD1         PLAG1         PLK1         PLAG1         PLM31	SGK1         SH2D1A         SH0X         SLC34A2         SLC7A8         SLX4         SMAD2         SMAD3         SMAD4         SMAC4         SMAC81         SMO         SOX2         SPOP         SPRY4         SRC         SRY         STAG2         STK11         STMN1         STRN         SUFU	ZNF217 ZNF444 ZNF703 NGS, next generation sequencing.
BRCA1         BRCA2         BRD4         BRIP1         BTG2         BTK         BUB1B         c11orf30         CBL         CBLB         CCND1         CCNE1         CD274 (PD-L1)         CD74         CDA         CDK10         CDK12         CDK4         CDKN1A         CDKN1B         CDKN1C         CDKN2B	EPCAM         EPHA2         EPHA3         EPS15         ERBB2 (HER2)         ERBB3         ERBB4         ERC1         ERC21         ERC23         ERC4         ERC5         ERG         ESR1         ETV1         ETV4         ETV6         EWSR1         EXT2         EZR         FANCA         FANCC         FANCC2	IL278         INPP4B         INPP5D         IRF2         JAK1         JAK2         JAK3         JUN         KDM5A         KDM6A         KDR (VEGFR2)         KIF5B         KIT         KL1N         KL1N         KMT2A         KMT2B         KRAS         KTN1         LHCGR         LM01         LRIG3         LYN         MAP2K1 (MEK1)	PALLD         PARK2         PARP1         PARP2         PARP2         PAK5         PBRM1         PCDH11Y         PDCD1 (PD1)         PDCD1LG2 (PD-L2)         PDE11A         PDGFRB         PDK1         PGR         PIK3C3         PIK3C4         PKD1         PKD2         PKD1         PKD2         PKD1         PLAG1         PLAG1         PLS1         PLMS1	SGK1         SH2D1A         SH0X         SLC34A2         SLC7A8         SLX4         SMAD2         SMAD3         SMAD4         SMAD7         SMARCA4         SMO         SOX2         SPOP         SPRY4         SRC         STAG2         STAT3         STK11         STMN1         STRN         SUFU         TACC1	ZNF217 ZNF703 NGS, next generation sequencing.
BRCA1         BRCA2         BRD4         BRIP1         BTG2         BTK         BUB1B         c11orf30         CBL         CBLB         CCND1         CD274 (PD-L1)         CD74         CDA         CDK10         CDK12         CDK4         CDK8         CDKN1A         CDKN1B         CDKN2A         CDKN2B	EPCAM         EPHA2         EPHA3         EPS15         ERBB2 (HER2)         ERBB3         ERC1         ERC2         ERC2         ERC2         ERC2         ERC2         ERC2         ERC4         ERC5         ERG         ESR1         ETV1         ETV4         ETV6         EWSR1         EXT1         EXT2         EZR         FANCA         FANCA         FANCA         FANCQ         FANCD2         FANCE	IL278         INPP4B         INPP5D         IRF2         JAK1         JAK2         JAK3         JUN         KDM5A         KDM6A         KDR (VEGFR2)         KIF5B         KIT         KUN         KLN         KMT2A         KMT2B         KRAS         KTN1         LHCGR         LMO1         LRIG3         LYN         AMP2K1 (MEK1)         MAP2K2 (MEK2)	PALLD         PARK2         PARP1         PARP2         PAX5         PBRM1         PCDH11Y         PDCD1 (PD1)         PDCD1LG2 (PD-L2)         PDE11A         PDGFRA         PDGFRB         PDK1         PGR         PIK3C3         PIK3C4         PKD1         PKD2         PKD1         PKD2         PKD1         PKD2         PKD1         PLAG1         PKN3         PLMS1         PMS2         POLD1	SGK1         SH2D1A         SH0X         SLC34A2         SLC7A8         SLX4         SMAD2         SMAD3         SMAD4         SMAD7         SMACA4         SMARCB1         SMO         SOX2         SPOP         SPRY4         STAG2         STAT3         STK11         STMN1         STRN         SUFU         TACC1         TACC3	ZNF217 ZNF444 ZNF703 NGS, next generation sequencing.
