Phosphorus Diagnostics

DRUG RESPONSE

PHOSPHORUS DIAGNOSTICS
400 PLAZA DRIVE, SECAUCUS, NJ, 07094

ORDERING PRACTICE
Central Oklahoma Early Detection Center
1227 E. 9th Street, Edmond, Oklahoma, 73034
Ordering Practitioner: Demo Physician

PATIENT
Patient: Demo Patient
DOB: 1953-11-17
Sample Barcode(s): S20191011222983
Specimen: Blood
Specimen Collected: 2019-10-09
Specimen Received: 2019-10-11

TEST ORDER
Report: Drug Response (DR.LDO1.V1)
Panel: Drug Response Full Panel
Procedure ID: 149312
Date Ordered: 2019-10-11
Generated: 2019-12-06 17:37:19 UTC

SUMMARY OF TEST RESULTS

Genes Tested: 60			Drugs Assessed: 152		
Disease Area of Interest	Drugs Assessed	Genes Tested	Use with Extreme Caution	Use with Caution	Normal Response Expected
Immunology	12	11	0	5	7
Oncology	25	24	0	11	14
Pain Management	16	10	0	11	5
Cardiovascular	16	12	0	9	7
Infectious Disease	25	12	0	9	16
Neurology	6	8	0	2	4
Psychiatry	33	7	0	6	27
Endocrinology	7	3	0	1	6
Other Drugs	5	5	0	3	2
Ophthalmology	2	3	0	1	1
Gastroenterology	5	2	0	0	5

INTERPRETATION OF RESULTS

Use with Extreme Caution/Consider Alternatives	Use with Caution	Normal Response Expected
These drugs are expected to have serious adverse effects or are contraindicated based on the patient's genotype.	These drugs may be less effective or result in adverse effects based on the patient's genotype.	These drugs are expected to have a normal response based on the patient's genotype.

DETAILED SUMMARY OF RESULTS

Use with Extreme Caution/Consider Alternatives

No recommendations were identified.

Use with Caution

IMMUNOLOGY

Drug	Drug Type	Gene	Genotype	Interpretation	Reference(s)
Tacrolimus	Calceineurin Inhibitor	CYP3A4	rs2740574 T/T	Patients with this genotype may require a decrease in dosage.	23778326; 21770725; 22108237; 12966368; 26039043; 17495880; 23588314; 24444408; 26615671; 27225724
			rs2242480 C/C	Patients with this genotype may have decreased metabolism of this drug.	21635144; 23459029; 24189425; 24465960; 26228923; 26227094
Adalimumab	TNF Inhibitor	TNF	rs1800629 G/A	Patients with this genotype may be less likely to respond to treatment.	26244882; 24192118; 23057546; 22960943; 22760475; 22129793; 19365401; 18713756; 18438841; 18050183; 17673491; 17343250; 16909270; 16720636; 15834068; 12847678; 12759288; 12190096
Etanercept	TNF Inhibitor	TNF	rs1800629 G/A	Patients with this genotype may be less likely to respond to treatment.	26244882; 24192118; 23057546; 22960943; 22760475; 22129793; 19365401; 18713756; 18438841; 18050183; 17673491; 17343250; 16909270; 16720636; 15834068; 12847678; 12759288; 12190096
Infliximab	TNF Inhibitor	TNF	rs1800629 G/A	Patients with this genotype may be less likely to respond to treatment.	26244882; 24192118; 23057546; 22960943; 22760475; 22129793; 19365401; 18713756; 18438841; 18050183; 17673491; 17343250; 16909270; 16720636; 15834068; 12847678; 12759288; 12190096
Lesinurad	Urate Transporter Inhibitor	CYP2C9	*2/*2	Patients with this genotype may have significantly reduced metabolism of this drug which could increase the risk for side effects. A significantly reduced starting dosage is recommended.	See FDA Drug Label

ONCOLOGY

Drug	Drug Type	Gene	Genotype	Interpretation	Reference(s)

Ondansetron	5-HT3 Antagonist	ABCB1	rs2032582 C/C	Patients with this genotype may have an increased risk for nausea and vomiting when using this drug.	20707787; 25012726
			rs1045642 G/G	Patients with this genotype may have an increased risk of nausea and vomiting when using this drug.	20707787; 25012726
Anthracyclines and Related Substances	Anthracyclines and Related Substances	SLC28A3	rs7853758 G/G	Patients with this genotype may be at increased risk for cardiotoxicity.	21900104; 23441093
		CBR3	rs1056892 G/G	Patients with this genotype may be at increased risk for cardiac exposure after exposure to anthracyclines.	22124095; 18457324
		HAS3	rs2232228 A/G	Patients with this genotype may have increased cardiomyopathy risk when exposed to high-dose (> 250 mg/m2) anthracyclines in children with Neoplasms.	24470002
Methotrexate	Antimetabolite	MTHFR	rs1801133 G/A	Patients with this genotype may be less likely to respond to treatment and may be at increased risk for drug toxicity.	11418485; 12453860; 12915598; 14647408; 15051775; 15781665; 16013960; 16019535; 16462575; 16463153; 16501586; 16870553; 17180579; 17323057; 17488658; 17512587; 18458567; 18987660; 19159907; 19648163; 21644011; 21747412; 22143415; 22838948; 23089671; 23488607; 23648444; 23775025; 24241962; 24637499; 25007187; 25065700; 25110820; 25303299; 25778468; 26014925; 27399166; 28696419
		ABCB1	rs1045642 G/G	Patients with this genotype may have a decreased risk of drug toxicity.	25007187; 25303299; 25582575; 27399166

