JOHNS HOPKINS MEDICINE JOHNS HOPKINS HEALTHCARE	**JOHNS HOPKINS HEALTHCARE**	**Policy Number** **CMS04.03**
	Medical Policy: Pharmacogenomics **Department: Health Services** **Lines of Business: EHP, USFHP, PPMCO, ADVANTAGE MD**	**Page 1 of 13**

ACTION:

☐ New Policy Number
☒ Revising Policy Number: CMS04.03
☐ Superseding Policy Number
☐ Archiving Policy Number
☐ Retiring Policy Number

Effective Date: 12/04/2015
Review Dates: 09/02/16, 03/03/17

Johns Hopkins HealthCare LLC (JHHC) provides a full spectrum of health care products and services for Employer Health Programs, Priority Partners, Advantage MD, and US Family Health Plan. Each line of business possesses its own unique contract and guidelines which, for benefit and payment purposes, should be consulted to know what benefits are available for reimbursement. Specific contract benefits, guidelines or policies supersede the information outlined in this policy.

SCOPE:

This policy presents criteria for medically necessary pharmacogenomics genotyping.

POLICY:

For Advantage MD, see Medicare Coverage Database:
Local Coverage Determination (LCD): Biomarkers Overview (L35062)
Local Coverage Determination (LCD): Biomarkers for Oncology (L35396)
Local Coverage Determination (LCD): BRCA1 and BRCA2 Genetic Testing (L36715)
Local Coverage Determination (LCD): Loss-of Heterozygosity Based Topographic Genotyping with Pathfinder TG® (L34864)
Local Coverage Determination (LCD): Assays for Vitamins and Metabolic Function (L34914)
National Coverage Determination (NCD) for Cytogenetic Studies (190.3)
National Coverage Determination (NCD) for Pharmacogenomic Testing for Warfarin Response (90.1)

I. When benefits are provided under the member's contract, JHHC considers pharmacogenomics genotyping medically necessary when the following criteria are met:
   A. The patient has signs and symptoms of the disorder in question, **AND**;
   B. A definitive diagnosis cannot be made using conventional medical tests, **AND**;
   C. The test results will be used to change medical management; or the test results will provide prognostic or pharmacogenetic information that will be used to change medical management, **OR**;
   D. If identification of the associated gene biomarker is clinically necessary prior to initiation of therapy, as noted in the Indications and Usage section of the FDA-approved prescribing label.

II. Unless specific benefits are provided under the member's contract, JHHC considers pharmacogenomics genotyping experimental and investigational for all other indications, as they do not meet Technology Evaluation Criteria (TEC) #2-5.

The following are lists of tests considered MEDICALLY NECESSARY and lists of tests considered EXPERIMENTAL AND INVESTIGATIONAL by JHHC.

MEDICALLY NECESSARY *Note* ~ this list is not all-inclusive	
ALK+	Crizotimib (Xalkori®)
BCR-ABL, KIT, or PDGFR mutations	Imatinib (Gleevec®), Nilotinib (Tasigna®), Dasatinib (Sprycel®)
BRAF V600E or V600K	Vemurafenib (Zelboraf) for the treatment of unresectable or metastatic melanoma
BRACAnalysis CDx test	Aid in identifying ovarian cancer patients eligible for treatment with Lynparza for treatment of advanced ovarian cancer in patients who have previously been treated with ≥ 3 lines of chemotherapy Results of the test are used as an aid in identifying ovarian cancer patients with deleterious or suspected deleterious germline BRCA variants eligible for treatment with Lynparza™ (olaparib). This assay is for professional use only and is to be performed only at Myriad Genetic Laboratories, a single laboratory site located at 320 Wakara Way, Salt Lake City, UT 84108
Bond Oracle Her2 IHC System	The Bond Oracle Her2 IHC system is indicated as an aid in the assessment of patients for whom Herceptin (trastuzumab) treatment is being considered
COBAS 4800 BRAF V600 Mutation Test	The Cobas 4800 BRAF V600 Mutation Test is a real-time PCR test on the Cobas 4800 system, and is intended to be used as an aid in selecting melanoma patients whose tumors carry the BRAF V600E mutation for treatment with Zelboraf (vemurafenib)
cobas EGFR Mutation Test P120019 S001-	The test is intended to be used as an aid in selecting patients with NSCLC for whom Tarceva® (erlotinib), an EGFR tyrosine kinase inhibitor (TKI), is indicated
CCR5	Miraviroc (Selzentry®)
CD20	Tositumomab and Iodine I 131 (Bexxar®)
CFTR (G551D)	Ivacaftor (Kalydeco™)
CYP2C19	Citalopram