BRCA1         BRCA2         BRD4         BRIP1         BTG2         BTK         BUB1B         c11orf30         CBL         CBL         CCND1         CCNE1         CD274 (PD-L1)         CD74         CDA         CDK10         CDK12         CDK4         CDK6         CDK8         CDKN1A         CDKN1B         CDKN1C         CDKN2A         CDKN2A	EPCAM         EPHA2         EPHA3         EPS15         ERBB2 (HER2)         ERBB3         ERBB4         ERC1         ERC2         ERC2         ERC2         ERC4         ERC5         ERG         EV1         ETV1         ETV4         ETV6         EWSR1         EXT1         EXT2         EZH2         FANCA         FANCA         FANCA         FANCE         FANCE	IL7R         INPP4B         INPP5D         IRF2         JAK1         JAK2         JAK3         JUN         KDM5A         KDM6A         KDR (VEGFR2)         KIF5B         KIT         KLC1         KLN         KMT2A         KRAS         KTN1         LHCGR         LMO1         LRIG3         LYN         LZTR1         MAP2K1 (MEK1)         MAP2K2 (MEK2)	PALLD         PARK2         PARP1         PARP2         PAX5         PBRM1         PCDH11Y         PCD1 (PD1)         PDCD1LG2 (PD-L2)         PDE11A         PDGFRA         PDGFRB         PK3C3         PIK3C4         PIK3R1         PKD1         PKD1         PKD2         PKD1         PKD2         PKD1         PKD2         PKD1         PKD2         PKD1         PLG1         PKD2         PKD1         PLG1         PLC1	SGK1         SH2D1A         SHOX         SLC34A2         SLC7A8         SLX4         SMAD2         SMAD3         SMAD4         SMAD7         SMACA4         SMARCB1         SMO         SOX2         SPOP         SPRY4         STAG2         STAT3         STK11         STRN         STT3A         SUFU         TACC1         TACC3	ZNF217 ZNF444 ZNF703 NGS, next generation sequencing.
BRCA1         BRCA2         BRD4         BRIP1         BTG2         BTK         BUB1B         c11orf30         CBL         CBLR         COND1         CCNE1         CD274 (PD-L1)         CD74         CD73         CDH1         CDK10         CDK12         CDK4         CDK4         CDK4         CDKN1A         CDKN1A         CDKN1B         CDKN1C         CDKN2A         CDKN2B         CDKN2C         CEBPA	EPCAM         EPHA2         EPHA3         EPS15         ERBB2 (HER2)         ERBB3         ERBB4         ERC1         ERC2         ERC3         ERC4         ERC5         ERG         ETV1         ETV4         ETV6         EWSR1         EXT1         EXT2         EZR         FANCA         FANCC         FANCC         FANCF	IL7R         INPP4B         INPP5D         IRF2         JAK1         JAK2         JAK3         JUN         KDM5A         KDM6A         KDR (VEGFR2)         KIF5B         KIT         KUR         KUN         KLN         KM12A         KM12B         KRAS         KTN1         LHCGR         LM01         LRIG3         LYN         MAP2K1 (MEK1)         MAP2K4	PALLD         PARK2         PARP1         PARP2         PARP2         PARP1         PARP2         PDG11Q2 (PD-L2)         POFRA         POGFRA         POGFRA         POGFRA         POK1         POK2         PKD1         PKD2         PKHD1         PLK1         PMS1         POLE         POLH	SGK1         SH2D1A         SHOX         SLC34A2         SLC34A2         SLC7A8         SLX4         SMAD2         SMAD3         SMAD4         SMAD5         SMAD4         SMAD7         SMACA4         SMARCA4         SMO         SOX2         SPOP         SPRY4         SRC         STAG2         STAG2         STAT3         STK11         STRN1         STRN1         STT3A         SUFU         TACC1         TACC3         TEK	ZNF217 ZNF444 ZNF703 NGS, next generation sequencing.