Carboplatin	Platinum Analogs	MTHFR	rs1801133 G/A	Patients with this genotype may be less likely to respond to treatment.	21605004; 19307503
		ERCC1	rs3212986 C/A	Patients with this genotype may be at increased risk for nephrotoxicity when using this drug.	21902499; 19786980
			rs11615 A/G	Patients with this genotype may have increased risk for drug toxicity.	19786980; 21262916; 21057378; 21902499; 22026922; 22188361; 19620936; 22329723; 15213713; 19362955; 18347182; 25069034; 27498158; 20530282
		XRCC1	rs25487 T/C	Patients with this genotype may have decreased drug response and survival, but also decreased risk of severe neutropenia.	16875718; 19362955; 19786980; 20530282; 21057378; 22026922; 22188361; 22761669; 24446315; 25025378; 28422153
Cisplatin	Platinum Analogs	GSTP1	rs1695 A/A	Patients with this genotype may be at decreased risk for ototoxicity.	23065688; 28448657
		ERCC1	rs3212986 C/A	Patients with this genotype may be at increased risk for nephrotoxicity when using this drug.	21902499; 19786980
			rs11615 A/G	Patients with this genotype may have increased risk for drug toxicity.	19786980; 21262916; 21057378; 21902499; 22026922; 22188361; 19620936; 22329723; 15213713; 19362955; 18347182; 25069034; 27498158; 20530282
		XRCC1	rs25487 T/C	Patients with this genotype may have decreased drug response and survival, but also decreased risk of severe neutropenia.	16875718; 19362955; 19786980; 20530282; 21057378; 22026922; 22188361; 22761669; 24446315; 25025378; 28422153
Oxaliplatin	Platinum Analogs	GSTP1	rs1695 A/A	Patients with this genotype may be less likely to respond to treatment and may have poorer overall outcome.	21449681; 15213713; 20078613; 27995989
		ERCC1	rs3212986 C/A	Patients with this genotype may be at increased risk for nephrotoxicity when using this drug.	21902499; 19786980
			rs11615 A/G	Patients with this genotype may have increased risk for drug toxicity.	19786980; 21262916; 21057378; 21902499; 22026922; 22188361; 19620936; 22329723; 15213713; 19362955; 18347182; 25069034; 27498158; 20530282
		XRCC1	rs25487 T/C	Patients with this genotype may have decreased drug response and survival, but also decreased risk of severe neutropenia.	16875718; 19362955; 19786980; 20530282; 21057378; 22026922; 22188361; 22761669; 24446315; 25025378; 28422153

Platinum Compounds	Platinum Compounds	GSTP1	rs1695 A/A	Patients with this genotype may be less likely to respond to treatment and may have increased risks for drug toxicity.	19203783; 15213713; 17409936; 15213713; 20530282
		ERCC1	rs3212986 C/A	Patients with this genotype may be at increased risk for nephrotoxicity when using this drug.	21902499; 19786980
			rs11615 A/G	Patients with this genotype may have increased risk for drug toxicity.	19786980; 21262916; 21057378; 21902499; 22026922; 22188361; 19620936; 22329723; 15213713; 19362955; 18347182; 25069034; 27498158; 20530282
		XRCC1	rs25487 T/C	Patients with this genotype may have decreased drug response and survival, but also decreased risk of severe neutropenia.	16875718; 19362955; 19786980; 20530282; 21057378; 22026922; 22188361; 22761669; 24446315; 25025378; 28422153
Capecitabine	Pyrimidine Analogs	TYMS	rs11280056 TTAAAG/TTAAAG	Patients with this genotype may have decreased risk of toxicity, but may also have decreased survival time when being treated with this drug.	24590654; 23736036; 23263912; 25041994
Fluorouracil	Pyrimidine Analogs	GSTP1	rs1695 A/A	Patients with this genotype may be less likely to respond to treatment and may have poorer overall outcome.	21449681; 15213713; 20078613; 27995989
		TYMS	rs11280056 TTAAAG/TTAAAG	Patients with this genotype may have decreased risk of toxicity, but may also have decreased survival time when being treated with this drug.	24590654; 23736036; 23263912; 25041994
Tumor Necrosis Factor Alpha (TNF-alpha) Inhibitors	TNF Inhibitor	TNF	rs1800629 G/A	Patients with this genotype may be less likely to respond to treatment.	26244882; 24192118; 23057546; 22960943; 22760475; 22129793; 19365401; 18713756; 18438841; 18050183; 17673491; 17343250; 16909270; 16720636; 15834068; 12847678; 12759288; 12190096
Irinotecan	Topoisomerase Inhibitors	UGT1A1	rs887829 C/T	Patients with this genotype may have an increased risk of adverse reactions, including neutropenia, diarrhea, or asthenia.	20335017; 20562211; 17728214; 17510208; 15280927; 16456808; 15297419; 17577039
		UGT1A4	rs887829 C/T	Patients with this genotype may have an increased risk of adverse reactions, including neutropenia, diarrhea, or asthenia.	20335017; 20562211; 17728214; 17510208; 15280927; 16456808; 15297419; 17577039
PAIN MANAGEMENT					
Drug	**Drug Type**	**Gene**	**Genotype**	**Interpretation**	**Reference(s)**

