

Supplementary Table S1. Treatment Benefit Prediction Score (TBPS) and suggestion of drug: 1) Over-expression genes-related analysis, 2) Under-expression genes-related analysis, 3) Mutation genes-related analysis (Full data).

1) Over-expression genes-related analysis				
Patient no.	Druggable Pathway	Druggable Gene	TBPS	Matched Drug
4	Measles, Hematopoietic cell lineage, Chagas disease (American trypanosomiasis), T cell receptor signaling pathway, HTLV-I infection	CD3E	72.7	Muromonab
5	RIG-I-like receptor signaling pathway, Hepatitis C, IL-17 signaling pathway, MAPK signaling pathway, Toll-like receptor signaling pathway, Herpes simplex infection, Influenza A	TNF	135.3	Adalimumab
				Golimumab
				Infliximab
	Toll-like receptor signaling pathway, Cell adhesion molecules (CAMs)	CD80	23.4	Durvalumab
	Cell adhesion molecules (CAMs)	CD274	9.1	Atezolizumab
				Avelumab
				Durvalumab
11	Cell adhesion molecules (CAMs)	PDCD1	9.1	Nivolumab
				Pembrolizumab
	MAPK signaling pathway, Hepatitis C, Hepatitis B, T cell receptor signaling pathway, Toll-like receptor signaling pathway, NF-kappa B signaling pathway, Herpes simplex infection, Cytokine-cytokine receptor interaction	TNF	120.2	Adalimumab
				Golimumab
16	Ras signaling pathway, Rap1 signaling pathway, MAPK signaling pathway	FGF1	19.3	Pazopanib
	Ras signaling pathway, Rap1 signaling pathway, MAPK signaling pathway	FGFR4	19.3	Lenvatinib
	Influenza A, Epstein–Barr virus infection, Kaposi's sarcoma-associated herpesvirus infection, Human papillomavirus infection, Pathways in cancer, Tuberculosis, Herpes simplex infection, HTLV-I infection	JAK1	41.4	Ruxolitinib
2) Under-expression genes-related analysis				
Patient No.	Druggable Pathway	Druggable Gene	TBPS	Matched Drug

14	Endocytosis, Human papillomavirus infection, MAPK signaling pathway, MicroRNAs in cancer, PI3K-Akt signaling pathway, Pathways in cancer	EGFR	18.4	Afatinib
				Cetuximab
				Erlotinib
				Gefitinib
				Icotinib
				Lapatinib
				Lidocaine
				Necitumumab
				Olmutinib
				Osimertinib
57	Human papillomavirus infection, MAPK signaling pathway, MicroRNAs in cancer, PI3K-Akt signaling pathway, Pathways in cancer	GRB2	17.8	Pegademase bovine
59	Kaposi's sarcoma-associated herpesvirus infection, Human papillomavirus infection, MicroRNAs in cancer, PI3K-Akt signaling pathway, Pathways in cancer	PIK3R2	16.5	Isoprenaline
57	Axon guidance, T cell receptor signaling pathway, Measles, Natural killer cell mediated cytotoxicity	FYN	30.2	Dasatinib
57	T cell receptor signaling pathway, Pathways in cancer, Human papillomavirus infection, Natural killer cell mediated cytotoxicity	GRB2	18.9	Pegademase bovine
57	Kaposi's sarcoma-associated herpesvirus infection, Pathways in cancer, Human papillomavirus infection, HTLV-I infection	PIK3R1	16.9	Isoprenaline
57	T cell receptor signaling pathway, HTLV-I infection, Natural killer cell mediated cytotoxicity	LCK	16	Dasatinib
				Nintedanib
				Ponatinib
59		NFKB1	124.9	Acetylsalicylic acid