BRCA1         BRCA2         BRD4         BRIP1         BTG2         BTK         BUB1B         c11orf30         CBL         CBLR         COND1         CCND1         CCNNE1         CD274 (PD-L1)         CD74         CDA         CDK10         CDK12         CDK12         CDK4         CDK4         CDKN1A         CDKN1B         CDKN1C         CDKN2B         CDKN2B         CDKN2B         CDEPS7	EPCAM         EPHA2         EPHA3         EPS15         ERBB2 (HER2)         ERBB3         ERBB4         ERC1         ERC21         ERC23         ERC3         ERC4         ERC5         ERG         EVX1         ETV1         ETV4         ETV6         EXT1         EXT2         EZR         FANCA         FANCC         FANCA         FANCE         FANCF         FANCG	IL7R         INPP4B         INPP5D         IRF2         JAK1         JAK2         JAK3         JUN         KDM5A         KDM6A         KDR (VEGFR2)         KIF5B         KIT         KU1         KM12A         KM12A         KM12B         KRAS         KTN1         LHCGR         LM01         LRG3         LYN         MAP2K1 (MEK1)         MAP3K1	PALLD         PARK2         PARP1         PARP2         PARP1         PARP2         PAK5         PARP1         PARP2         PAS5         PARP2         PARP1         PAS5         PBR11         PDGFRA         PDGFRB         PDK1         PGR         PIK3C3         PIK3C4         PIK3R1         PIK3R2         PKD1         PKD2         PKHD1         PLAG1         PLK1         PMS1         POLD1         POLE         POLH	SGK1         SH2D1A         SHOX         SLC34A2         SLC7A8         SLX4         SMAD2         SMAD3         SMAD4         SMAD7         SMARC4         SMARC51         SMO         SOX2         SPOP         SPRY4         SRC         STAG2         STAG1         STMN1         STRN         SUFU         TACC1         TACC3         TEK	ZNF217 ZNF444 ZNF703 NGS, next generation sequencing.
BRCA1         BRCA2         BRD4         BRD1         BRG2         BTG2         BTK         BUB1B         c11orf30         CBL         CBLB         CCND1         CCN274 (PD-L1)         CD274 (PD-L1)         CD74         CDK10         CDK12         CDK12         CDK4         CDK6         CDKN1A         CDKN1B         CDKN1C         CDKN2A         CDKN2A         CDKN2A         CDKN2C         CEBPA         CHD4	EPCAM         EPHA2         EPHA3         EPS15         ERBB2 (HER2)         ERBB3         ERBB4         ERC1         ERC2         ERC3         ERC4         ERC5         ERG         EV1         ETV1         ETV4         ETV6         EWSR1         EXT2         EZR         FANCA         FANCA         FANCA         FANCE	IL7R         INPP4B         INPP5D         IRF2         JAK1         JAK2         JAK3         JUN         KDM5A         KDM6A         KDR (VEGFR2)         KIF5B         KITLG         KLLN         KMT2A         KMT2B         KRAS         KTN1         LHCGR         LMO1         LRIG3         LYN         MAP2K1 (MEK1)         MAP2K4         MAP3K1         MAP4K3	PALLD         PARK2         PARP1         PARP2         PARP1         PARP2         PAX5         PARP1         PARP2         PAS5         PAS5         PAS5         PBRM1         PCDH11Y         PDGFRA         PDGFRA         PDGFRA         PDGFRB         PDK1         PGR         PIK3C3         PIK3C4         PIK3R1         PIK3R2         PKD1         PLAG1         PLAG1         PIK31         PMS2         POLD1         POLE         POLH         POT1	SGK1         SH2D1A         SHOX         SLC34A2         SLC7A8         SLX4         SMAD2         SMAD3         SMAD4         SMAD7         SMARC81         SMO         SOX2         SPOP         SPRY4         SRC         STAG2         STAG1         STRN         STK11         STRN1         STRN         SUFU         TACC1         TACC3         TEKT4         TERC	ZNF217 ZNF703 NGS, next generation sequencing.