Celecoxib	Nonsteroidal Antinflammatory Drugs (NSAIDS)	CYP2C9	*2/*2	Patients with this genotype may have reduced metabolism of this drug and may require a reduced dose.	See FDA Drug Label
Diclofenac	Nonsteroidal Antinflammatory Drugs (NSAIDS)	CYP2C9	*2/*2	Patients with this genotype may have increased plasma levels of this drug.	See FDA Drug Label
Flurbiprofen	Nonsteroidal Antinflammatory Drugs (NSAIDS)	CYP2C9	*2/*2	Patients with this genotype may have reduced metabolism of this drug and may require a reduced dose.	See FDA Drug Label
Piroxicam	Nonsteroidal Antinflammatory Drugs (NSAIDS)	CYP2C9	*2/*2	Patients with this genotype may have reduced metabolism of this drug and may require a reduced dose.	See FDA Drug Label
Alfentanil	Opioids	OPRM1	rs1799971 A/G	Patients with this genotype may have decreased drug efficacy, and may require an increased dose.	28745577; 28379874; 28346387; 25760804; 25752520; 25715171; 25556837; 25266679; 25239082; 25155931; 23632726; 21902500; 21837673; 21383334; 21150856; 19783098; 19605407; 18403122; 18250251; 17898703; 17156920
Buprenorphine	Opioids	OPRM1	rs1799971 A/G	Patients with this genotype may have decreased drug efficacy, and may require an increased dose.	28745577; 28379874; 28346387; 25760804; 25752520; 25715171; 25556837; 25266679; 25239082; 25155931; 23632726; 21902500; 21837673; 21383334; 21150856; 19783098; 19605407; 18403122; 18250251; 17898703; 17156920
Fentanyl	Opioids	OPRM1	rs1799971 A/G	Patients with this genotype may have decreased drug efficacy, and may require an increased dose.	28745577; 28379874; 28346387; 25760804; 25752520; 25715171; 25556837; 25266679; 25239082; 25155931; 23632726; 21902500; 21837673; 21383334; 21150856; 19783098; 19605407; 18403122; 18250251; 17898703; 17156920
		ABCB1	rs1045642 G/G	Patients with this genotype may experience decreased efficacy and may require an increased dose.	23632726; 17898703; 21902500; 21383334
Methadone	Opioids	CYP2B6	rs3745274 G/T	Patients with this genotype may require an increased dose when being treated for addiction.	25456329; 21902500; 21790905
		ABCB1	rs1045642 G/G	Patients with this genotype may experience decreased efficacy and may require an increased dose.	23632726; 17898703; 21902500; 21383334

Morphine	Opioids	OPRM1	rs1799971 A/G	Patients with this genotype may have decreased drug efficacy, and may require an increased dose.	28745577; 28379874; 28346387; 25760804; 25752520; 25715171; 25556837; 25266679; 25239082; 25155931; 23632726; 21902500; 21837673; 21383334; 21150856; 19783098; 19605407; 18403122; 18250251; 17898703; 17156920
		ABCB1	rs1045642 G/G	Patients with this genotype may experience decreased efficacy and may require an increased dose.	23632726; 17898703; 21902500; 21383334
Oxycodone	Opioids	ABCB1	rs1045642 G/G	Patients with this genotype may experience decreased efficacy and may require an increased dose.	23632726; 17898703; 21902500; 21383334
Tramadol	Opioids	OPRM1	rs1799971 A/G	Patients with this genotype may have decreased drug efficacy, and may require an increased dose.	28745577; 28379874; 28346387; 25760804; 25752520; 25715171; 25556837; 25266679; 25239082; 25155931; 23632726; 21902500; 21837673; 21383334; 21150856; 19783098; 19605407; 18403122; 18250251; 17898703; 17156920
		ABCB1	rs1045642 G/G	Patients with this genotype may experience decreased efficacy and may require an increased dose.	23632726; 17898703; 21902500; 21383334

CARDIOVASCULAR

Drug	Drug Type	Gene	Genotype	Interpretation	Reference(s)
Warfarin	Anticoagulant	CYP2C9	*2/*2	Patients with this genotype may require a change in dosage. Please refer to warfarin dosing algorithm for specific details.	28198005
		VKORC1	rs9923231 C/T	Patients with this genotype may require a decrease in dosage. Please refer to warfarin dosing algorithm for specific details.	28198005
Clopidogrel	Antiplatelets	CES1	rs71647871 C/C	Patients with this genotype may have lower levels of active metabolite and increased platelet aggregation.	23111421; 23275066; 25704243
Atorvastatin	Statins	KIF6	rs20455 A/A	Patients with this genotype may be less likely to respond to treatment.	20886236; 18222353; 18222355