	Escitalopram Sertraline
CYP2C19*	dosing of amitriptyline
DAKO C-KIT PharmDx	The c-Kit pharmDx is indicated as an aid in the differential diagnosis of gastrointestinal stromal tumors (GIST). After diagnosis of GIST, results from c-Kit pharmDx may be used as an aid in identifying those patients eligible for treatment with Gleevec (imatinib mesylate)
DAKO EGFR PharmDx Kit	EGFR pharmDx is indicated as an aid in identifying colorectal cancer patients eligible for treatment with Erbitux (cetuximab) or Vectibix (panitumumab)
ER	Fulvestrant (Faslodex®)
EGFR (i.e., K-RAS mutation-negative [wild-type], EGFR-expressing, metastatic colorectal cancer)	Cetuximab (Erbitux®)
EGFR	Afatinib Dimaleate (Gilotrif)
therascreen EGFR RGQ PCR Kit	The test is intended to be used to select patients with NSCLC for whom GILOTRIF (afatinib), an EGFR tyrosine kinase inhibitor (TKI**),** is indicated. Safety and efficacy of GILOTRIF (afatinib) have not been established in patients whose tumors have L861Q, G719X, S768I, exon 20 insertions, and T790M mutations, which are also detected by the therascreen EGFR RGQ PCR Kit
therascreen KRAS RGQ PCR Kit	The therascreen KRAS RGQ PCR Kit is intended to aid in the identification of CRC patients for treatment with Erbitux (cetuximab) and Vectibix (panitumumab) based on a KRAS no mutation detected test result
therascreen® EGFR RGQ PCR Kit	The test is intended to be used to select patients with NSCLC for whom GILOTRIF® (afatinib) or IRESSA® (gefitinib), EGFR tyrosine kinase inhibitors (TKIs), is indicated
Ferriscan	The FerriScan R2-MRI Analysis System is intended to measure liver iron concentration to aid in the identification and monitoring of non-transfusion dependent thalassemia patients receiving therapy with Exjade (deferasirox)
G551D mutation in the CTFR	For persons with cystic fibrosis who are being considered for treatment with ivacaftor (Kalydeco)
G6PD	Rasburicase
Genotype I chronic hepatitis C	Teleprevir (Incivek®)
HER2 CISH PharmDx Kit	HER2 CISH pharmDx Kit is indicated as an aid in the assessment of patients for whom Herceptin (trastuzumab)