BRCA1         BRCA2         BRD4         BRD1         BRG2         BTG2         BTK         BUB1B         c11orf30         CBL         CBL74         CCND1         CCND1         CD274 (PD-L1)         CD74         CDA1         CDK10         CDK12         CDK12         CDK4         CDK6         CDKN1A         CDKN1B         CDKN1C         CDKN2A         CDKN2A         CDKN2C         CEBPA         CHEK1	EPCAM         EPHA2         EPHA3         EPS15         ERBB2 (HER2)         ERBB3         ERBB4         ERC1         ERC21         ERC23         ERC4         ERC5         ERG         ESR1         ETV1         ETV4         ETV6         EXT1         EXT2         EZR         FANCA         FANCC2         FANCA         FANCE         FANCE         FANCE         FANCE         FANCE         FANCL         FAT1	IL7R         INPP4B         INPP5D         IRF2         JAK1         JAK2         JAK3         JUN         KDM5A         KDM6A         KDR (VEGFR2)         KIF5B         KIT         KLIN         KLN         KM12A         KM12B         KRAS         KTN1         LHCGR         LM01         LRG3         LYN         MAP2K1 (MEK1)         MAP2K4         MAP3K1         MAP4K3         MAX	PAILLD         PARK2         PARP1         PARP2         PARP2         PAX5         PBRM1         PCDH11Y         PDCD1(PD1)         PDCD1LG2 (PD-L2)         PDE11A         PDGFRB         PDK1         PGR         PIK3C3         PIK3C4         PKD1         PKD2         PKD1         PKD2         PKD1         PKD2         PKD1         PLS3         PKD2         PKD1         PLG1         PLS1         POLD1         POLD1         POLD1         POLD1         POLF <t< td=""><td>SGK1         SH2D1A         SHOX         SLC34A2         SLC7A8         SLX4         SMAD2         SMAD3         SMAD4         SMAD7         SMARC81         SMO         SOX2         SPOP         SPRY4         SRC         STAG2         STAG1         STK11         STKN1         STRN         SUFU         TACC1         TACC3         TEKT4         TERC         TERT</td><td>ZNF217 ZNF703 NGS, next generation sequencing.</td></t<>	SGK1         SH2D1A         SHOX         SLC34A2         SLC7A8         SLX4         SMAD2         SMAD3         SMAD4         SMAD7         SMARC81         SMO         SOX2         SPOP         SPRY4         SRC         STAG2         STAG1         STK11         STKN1         STRN         SUFU         TACC1         TACC3         TEKT4         TERC         TERT	ZNF217 ZNF703 NGS, next generation sequencing.
BRCA1         BRCA2         BRD4         BRD4         BRIP1         BTG2         BTK         BUB1B         c11orf30         CBL         CDCND1         CCND1         CCNE1         CD274 (PD-L1)         CD74         CDA         CDK12         CDK13         CDK14         CDK15         CDK16         CDK12         CDK13         CDK14         CDK15         CDK16         CDK12         CDK4         CDK5         CDKN1A         CDKN1A         CDKN1A         CDKN2A         CDKN2B         CDKN2C         CEP57         CHD4         CHEK1	EPCAM         EPHA2         EPHA3         EPS15         ERBB2 (HER2)         ERBB3         ERBB4         ERC1         ERC21         ERC23         ERC4         ERC5         ERG         ESR1         ETV1         ETV4         ETV6         EXT2         EZR         FANCA         FANCA         FANCA         FANCA         FANCF         FANCL         FANCL         FANCL         FANCL         FANCL         FANCL         FANCL         FANCL         FANCL	IL7R         INPP4B         INPP5D         IRF2         JAK1         JAK2         JAK3         JUN         KDM5A         KDM6A         KDFSB         KIT         KITG         KL10         KL11G         KL11G         KM12A         KM12B         KM12B         KRAS         KTN1         LHCGR         LM01         LRG3         LYN         MAP2K1 (MEK1)         MAP2K4         MAP3K1         MAP3K1         MAX         MCL1	PALLD         PARK2         PARP1         PARP2         PAX5         PBRM1         PCDH11Y         PDCD1 (PD1)         PDCD1LG2 (PD-L2)         PDE11A         PDGFRB         PDK1         PGR         PK3C3         PIK3C4         PKD2         PKD1         PLS11         POGFFRB         PUK1         PGR         PIK3C3         PIK3C4         PIK3R1         PIK3R2         PKD1         PLAG1         PLAG1         PLK1         POLD1         POLF         POLH         POU5F1         POP2R1A	SGK1         SH2D1A         SHOX         SLC34A2         SLC7A8         SLX4         SMAD2         SMAD3         SMAD4         SMAD5         SMAD4         SMAD7         SMARC44         SMARC51         SMAR         SV2         SPOP         SPRY4         SRC         STAG2         STK11         STK11         STKNN         STRN         SUFU         TACC1         TACC3         TEK         TERC         TERT         TERT	ZNF217 ZNF703 NGS, next generation sequencing.