Hmg CoA Reductase Inhibitors	Statins	SLCO1B1	rs4149056 T/C	Patients with this genotype may have increased plasma concentrations of some statins, which can lead to adverse events, including myopathy, in some individuals. This association is strongest for simvastatin, but has also been demonstrated to a lesser degree for other statins, including atorvastatin, pravastatin, and rosuvastatin.	26367500; 26164721; 26086347; 25673568; 25630984; 25446771; 24598718; 24595600; 24263182; 23942138; 23930675; 23876492; 23708174; 23361102; 22668755; 21928084; 21851379; 21386754; 21243006; 21178985; 19833260; 18794729; 18650507; 17622941; 17473846; 17439540; 17108811; 17015053; 16722833; 16678544; 16103896; 15226675; 15116054; 12811365
Pravastatin	Statins	KIF6	rs20455 A/A	Patients with this genotype may be less likely to respond to treatment.	20886236; 20215968; 18222353; 20403483
Rosuvastatin	Statins	ABCG2	rs2231142 G/G	Patients with this genotype may have reduced drug plasma levels and reduced response to treatment.	20130569; 20679960; 16784736; 19474787; 23930675; 23930675; 23876492; 25630984; 20207952; 28322941
Simvastatin	Statins	ABCB1	rs2032582 C/C	Patients with this genotype may experience decreased drug response.	16321621; 19891551
		SLCO1B1	rs4149056 T/C	Patients with this genotype are at increased risk for statin-induced myopathy.	25446771; 21243006; 19833260; 18650507; 17108811
Acenocoumarol	Anticoagulant	CYP2C9	*2/*2	Patients with this genotype should have their INR checked more frequently after initiating or discontinuing NSAIDs.	21412232
Phenprocoumon	Anticoagulant	CYP2C9	*2/*2	Patients with this genotype should have their INR checked more frequently.	21412232

INFECTIOUS DISEASE

Drug	Drug Type	Gene	Genotype	Interpretation	Reference(s)
Ethambutol	Antibiotic	NAT2	*5/*6	Patients with this genotype may be at increased risk for developing hepatoxicity when using this drug.	24637014; 26616266; 24465778; 17950035
Isoniazid	Antibiotic	NAT2	*5/*6	Patients with this genotype may be at increased risk for developing hepatoxicity when using this drug.	24637014; 26616266; 24465778; 17950035
Pyrazinamide	Antibiotic	NAT2	*5/*6	Patients with this genotype may be at increased risk for developing hepatoxicity when using this drug.	24637014; 26616266; 24465778; 17950035
Rifampin	Antibiotic	NAT2	*5/*6	Patients with this genotype may be at increased risk for developing hepatoxicity when using this drug.	24637014; 26616266; 24465778; 17950035

Efavirenz	Antivirals	CYP2B6	rs3745274 G/T	Patients with this genotype may have increased plasma concentrations of this drug and an increased risk for side effects.	25611810; 26774523; 26779253; 22927450
Nevirapine	Antivirals	HLA-DRB1	DRB1*01:01	Patients with this genotype may be at inreased risk for adverse reactions, including rash, fever, and hepatotoxicity.	24911354; 18301070; 21505298; 25714001; 15627041
		ABCB1	rs1045642 G/G	Patients with this genotype may have an increased risk for hepatotoxicity.	20017669; 16912956; 16912957
Peginterferon Alfa-2B	Antivirals	ITPA	rs7270101 A/C	Patients with this genotype may have a decreased risk of anemia, but an increased risk of thrombocytopenia when using this drug.	21274861; 20547162; 26441325
			rs1127354 C/C	Patients with this genotype may have a decreased risk of anemia, but an increased risk of thrombocytopenia when using this drug.	21274861; 21246582; 21503919; 23707372; 20173735; 20637204; 23730840; 20547162; 26071337; 26441325; 26670100
		VDR	rs2228570 G/G	Patients with this genotype may have a decreased likelihood of sustained virological response.	24073221; 26911666
Ribavirin	Antivirals	ITPA	rs7270101 A/C	Patients with this genotype may have a decreased risk of anemia, but an increased risk of thrombocytopenia when using this drug.	21274861; 20547162; 26441325
			rs1127354 C/C	Patients with this genotype may have a decreased risk of anemia, but an increased risk of thrombocytopenia when using this drug.	21274861; 21246582; 21503919; 23707372; 20173735; 20637204; 23730840; 20547162; 26071337; 26441325; 26670100
		VDR	rs2228570 G/G	Patients with this genotype may have a decreased likelihood of sustained virological response.	24073221; 26911666
Ritonavir	Antivirals	UGT1A1	rs887829 C/T	Patients with this genotype may have an increased risk for hyperbilirubinemia.	16170755; 17058217; 17148966; 19710077; 20504240; 21288825; 21317582; 21348813; 22179231; 22661571; 23148286; 23548653; 24516079; 26857335
		UGT1A4	rs887829 C/T	Patients with this genotype may have an increased risk for hyperbilirubinemia.	16170755; 17058217; 17148966; 19710077; 20504240; 21288825; 21317582; 21348813; 22179231; 22661571; 23148286; 23548653; 24516079; 26857335
NEUROLOGY					
Drug	**Drug Type**	**Gene**	**Genotype**	**Interpretation**	**Reference(s)**