	treatment is being considered. Results from the HER2 CISH pharmDx Kit are intended for use as an adjunct to the clinicopathologic information currently used for estimating prognosis in stage II, node-positive breast cancer patients
HER2 FISH PharmDx Kit	HER2 IQFISH pharmDx is indicated as an aid in the assessment of breast and gastric cancer patients for whom Herceptin (trastuzumab) treatment is being considered and for breast cancer patients for whom Perjeta (pertuzumab) or Kadcyla (ado-trastuzumab emtansine) treatment is being considered For breast cancer patients, results from the HER2 IQFISH pharmDx are intended for use as an adjunct to the clinicopathologic information currently used for estimating prognosis in stage II, node-positive breast cancer patients
HERCEPTEST	HercepTest is indicated as an aid in the assessment of breast and gastric cancer patients for whom Herceptin (trastuzumab) treatment is being considered and for breast cancer patients for whom Perjeta (pertuzumab) treatment or Kadcyla (ado-trastuzumab emtansine) treatment is being considered (see Herceptin, PERJETA and KADCYLA package inserts)
INFORM HER2 DUAL ISH DNA Probe Cocktail	The INFORM HER2 Dual ISH DNA Probe Cocktail is indicated as an aid in the assessment of patients for whom Herceptin (trastuzumab) treatment is being considered
INSITE HER-2/NEU KIT	InSite Her-2/neu is indicated as an aid in the assessment of breast cancer patients for whom Herceptin (Trastuzumab) therapy is being considered
HER2/neu	Lapatinib (Tykerb®), Trastuzumab (Herceptin®)
HLA-B*1502	For persons of Asian ancestry before commencing treatment with carbamazepine (Tegretol)
HLA-B*5701	Abacavir (Ziagen; ABC) therapy
HLA-B*5801	Allopurinol contraindicated in individuals with the HLA-B*58:01 variant allele ("HLA-B*58:01-positive") due to significantly increased risk of allopurinol-induced SCAR.
IFNL3	PEG-interferon-alpha-2a PEG-interferon-alpha-2b Ribavirin
K-RAS	Cetuximab (Erbitux®), Panitumumab (Vectibix®)
MGMT (O(6)-methylguanine-DNA methyltransferase) gene	For predicting response to temozolomide (Temodar) in persons with glioblastoma

methylation assay	
PATHVYSION HER-2 DNA Probe Kit	The Pathvysion Kit is indicated as an aid in the assessment of patients for whom herceptin (trastuzumab) treatment is being considered
PATHWAY ANTI-HER-2/NEU (4B5) Rabbit Monoclonal Primary Antibody	It is indicated as an aid in the assessment of breast cancer patients for whom Herceptin (trastuzumab) treatment is being considered
SLCO1B1	Simvastatin
SPOT-LIGHT HER2 CISH Kit	The SPOT-Light HER2 CISH Kit is indicated as an aid in the assessment of patients for whom Herceptin (trastuzumab) treatment is being considered. The assay results are intended for use as an adjunct to the clinicopathological information currently being used as part of the management of breast cancer patients
T(15;17) translocation, PML/RAR-alpha gene expression	Arsenic trioxide (Trisenox®)
Testing for the presence of virus with the NS3 Q80K polymorphism	For persons with hepatitis C virus (HCV) genotype 1a infection being considered for treatment with simeprevir (Olysio)
THxID BRAF	For detecting mutation of the BRAF gene (V600E or V600K) in persons with unresectable or metastatic melanoma who are being considered for treatment with dabrafenib (Tafinlar), pembrolizumab (Keytruda), or trametinib (Mekinist)
The cobas® KRAS Mutation Test	The test is intended to be used as an aid in the identification of CRC patients for whom treatment with Erbitux® (cetuximab) or with Vectibix® (panitumumab) may be indicated based on a no mutation detected result
TPMT gene mutation assays (e.g., PRO-PredictR TPMT) or TPMT phenotypic assays (Thiopurine metabolite testing, TPMT enzymatic activity, e.g., PRO-PredictR EnzAct)	Prior to initiation of 6-mercaptopurine or azathioprine therapy Thioguanine
UGT1A1	Atazanavir
UCD (NAGS, CPS, ASS, OTC, ASL, ARG)	Sodium phenylbutyrate (Buphenyl®)
VENTANA ALK (D5F3) CDx Assay	It is indicated as an aid in identifying patients eligible for treatment with XALKORI® (crizotinib)

VeriStrat	(Biodesix Inc.)For Predicting Response to Epidermal Growth Factor Receptor (EGFR) Tyrosine Kinase Inhibitors (TKIs) in Non-Small Cell Lung Cancer (NSCLC)
VYSIS ALK Break Apart FISH Probe Kit	Aids in identifying patients eligible for treatment with Xalkori (crizotinib)