BRCA1         BRCA2         BRD4         BRIP1         BTG2         BTK         BUB1B         c11orf30         CBL         CBL         CDCND1         CCND1         CD274 (PD-L1)         CD74         CDA         CDK10         CDK12         CDK4         CDK4         CDKN1A         CDKN1B         CDKN1C         CDKN2A         CDKN2B         CDKN2C         CEBPA         CHEK1         CHEK2	EPCAM         EPHA2         EPHA3         EPS15         ERBB2 (HER2)         ERBB3         ERBB4         ERC1         ERC21         ERC23         ERC4         ERC5         ERG         ESR1         ETV1         ETV4         ETV6         EXT2         EZR         FANCA         FANCA         FANCA         FANCE         FANCE	IL7R         INPP4B         INPP5D         IRF2         JAK1         JAK2         JAK3         JUN         KDM5A         KDM6A         KDF5B         KIT         KITG         KLN         KUT2A         KM12A         KM12B         KRAS         KTN1         LHCGR         LM01         KRAS         KTN1         LHCGR         LM01         MAP2K1 (MEK1)         MAP2K4         MAP3K1         MAP4K3         MAX         MCL1         MDM2	PALLD         PARK2         PARP1         PARP2         PAX5         PBRM1         PCDH11Y         PDCD1 (PD1)         PDCD1LG2 (PD-L2)         PDE11A         PDGFRA         PDGFRB         PLK1         PGR         PIK3C3         PIK3R2         PKD1         PKD2         PKD1         PKD2         PKD1         PLS1         PKD2         PKD1         PLS2         PKHD1         PLS1         PMS2         POLD1         POLD1         POLD1         POLD1         POLD1         POLD1         PMS2         POLD1         POLD1 </td <td>SGK1         SH2D1A         SHOX         SLC34A2         SLC7A8         SLX4         SMAD2         SMAD3         SMAD4         SMAD5         SMAD4         SMAD7         SMARC44         SMO         SOX2         SPOP         SPRY4         SRC         STAG2         STAG2         STAT3         STK11         STMN1         STRN         SUFU         TACC3         TEK         TERC         TERT         TERT2         TFG</td> <td>ZNF217 ZNF703 NGS, next generation sequencing.</td>	SGK1         SH2D1A         SHOX         SLC34A2         SLC7A8         SLX4         SMAD2         SMAD3         SMAD4         SMAD5         SMAD4         SMAD7         SMARC44         SMO         SOX2         SPOP         SPRY4         SRC         STAG2         STAG2         STAT3         STK11         STMN1         STRN         SUFU         TACC3         TEK         TERC         TERT         TERT2         TFG	ZNF217 ZNF703 NGS, next generation sequencing.
BRCA1         BRCA2         BRD4         BRIP1         BTG2         BTK         BUB1B         c11orf30         CBL         CBL         CDCND1         CCND1         CD274 (PD-L1)         CD74         CDA         CDK12         CDK13         CDK14         CDK12         CDK12         CDK13         CDK14         CDK12         CDK12         CDK4         CDKN1A         CDKN1A         CDKN2A         CDKN2A         CDKN2B         CDKN2C         CEBPA         CHEK1         CHEK2         CLIP1	EPCAM         EPHA2         EPHA3         EPS15         ERBB2 (HER2)         ERBB3         ERC1         ERC1         ERC2         ERC3         ERC4         ERC5         ERG         ESR1         ETV1         ETV4         EVSR1         EXT1         EXT2         ZR         FANCA         FANCA         FANCA         FANCE         FANCE	IL7R         INPP4B         INPP5D         IRF2         JAK1         JAK2         JAK3         JUN         KDM5A         KDM6A         KDR (VEGFR2)         KIF5B         KIT         KLN         KUN2A         KM12A         LWN         KM2A         KM12B         KRAS         KTN1         LHCGR         LWO1         LZTR1         MAP2K1 (MEK1)         MAP2K2 (MEK2)         MAP3K1         MAP3K1         MAP3K1         MAP4K3         MAX         MCL1         MDM2	PALLD         PARK2         PARP1         PARP2         PAX5         PBRM1         PCDH11Y         PDCD1 (PD1)         PDCD1LG2 (PD-L2)         PDE11A         PDGFRA         PDGFRB         PK1         PGR         PIK3C3         PIK3R1         PKD1         PKD2         PKD1         PKD2         PKD1         PLS3         PUS1         PKD2         PKD1         PLS1         PKD2         PKD1         PLS3         PLS1         PKD2         PKD1         PLS1         PLS1         PLS1         PLS1         PLS1         POLD1         POLD1         POLD1         POLF         POLF1         POLF1         POLF1         POLS51         PRM1         PRM1         PRM1         PRM1	SGK1         SH2D1A         SH0X         SLC34A2         SLC7A8         SLX4         SMAD2         SMAD3         SMAD4         SMAD7         SMARCA1         SMARCB1         SMO         SOX2         SPOP         SPRY4         SRC         STAG2         STAG1         STRN         STK11         STRN1         STRN         SUFU         TACC3         TEKT4         TERC         TERT         TER2         TFG         TGFBR2	ZNF217 ZNF703 NGS, next generation sequencing.