Carbamazepine	Anticonvulsant	EPHX1	rs2234922 A/G	Patients with this genotype may require increased dosage.	23252947; 19620853; 22188362; 15692831; 25495409; 26555147
			rs1051740 T/C	Patients with this genotype may require increased dosage.	15692831; 23252947; 19620853; 22188362; 26555147; 26314341
		SCN1A	rs3812718 C/C	Patients with this genotype may be less resistant to antiepileptic treatment.	22292851; 22591328; 25155934
Phenytoin	Anticonvulsant	SCN1A	rs3812718 C/C	Patients with this genotype may require a reduced dose.	15805193
		CYP2C9	*2/*2	Patients with this genotype may have significantly reduced metabolism of this drug which could increase the risk for side effects. A significantly reduced starting dosage is recommended.	25099164
PSYCHIATRY					
Drug	**Drug Type**	**Gene**	**Genotype**	**Interpretation**	**Reference(s)**
Clozapine	Antipsychotics	ANKK1	rs1800497 G/G	Patients with this genotype may be at decreased risk for weight gain and hyperprolactinemia, but increased risk for tardive dyskinesia when treated with antipsychotic drugs.	18579277; 23851570; 20714340; 19339912; 23859574; 23859574; 23859574; 23859574; 17767146; 18086475; 18180754; 26872113
Olanzapine	Antipsychotics	ANKK1	rs1800497 G/G	Patients with this genotype may be at decreased risk for weight gain and hyperprolactinemia, but increased risk for tardive dyskinesia when treated with antipsychotic drugs.	18579277; 23851570; 20714340; 19339912; 23859574; 23859574; 23859574; 23859574; 17767146; 18086475; 18180754; 26872113
Risperidone	Antipsychotics	ANKK1	rs1800497 G/G	Patients with this genotype may be at decreased risk for weight gain and hyperprolactinemia, but increased risk for tardive dyskinesia when treated with antipsychotic drugs.	18579277; 23851570; 20714340; 19339912; 23859574; 23859574; 23859574; 23859574; 17767146; 18086475; 18180754; 26872113
Lorazepam	Benzodiazepines	UGT2B15	rs1902023 A/C	Patients with this genotype may have decreased clearance of this drug.	19916996; 15044558; 15961980
Oxazepam	Benzodiazepines	UGT2B15	rs1902023 A/C	Patients with this genotype may have decreased clearance of this drug.	19916996; 15044558; 15961980
Paroxetine	Selective Serotonin Reuptake Inhibitors (SSRIs)	HTR1A	rs6295 C/G	Patients with this genotype may be less likely to respond to treatment.	19590397; 21688171; 19800133
ENDOCRINOLOGY					
Drug	**Drug Type**	**Gene**	**Genotype**	**Interpretation**	**Reference(s)**

Rosiglitazone	Thiazolidinediones	CYP2C8	rs10509681 C/C	Patients with this genotype may be less likely to respond to treatment.	23426382; 17178266
OTHER DRUGS					
Drug	**Drug Type**	**Gene**	**Genotype**	**Interpretation**	**Reference(s)**
Nicotine	Smoking Cessation Aid	COMT	rs4680 G/G	Patients with this genotype may be less likely to quit smoking when treated with this drug.	23459442; 16395295; 22695756; 17548664; 18192898; 26555332
Ataluren	Genetic Disease	CFTR	No Pathogenic Variants Detected	Only patients with specific CFTR mutations will benefit from treatment with this drug.	See FDA Drug Label
Ivacraftor	Genetic Disease	CFTR	No Pathogenic Variants Detected	Only patients with specific CFTR mutations will benefit from treatment with this drug.	See FDA Drug Label
OPHTHALMOLOGY					
Drug	**Drug Type**	**Gene**	**Genotype**	**Interpretation**	**Reference(s)**
Latanoprost	Ophthalmology	PTGFR	rs3753380 T/C	Patients with this genotype may be less likely to respond to treatment.	17467803; 25339146

Normal Response Expected

IMMUNOLOGY		
Drug	**Drug Type**	**Reference(s)**
Allopurinol	Xanthine Oxidase Inhibitor	15743917; 17587850; 21301380; 21393610; 21545408; 21912425; 23232549; 23669020; 25676789; 26810134
Azathioprine	Immunosuppressant	21270794; 25108385; 25624441; 26033531; 26405151
Cyclosporine	Immunosuppressant	See FDA Drug Label
Pegloticase	Antigout Agent	See FDA Drug Label
Probenecid	Uricosuric Agent	See FDA Drug Label
Sirolimus	MTOR Inhibitors	See FDA Drug Label
Sulfasalazine	5-Aminosalicyclic-Acid Derivative	See FDA Drug Label
ONCOLOGY		
Drug	**Drug Type**	**Reference(s)**
Alkylating Agents	Alkylating Agents	10208650; 11160862; 18511948; 21479364; 21946896; 24533712; 25545243