	HTLV-I infection, Influenza A, Human papillomavirus infection, Viral carcinogenesis, Epstein–Barr virus infection, Ras signaling pathway, IL-17 signaling pathway, cAMP signaling pathway, Herpes simplex infection, Pathways in cancer				Pranlukast
					Thalidomide
					Triflusal
	IL-17 signaling pathway, Pathways in cancer	HSP90AA1	26.2		Nedocromil
					Rifabutin
3) Mutation genes-related analysis					
Patient No.	Druggable Pathway	Druggable Gene	TBPS	Matched Drug	
3	Pathways in cancer, PI3K-Akt signaling pathway, HTLV-I infection, Human papillomavirus infection, MicroRNAs in cancer, Kaposi's sarcoma-associated herpesvirus infection, Epstein–Barr virus infection, Breast cancer, Prostate cancer	TP53	42.5	Acetylsalicylic acid	
	Pathways in cancer, PI3K-Akt signaling pathway, Human papillomavirus infection, MicroRNAs in cancer, Focal adhesion, Breast cancer, Prostate cancer	GRB2	27.7	Pegademase bovine	
14	Tight junction, Rap1 signaling pathway, Endocytosis, Adherens junction	SRC	26.6	Nintedanib	
				Ponatinib	
				Bosutinib	
				Dasatinib	
	Human papillomavirus infection, Transcriptional misregulation in cancer, Alcoholism	HDAC1	14	Romidepsin	
				Vorinostat	
	Human papillomavirus infection, Transcriptional misregulation in cancer, Alcoholism	HDAC2	11.3	Aminophylline	
				Lovastatin	
				Oxtriphylline	
				Romidepsin	
				Theophylline	
				Valproic Acid	
				Vorinostat	

18	Human papillomavirus infection, Transcriptional misregulation in cancer, Herpes simplex infection	TP53	10.8	Acetylsalicylic acid
	Human papillomavirus infection, Alcoholism	GRB2	7.8	Pegademase bovine
	Human papillomavirus infection, Alcoholism	HDAC3	7.8	Vorinostat
	Human papillomavirus infection, Rap1 signaling pathway	PIK3R1	7	Isoprenaline
	Human papillomavirus infection	AKT1	2	Arsenic trioxide
	Human papillomavirus infection	CTNNB1	2	Urea
	Human papillomavirus infection	EGFR	2	Afatinib
				Cetuximab
				Erlotinib
				Gefitinib
				Icotinib
				Lapatinib
				Lidocaine
				Necitumumab
				Olmutinib
				Osimertinib
				Panitumumab
				Trastuzumab
				Vandetanib
	Human papillomavirus infection	GSK3B	2	Lithium
	Pathways in cancer, PI3K-Akt signaling pathway, Prostate cancer, Th17 cell differentiation, Fluid shear stress and atherosclerosis	HSP90AA1	29.1	Nedocromil
	MAPK signaling pathway, Osteoclast differentiation	JUN	6.9	Rifabutin
				Arsenic trioxide
				Irbesartan
				Pseudoephedrine
	MAPK signaling pathway, FoxO signaling pathway	EGFR	6.1	Vinblastine
				Afatinib
				Cetuximab

			Erlotinib
			Gefitinib
			Icotinib
			Lapatinib
			Lidocaine
			Necitumumab
			Olmutinib
			Osimertinib
			Panitumumab
			Trastuzumab
			Vandetanib
MAPK signaling pathway, Cellular senescence	MYC	5.9	Nadroparin
Osteoclast differentiation	FYN	4.3	Dasatinib
Osteoclast differentiation	NFKBIA	4.3	Acetylsalicylic acid

AKT1: AKT Serine/Threonine Kinase 1, CD274: Programmed cell death 1 ligand 1, CD3E: T-cell surface glycoprotein CD3 epsilon chain, CD80: T-lymphocyte activation antigen CD80, CTNNB1: Catenin Beta 1, EGFR: Epidermal Growth Factor Receptor, EGFR: Epidermal Growth Factor Receptor, FGF1: Fibroblast growth factor 1, FGFR4: Fibroblast growth factor receptor 4, FYN: FYN Proto-Oncogene, FYN: FYN Proto-Oncogene, GRB2: Growth Factor Receptor Bound Protein 2, GRB2: Growth Factor Receptor Bound Protein 2, GSK3B: Glycogen Synthase Kinase 3 Beta, HDAC1: Histone Deacetylase 1, HDAC2: Histone Deacetylase 2, HDAC3: Histone Deacetylase 3, HSP90AA1: Heat Shock Protein 90 Alpha Family Class A Member 1, HSP90AA1: Heat Shock Protein 90 Alpha Family Class A Member 1, JAK1: Tyrosine-protein kinase JAK1, JUN: Jun Proto-Oncogene, AP-1 Transcription Factor Subunit, LCK: LCK Proto-Oncogene, Src Family Tyrosine Kinase, MYC: MYC Proto-Oncogene, BHLH Transcription Factor, NFKB1: Nuclear Factor Kappa B Subunit 1, NFKBIA: NFKB Inhibitor Alpha, Non-Receptor Tyrosine Kinase, PDCD1: Programmed cell death protein 1, PIK3R1: Phosphoinositide-3-Kinase Regulatory Subunit 1, PIK3R2: Phosphoinositide-3-Kinase Regulatory Subunit 2, Src Family Tyrosine Kinase, Src Family Tyrosine Kinase, SRC: SRC Proto-Oncogene, TNF: Tumor necrosis factor, TP53: Tumor Protein P53