BRCA1         BRCA2         BRD4         BRIP1         BTG2         BTK         BUB1B         c11orf30         CBL         CBL         CDCND1         CCND1         CD274 (PD-L1)         CD74         CDA         CDC73         CDK12         CDK12         CDK4         CDK6         CDK8         CDKN1A         CDKN1A         CDKN1B         CDKN1C         CDKN2A         CDKN2A         CDKN2C         CEBPA         CHEK1         CHEK2         CLIP1	EPCAM         EPHA2         EPHA3         EPS15         ERBB2 (HER2)         ERBB3         ERBB4         ERC1         ERC21         ERC23         ERC4         ERC5         ERG         ESR1         ETV1         ETV4         ETV6         EXT2         EZR         FANCA         FANCA         FANCA         FANCE         FANCE	IL7R         INPP4B         INPP5D         IRF2         JAK1         JAK2         JAK3         JUN         KDM5A         KDM6A         KDR (VEGFR2)         KIF5B         KIT         KUT1G         KL01         KMT2A         KMT2B         KRAS         KTN1         LHCGR         LW01         KRAS         KTN1         LHCGR         LM01         MAP2K1 (MEK1)         MAP2K2 (MEK2)         MAP3K1         MAP3K1         MAP3K1         MAP4K3         MAZ         MAD12	PALLD         PARK2         PARP1         PARP2         PAX5         PBRM1         PCDH11Y         PDCD1 (PD1)         PDCD1LG2 (PD-L2)         PDE11A         PDGFRA         PDGFRB         PDK1         PGR         PIK3C3         PIK3C4         PKD1         PKD2         PKD1         PIK3C3         PIK3R1         PIK3R2         PKD1         PLK1         POLD1         PUK1         PIK3R2         PKD1         PLK1         PUK1         PLK1         PUK1         PUK1         PUK3         PUK1         PUL1         PUL1         PUL1         PUL1         PUL1	SGK1         SH2D1A         SH0X         SLC34A2         SLC7A8         SLX4         SMAD2         SMAD3         SMAD4         SMAD5         SMAD4         SMAC41         SMARC81         SMO         SOX2         SPOP         SPRY4         SRC         STAG2         STK11         STMN1         STRN         STT3A         SUFU         TACC3         TEK         TERC         TERT         TERT         TERT         TERT         TERD         THADA	ZNF217 ZNF444 ZNF703 NGS, next generation sequencing.
BRCA1         BRCA2         BRD4         BRIP1         BTG2         BTK         BUB1B         c11orf30         CBL         CBLB         CCND1         CD274 (PD-L1)         CD74         CDA         CDK10         CDK12         CDK12         CDK4         CDKN1A         CDKN1A         CDKN1A         CDKN2A         CDKN2A         CDKN2A         CDKN2C         CEBPA         CHEK1         CHEK2         CLIP1         CDLTA1	EPCAM         EPHA2         EPHA3         EPS15         ERBB2 (HER2)         ERBB3         ERBB4         ERC1         ERC21         ERC23         ERC4         ERC5         ERG         ESR1         ETV1         ETV4         ETV6         EXR1         EXT1         EXT2         EZR         FANCA         FANCA         FANCA         FANCE         FANCE	IL7R         INPP4B         INPP5D         IRF2         JAK1         JAK2         JAK3         JUN         KDM5A         KDM6A         KDR (VEGFR2)         KIF5B         KIT         KUT1G         KLC1         KMT2A         KMT2B         KRAS         KTN1         LHCGR         LYN         LZTR1         MAP2K1 (MEK1)         MAP2K4         MAP3K1         MAP4K3         MAZ         MAP4         MAP12         MAP12         MAP2         MAP3         MAP3   MAP3   MAP3	PALLD         PARK2         PARP1         PARP2         PAX5         PBRM1         PCDH11Y         PDCD1 (PD1)         PDCD1LG2 (PD-L2)         PDE11A         PDGFRB         PDK1         PGR         PIK3C3         PIK3C4         PKD2         PKD1         PLK12         PKD2         PIK3R1         PIK3R2         PKD1         PLK1         POLD1         PUK1         PKD2         