Antineoplastic Agents	Antineoplastic Agents	19052714; 19786980; 20638924; 22188361
Cyclophosphamide	Antineoplastic Agent	15051775; 19052714; 19159907; 19786980; 20568049; 20638924; 21362365; 22188361; 23775025; 25008867
Epirubicin	Antineoplastic Agent	20568049; 21362365; 23775025; 25008867
Lapatinib	Tyrosine Kinase Inhibitors	21245432; 24687830
Leucovorin	Folic Acid Analogs	16818689; 20647221; 24167597
Mercaptopurine	Purine Analogs	21270794; 25108385; 25624441; 26033531; 26405151
Paclitaxel	Antineoplastic Agent	19052714; 19786980; 20638924; 22188361
Pyrimidine Analogs	Pyrimidine Analogs	23988873
Rasburicase	Recombinant Urate Oxidase Enzyme	See FDA Drug Label
Tamoxifen	Estrogen Modulator	29385237
Tegafur	Pyrimidine Analogs	16818689; 20647221; 23988873; 24167597
Thioguanine	Purine Analogs	21270794
Tropisetron	5-HT3 Antagonist	28002639
PAIN MANAGEMENT		
Drug	**Drug Type**	**Reference(s)**
Aspirin	Nonsteroidal Antinflammatory Drugs (NSAIDS)	9179433; 15007363; 15100686; 16433794; 16493486; 19392989; 19862937; 22940005
Carisoprodol	Muscle Relaxant	See FDA Drug Label
Codeine	Opioids	22205192
Lidocaine	Anesthetic	See FDA Drug Label
Prilocaine	Anesthetic	See FDA Drug Label
CARDIOVASCULAR		
Drug	**Drug Type**	**Reference(s)**
Carvedilol	Beta Blockers	See FDA Drug Label
Digoxin	Antiarrhythmic Drug	10716719; 12189368
Flecainide	Antiarrhythmic Drug	21412232
Furosemide	Diuretics	21692745
Metoprolol	Beta Blockers	21412232
Propafenone	Antiarrhythmic Drug	21412232
Spironolactone	Diuretics	21692745
INFECTIOUS DISEASE		
Drug	**Drug Type**	**Reference(s)**
Abacavir	Antivirals	26151496; 26599303
Atazanavir	Antivirals	24557078; 26180834

Chloroquine	Antimalarial	See FDA Drug Label
Chlorproguanil	Antimalarials	See FDA Drug Label
Dapsone	Antibiotic	23604100; 24152261
Erythromycin Ethylsuccinate and Sulfisoxazole Acetyl	Antibiotic	See FDA Drug Label
Mafenide	Antibiotic	See FDA Drug Label
Nalidixic Acid	Antibiotic	See FDA Drug Label
Nitrofurantoin	Antibiotic	See FDA Drug Label
Norfloxacin	Antibiotic	See FDA Drug Label
Primaquine	Antimalarials	See FDA Drug Label
Quinine	Antimalarials	See FDA Drug Label
Sulfadiazine	Antibiotic	See FDA Drug Label
Sulfamethoxazole	Antibiotic	See FDA Drug Label
Sulfisoxazole	Antibiotic	See FDA Drug Label
Voriconazole	Antifungal	27981572
NEUROLOGY		
Drug	**Drug Type**	**Reference(s)**
Brivaracetam	Anticonvulsant	See FDA Drug Label
Lamotrigine	Anticonvulsant	22047493; 23263737; 24820767; 26790665
Oxcarbazepine	Anticonvulsant	22292851; 22591328; 25155934
Tetrabenazine	Monamine Depletor	See FDA Drug Label
PSYCHIATRY		
Drug	**Drug Type**	**Reference(s)**
Amitriptyline	Tricyclic Antidepressants	27997040
Aripiprazole	Antipsychotics	22566560; 23920449; 27217270
Atomoxetine	Serotonin-Norepinephrine Reuptake Inhibitors	21412232
Brexpiprazole	Antipsychotics	See FDA Drug Label
Bupropion	Norepinephrine-Dopamine Reuptake Inhibitor (NDRI)	15492764; 17654295; 18058343; 26153084
Citalopram	Selective Serotonin Reuptake Inhibitors (SSRIs)	14624186; 16642436; 17606812; 17671280; 18618621; 19077664; 19468717; 19924111; 19996755; 20453658; 20640435; 23394390; 23510446; 23973251; 25303296; 25974703
Clobazam	Benzodiazepines	See FDA Drug Label
Clomipramine	Tricyclic Antidepressants	27997040
Desipramine	Tricyclic Antidepressants	27997040
Doxepin	Tricyclic Antidepressants	27997040