Supplementary Table S2. The results of pathway analysis in PIK3CA Inhibitor responding patient.

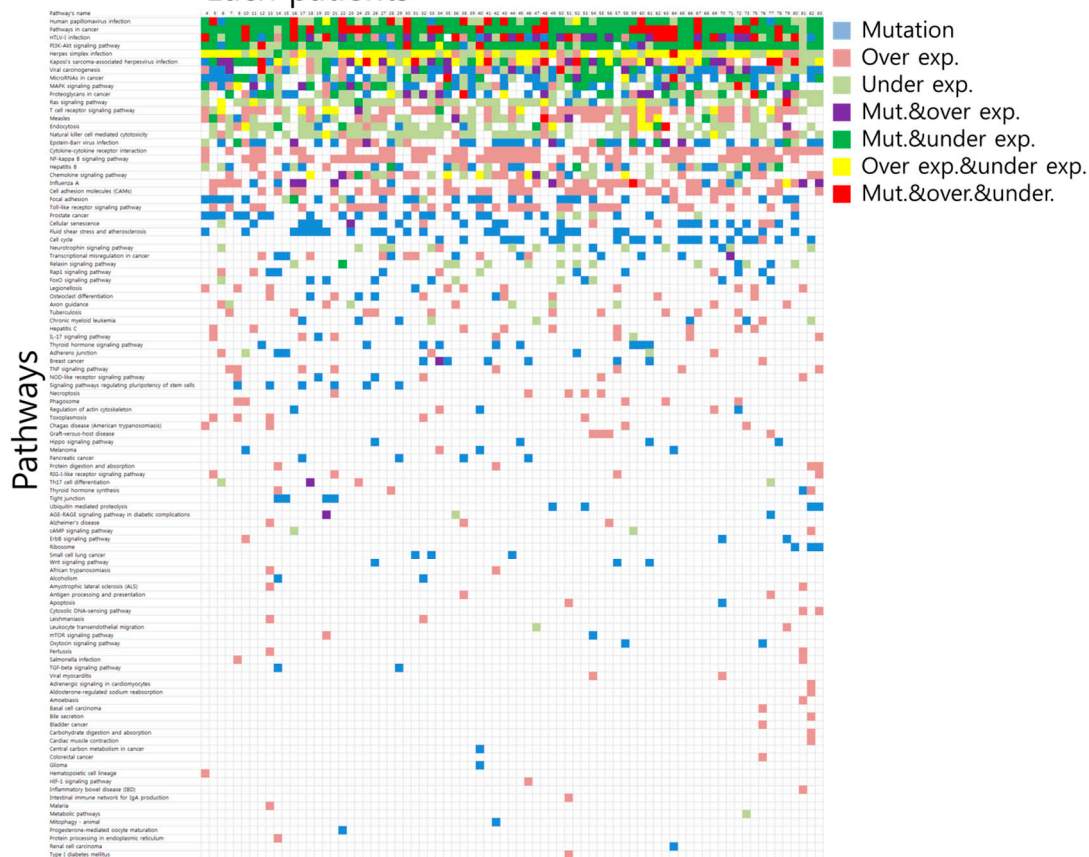
NGS based analysis				
Pathway Name	High Frequency Gene	Frequency Ratio	TBPS	Matching drug names
PI3K-Akt signaling pathway	HSP90AA1	100.0	3.7	Alvespimycin, Tanespimycin
PI3K-Akt signaling pathway	PIK3CA	66.7	2.4	Alpelisib , Copanlisib
PI3K-Akt signaling pathway	PDGFRA	66.7	2.4	Erdaftinib, Midostaurin