PKD1         PIK3R2         PKD1         PLK1         PMS1         PMS2         POLD1         POLF         POLD1         POLF         POLD1         POLF         POLD1         POLF         POLF1         POLF1 <td>SGK1         SH2D1A         SH0X         SLC34A2         SLC7A8         SLX4         SMAD2         SMAD3         SMAD4         SMAD5         SMAD4         SMAC4         SMARC81         SMO         SOX2         SPOP         SPRY4         SRC         STAG2         STAG2         STAT3         STK11         STRN         STT3A         SUFU         TACC3         TEK         TERC         TERT         TERT         TERT         THADA         TMEM127</td> <td>ZNF217 ZNF444 ZNF703 NGS, next generation sequencing.</td>	SGK1         SH2D1A         SH0X         SLC34A2         SLC7A8         SLX4         SMAD2         SMAD3         SMAD4         SMAD5         SMAD4         SMAC4         SMARC81         SMO         SOX2         SPOP         SPRY4         SRC         STAG2         STAG2         STAT3         STK11         STRN         STT3A         SUFU         TACC3         TEK         TERC         TERT         TERT         TERT         THADA         TMEM127	ZNF217 ZNF444 ZNF703 NGS, next generation sequencing.
BRCA1         BRCA2         BRD4         BRIP1         BTG2         BTK         BUB1B         c11orf30         CBL         CBLB         CCND1         CD274 (PD-L1)         CD74         CDA         CDK10         CDK12         CDK10         CDK12         CDK6         CDKN1A         CDKN1B         CDKN1C         CDKN2A         CDKN2B         CDKN2C         CEBPA         CEP57         CHD4         CHEK1         CHEK2         CLIP1         CLTC         COL1A1	EPCAM         EPHA2         EPHA3         EPS15         ERBB2 (HER2)         ERBB3         ERBB4         ERC1         ERC21         ERC23         ERC4         ERC5         ERG         ESR1         ETV1         ETV4         ETV6         EWSR1         EXT1         EXT2         EZR         FANCA         FANCA         FANCE         FANCE	ILTR         INPP4B         INPP5D         IRF2         JAK1         JAK2         JAK3         JUN         KDM5A         KDM6A         KDFSB         KIT         KITG         KLIN         KMT2A         KMT2B         KRAS         KTN1         LHCGR         LM01         LRIG3         LYN         LZTR1         MAP2K2 (MEK2)         MAP2K4         MAP3K1         MAP4K3         MAX         MCL1         MDM4         MED12         MEF2B	PALLD         PARK2         PARP1         PARP2         PAX5         PBRM1         PCDH11Y         PDCD1 (PD1)         PDC1LG2 (PD-L2)         PDE11A         PDGFRA         PDGFRB         PDK1         PGR         PHOX2B         PIK3C3         PIK3C4         PKD1         PKD2         PKD1         PKD2         PKD1         PLS1         PMS2         POLD1         POLD1         POLF1         PMS1         POLF1         PRM1         PRF1         PRKACA         PRKAR1A	SGK1         SH2D1A         SHOX         SLC34A2         SLC7A8         SLX4         SMAD2         SMAD3         SMAD4         SMAD7         SMARCA4         SMO         SOX2         SPOP         SPRY4         SRC         SRY         STAG2         STAT3         STK11         STRN1         STRN1         STRN1         STT3A         SUFU         TACC1         TACC3         TEK         TERT         TERT         TERT         TERT         TERT         THADA         TMEM127	ZNF217 ZNF444 ZNF703 NGS, next generation sequencing.

Variable	PD-L1 TPS ≥50%	PD-L1 TPS <50%	Р
Gender			0.025
Male	17	48	
Female	6	52	
Age, years			0.85
<65	14	63	
≥65	9	37	
Smoking history			0.01
Yes	15	36	
No	8	64	
Metastasis site			0.53
M1a	15	58	
M1b	8	42	
Chemotherapy history			0.33
Yes	5	32	
No	18	68	
Performance status			0.33
0–1	19	92	
2	4	8	

Table S2 Comparison of clinical characteristics of PD-L1 TPS ≥50% versus TPS <50%

PD-L1, programmed death ligand 1; TPS, tumor proportion score.