Escitalopram	Selective Serotonin Reuptake Inhibitors (SSRIs)	16642436; 17671280; 19077664; 19272758; 19375170; 19567893; 19924111; 20212518; 20453658; 21388237; 23394390; 24014145; 25303296; 25974703
Flibanserin	Serotonin 5-HT-Receptor Agonists	See FDA Drug Label
Fluvoxamine	Selective Serotonin Reuptake Inhibitors (SSRIs)	16642436; 17671280; 19077664; 19924111; 20453658; 23394390; 25303296; 25974703
Haloperidol	Antipsychotics	21412232; 22566560; 23920449; 27217270
Iloperidone	Antipsychotics	See FDA Drug Label
Imipramine	Tricyclic Antidepressants	27997040
Nortriptyline	Tricyclic Antidepressants	27997040
Perphenazine	Antipsychotics	See FDA Drug Label
Pimozide	Antipsychotics	25868121
Protriptyline	Tricyclic Antidepressants	27997040
Selective Serotonin Reuptake Inhibitors	Selective Serotonin Reuptake Inhibitors (SSRIs)	20877297
Sertraline	Selective Serotonin Reuptake Inhibitors (SSRIs)	16642436; 17671280; 19077664; 19924111; 20453658; 23394390; 25303296; 25974703
Thioridazine	Antipsychotics	See FDA Drug Label
Trimipramine	Tricyclic Antidepressants	27997040
Venlafaxine	Serotonin-Norepinephrine Reuptake Inhibitors	17671280; 19924111; 21412232; 23394390; 25303296
Vortioxetine	Serotonin Modulator	See FDA Drug Label
Zuclopenthixol	Antipsychotic	21412232
ENDOCRINOLOGY		
Drug	**Drug Type**	**Reference(s)**
Carbimazole	Antithyroid Drugs	26151496; 26599303
Chlorpropamide	Sulfonylureas	17519421; 21114608
Glibenclamide	Sulfonylureas	17519421; 21114608
Glipizide	Sulfonylureas	17519421; 21114608
Methimazole	Antithyroid Drugs	26151496; 26599303
Propylthiouracil	Antithyroid Drugs	26151496; 26599303
OTHER DRUGS		
Drug	**Drug Type**	**Reference(s)**
Hormonal Contraceptives	Gynecology	7968118; 12069454; 15208046; 15946211; 16769590; 28750087
Tolterodine	Urology	See FDA Drug Label
OPHTHALMOLOGY		
Drug	**Drug Type**	**Reference(s)**
Methazolamide	Ophthalmology	9109770; 20504258; 25918017

GASTROENTEROLOGY		
Drug	**Drug Type**	**Reference(s)**
Esomeprazole	Proton-Pump Inhibitor	21412232
Lansoprazole	Proton Pump Inhibitors (PPIs)	21412232
Metoclopramide	Prokinetic Agent	See FDA Drug Label
Omeprazole	Proton Pump Inhibitors (PPIs)	21412232
Pantoprazole	Proton-Pump Inhibitor	21412232

GENOTYPING RESULTS

Gene	Variants Assayed	Genotype
ABCB1	rs2032582[A>C]	C/C
	rs1045642[A>G]	G/G
	rs2032582[A>T]	A/A
ABCG2	rs2231142[G>T]	G/G
ADD1	rs4961[G>T]	G/G
ANKK1	rs1800497[G>A]	G/G
APOE	rs7412[C>T]	C/T
CBR3	rs1056892[G>A]	G/G
CES1	rs71647871[C>T]	C/C
CFTR	CFTR	No Pathogenic Mutations Found
COMT	rs4680[G>A]	G/G
CYP2B6	rs28399499[T>C]	T/T
	rs3745274[G>T]	G/T
CYP2C19	Normal Metabolizer	*1/*1
CYP2C8	rs10509681[T>C]	C/C
CYP2C9	Poor Metabolizer	*2/*2
CYP2D6	Normal Metabolizer	*1/*4
CYP3A4	rs2740574[C>T]	T/T
	rs2242480[C>T]	C/C
CYP3A5	Poor Metabolizer	*3/*3

CYP4F2	rs2108622[C>T]	C/C
DPYD	Normal Metabolizer	*1/*1
DRD2	rs1799978[T>C]	T/T
EPHX1	rs1051740[T>C]	T/C
	rs2234922[A>G]	A/G
ERCC1	rs11615[A>G]	A/G
	rs3212986[C>A]	C/A
F2	rs1799963[G>A]	G/G
F5	rs6025[T>C]	C/C
G6PD	G6PD	No Pathogenic Mutations Found
GSTP1	rs1695[A>G]	A/A
HAS3	rs2232228[A>G]	A/G
HLA-A	HLA-A Type	A*02:01
	HLA-A Type	A*01:01
HLA-B	HLA-B Type	B*38:01
	HLA-B Type	B*08:01
HLA-C	HLA-C Type	C*07:01
	HLA-C Type	C*12:03
HLA-DPB1	HLA-DPB1 Type	DPB1*04:01
	HLA-DPB1 Type	DPB1*10:01
HLA-DQA1	HLA-DQA1 Type	DQA1*05:01
	HLA-DQA1 Type	DQA1*01:01
HLA-DRB1	HLA-DRB1 Type	DRB1*01:01
	HLA-DRB1 Type	DRB1*03:01
HTR1A	rs6295[C>G]	C/G
ITPA	rs1127354[C>A]	C/C
	rs7270101[A>C]	A/C
KIF6	rs20455[A>G]	A/A
LTC4S	rs730012[A>C]	A/A
MTHFR	rs1801133[G>A]	G/A
MTRR	rs1801394[A>G]	A/A