PI3K-Akt signaling pathway	KIT	33.3	1.2	Ancestim, Erdafitinib, Midostaurin
PI3K-Akt signaling pathway	CSF1R	33.3	1.2	Erdafitinib
PI3K-Akt signaling pathway	FGFR1	33.3	1.2	Erdafitinib
PI3K-Akt signaling pathway	PDGFRB	33.3	1.2	Erdafitinib, Midostaurin
PI3K-Akt signaling pathway	CSF3R	33.3	1.2	Filgrastim, Lenograstim, Lipegfilgrastim, Pegfilgrastim
PI3K-Akt signaling pathway	HSP90AB1	33.3	1.2	Tanespimycin
PI3K-Akt signaling pathway	FLT1	33.3	1.2	Vatalanib
nCounter based analysis				
Pathway Name	High Frequency Gene	Frequency Ratio	TBPS	Matching drug names
PI3K-Akt signaling pathway	HSP90AA1	80.0	2.6	Alvespimycin, Tanespimycin
Proteoglycans in cancer	EGFR	58.3	2.5	Dacomitinib
PI3K-Akt signaling pathway	HSP90AB1	70.0	2.3	Tanespimycin
Pathways in cancer	HSP90AA1	80.0	1.9	Alvespimycin
Pathways in cancer	PIK3R1	80.0	1.9	Enzastaurin
Pathways in cancer	EGFR	70.0	1.6	Afatinib, Brigatinib, Canertinib, Cetuximab, Erlotinib, Gefitinib, Icotinib, Lapatinib, Neratinib, Olmutinib, Osimertinib, Panitumumab, Pelitinib, Rindopepimut, Trastuzumab, Vandetanib, Varlitinib, Zalutumumab
PI3K-Akt signaling pathway	MET	50.0	1.6	Cabozantinib
Proteoglycans in cancer	ESR1	33.3	1.4	Toremifene
PI3K-Akt signaling pathway	FGFR1	40.0	1.3	Erdafitinib

PI3K-Akt signaling pathway	FGFR2	40.0	1.3	Erdafitinib
PI3K-Akt signaling pathway	FGFR4	40.0	1.3	Erdafitinib
Pathways in cancer	ERBB2	50.0	1.2	Afatinib, Brigatinib, Lapatinib, Pertuzumab, Trastuzumab, Trastuzumab emtansine, Tucatinib, Varlitinib
Pathways in cancer	MET	50.0	1.2	Amuvatinib, Brigatinib, Cabozantinib, Crizotinib, Tivantinib
Pathways in cancer	AKT1	50.0	1.2	Arsenic trioxide, Enzastaurin
Pathways in cancer	JAK2	50.0	1.2	Ruxolitinib
PI3K-Akt signaling pathway	CDK4	30.0	1.0	Abemaciclib, Palbociclib, Ribociclib
PI3K-Akt signaling pathway	PIK3CA	30.0	1.0	Alpelisib , Copanlisib

AKT1: AKT Serine/Threonine Kinase 1, CDK4: Cyclin-dependent kinase 4, CSF1R: Macrophage colony-stimulating factor 1 receptor, CSF3R: Granulocyte colony-stimulating factor receptor, EGFR: Epidermal growth factor receptor, ERBB2: Receptor tyrosine-protein kinase erbB-2, ESR1: Estrogen receptor, FGFR1: Fibroblast growth factor receptor 1, FGFR2: Fibroblast growth factor receptor 2, FGFR4: Fibroblast growth factor receptor 4, FLT1: Vascular endothelial growth factor receptor 1, HSP90AA1: Heat shock protein HSP 90-alpha, HSP90AB1: Heat shock protein HSP 90-beta, JAK2: Tyrosine-protein kinase JAK2, KIT: Mast/stem cell growth factor receptor Kit, MET: Hepatocyte growth factor receptor, PDGFRA: Platelet-derived growth factor receptor alpha, PDGFRB: Platelet-derived growth factor receptor beta, PIK3CA: Phosphatidylinositol 4,5-bisphosphate 3-kinase catalytic subunit alpha isoform, PIK3R1: Phosphatidylinositol 3-kinase regulatory subunit alpha

Each patients



Supplementary Figure S1. Oncoplot for pathway analysis in all patients.