NAT2	Slow Acetylator	*5/*6
NQO1	rs1800566[G>A]	G/A
NUDT15	rs116855232[C>T]	C/C
OPRM1	rs1799971[A>G]	A/G
PTGFR	rs3753380[T>C]	T/C
PTGS1	rs10306114[A>G]	A/A
SCN1A	rs3812718[C>T]	C/C
SLC28A3	rs7853758[G>A]	G/G
SLCO1B1	rs4149056[T>C]	T/C
TNF	rs1800629[G>A]	G/A
TP53	rs1042522[G>C]	C/C
TPMT	Normal Function	*1/*1
TYMS	rs11280056[TTAAAG>-]	TTAAAG/TTAAAG
UGT1A1	rs4148323[G>A]	G/G
	rs887829[C>T]	C/T
UGT1A4	rs2011425[T>G]	T/T
	rs4148323[G>A]	G/G
	rs887829[C>T]	C/T
UGT2B15	rs1902023[A>C]	A/C
UMPS	rs1801019[G>C]	G/C
VDR	rs2228570[A>G]	G/G
VKORC1	rs9923231[C>T]	C/T
XPC	rs2228001[G>T]	T/T
XRCC1	rs25487[T>C]	T/C

METHODS & LIMITATIONS

SEQUENCING

Genomic DNA obtained from the submitted sample is enriched for targeted regions using a hybridization-based protocol and sequenced using Illumina technology. Reads are aligned to the reference sequence (Grch37, standard genome build hg19), and sequence changes are identified and interpreted in the context of a single clinically relevant transcript. Exonic deletions and duplications are called using a copy number variation (CNV) algorithm. The CNV algorithm calculates a statistical likelihood of each copy number state by comparing the depth of sequencing coverage at targeted exons to a baseline depth measure in control samples. A confidence threshold is used for each assertion of copy number state for each exon where the sequence data met a minimum quality standard of >20x depth of unique properly paired reads. This algorithm detects most intragenic deletions and duplications, although rare single-exon events may be missed.

The analytical sensitivity and specificity of this assay is >99% and >99%, respectively. All reportable variants are confirmed by orthogonal technologies as part of our ongoing quality management process. Unless otherwise indicated, all targeted regions were sequenced with >20x depth of coverage. Regions with a read depth below this are supplemented with orthogonal testing, if they contain previously reported pathogenic variants. The assay targets all coding regions of the indicated transcript, 10 base pairs of flanking intronic sequence, and specific intronic and intragenic genomic regions demonstrated to be causative of disease. However, for some genes, only targeted loci are analyzed.

All data is processed and analyzed using Elements Software Version 1.

Phosphorus can be contacted via phone at 1-855-746-7423 or by email at support@phosphorus.com.

LIMITATIONS

Although this test is highly accurate, no genetic test is 100{}ensitive. This analysis is designed to detect variants with pharmacogenomics association within the genes included in this assay. Hence this analysis will not detect novel sequence variants in the promoter region and other non-coding regions, as well as it does not assay untranslated exons. Also, the sensitivity to detect insertions and deletions larger than 15 base pairs but smaller than a full exon may be reduced. Some exons of a few individual genes have inherent sequence properties that yield suboptimal data, and pathogenic variants in those regions may not be reliably identified. The low-level mosaicism will not be detected. Moreover, this analysis does not detect every pathogenic variant associated with this disease because of genes not included in the current panel or unknown to be associated with the disease at this time. It also does not test for all known genetic diseases. Errors in testing (both false positives and false negatives) may also occur for reasons that include, but are not limited to specimen issues (e.g. inaccurately marked samples causing sample mix-up, DNA quality and quantity not meeting minimum requirements), rare genetic variants interfering with analysis, assay technical limitations, biological factors (e.g. recent blood transfusions, circulating hematolymphoid neoplasm, or history of bone marrow transplantation), and other technical issues. If a pathogenic variant is detected, the patient may be a carrier of, affected with, predisposed to, or at risk for certain disease(s) or condition(s) associated with that variant. If no pathogenic variant is found, the patient may be at reduced risk of being carrier of, affected with, predisposed to, or at risk for the disease(s) or condition(s) tested for in the current panel. However, further testing may be necessary, since negative test results may reduce, but do not eliminate, the chance that the patient is a carrier of, affected with, predisposed to, or at risk of having said disease(s) or condition(s). In addition, other pathogenic variant(s) or factors that are not included in our services may impact an individual's risk of, or predisposition to certain disease(s) or condition(s). Thus, this report does not provide definitive conclusions regarding risk of, predisposition to, or diagnosis of certain disease(s) or condition(s).

DISCLAIMER

This report reflects the analysis of an extracted DNA sample; and it does not constitute medical advice. Any questions or concerns regarding the contents of this report or any prevention, cure, mitigation, or treatment of a medical condition or disease should be directed to a qualified medical professional.

This test was developed and its performance characteristics determined by Phosphorus Diagnostics, LLC. It has not been cleared or approved by the FDA. The laboratory is regulated under CLIA as qualified to perform high-complexity testing. These test results are to be used for clinical purposes and should not be regarded as investigational or for research.

This assay only detects and reports variants with known pharmacogenomic associations, as listed in the Genotyping Results section, and does not report all variants in the genes assayed.

VARIANT CLASSIFICATION

This test includes analysis of variants with strong evidence of pharmacogenomic association. The variants included in this test are either classified as evidence level A and B by the Clinical Pharmocogenetics Implementation Consortium (CPIC), evidence level 1 and 2 by PharmGKB, or referenced in an FDA drug label.

SIGNED BY

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