EXPERIMENTAL AND INVESTIGATIONAL *Note* ~ this list is not all-inclusive	
Apolipoprotein E (Apo E)	For determining therapeutic response to lipid-lowering medications
(AUC)-targeted 5-fluorouracil dosing	For area under the curve (AUC)-targeted 5-fluorouracil dosing, (e.g., Myriad Genetics' OnDose)
Beta adrenergic receptor genotyping	For evaluating persons with treatment resistant asthma and for all other indications
CYP2C9	Warfarin
CYP2C19*	Clopidogrel (Plavix)
CYP2D6	For predicting response to beta blockers
CYP2D6	For identifying individuals with Alzheimer's disease with different clinical response to donepezil (Aricept)
CYP2D6	Tamoxifen (Nolvadex®), antipsychotics, antidepressants, including serotonin reuptake inhibitors [SSRI]), opioid analgesics (e.g., codeine, morphine)
CYP3A4	Codeine, cyclosporin A, diazepam, erythromycin, irinotecan (Camptosar®), statins
CYP3A5	Cyclosporine, nifedipine, statins, steroid hormones (e.g., testosterone, progesterone, androstenedione), tacrolimus
Cytochrome P450 polymorphisms	Diagnostic tests to identify specific genetic variations that may be linked to reduced/enhanced effect or severe side effects of drugs metabolized by the cytochrome P450 system including opioid analgeics, warfarin, tamoxifen, proton pump inhibitors, antipsychotic medications, and selective serotonin reuptake inhibitors)
DPYD	Flourouracil (5FU), capecitabine (Xeloda®)
Genecept Assay (Genomind)	For managing psychiatric conditions
GeneSightRx testing	For the management of individuals treated with anti-depressant and/or anti-psychotic medications
Genetic polymorphisms of	To predict 5-fluorouracil toxicit

dihydropyrimidine dehydrogenase and thymidylate synthase	
IL28B polymorphism genotyping	For interferon therapy for hepatitis C
Methotrexate polyglutamates (Avise PG test)	For evaluating response to methotrexate therapy
Methylenetetrahydrofolate reductase (MTHFR)	For determining therapeutic response to antifolate chemotherapy and for guiding antidepressant therapy
Millennium PGT (Millennium Laboratories)	For management of medications for chronic pain and for all other indications
PersonaGene Genetic Panels (AlBioTech)	For making medication adjustments and for all other indications
Platelet reactivity/function testing (VerifyNow P2Y12 Assay, Ultegra System Rapid Platelet Function Assay-ASA)	For individuals who have undergone percutaneous coronary intervention
rs3798220 allele	For selecting persons for chronic aspirin therapy or other indications
Thromboxane metabolites in urine (e.g., AspirinWorks)	To evaluate aspirin resistance
UGT1A1 or UGT1A1*28	Irinotecan (Camptosar®)
VKORC1	Warfarin

BACKGROUND:

Pharmacogenomics describes the use of information about an individual's genome to inform decisions about pharmacological treatments. Because of advances in molecular biology that have facilitated high-throughput analyses of DNA, it is possible to examine the genome of individuals prior to prescribing medication (Rabbani, 2016). By having knowledge of the composition of an individual's genome, the treatment that will likely be most effective for that person can be recommended. Potential benefits of a pharmacogenomic approach to treatment include minimizing side effects while maximizing effectiveness.

Cancer treatment is the field in which pharmacogenomics is currently showing the most progress. By genotyping tumors, it is possible to prescribe treatments and doses that are optimally effective for individuals (Calvo et al., 2016). Following a process for cancer treatment that includes genomic information has the combined benefit of identifying the most appropriate drugs and dosages while avoiding the unpleasant side-effects that frequently occur when pharmaceutical decisions are not informed by genomic knowledge.

Beyond cancer treatment, pharmacogenomic approaches are being considered to improve available treatments for conditions such as asthma and diabetes (El-Qutob and Raducan, 2016; Dawed et al.,

2016), and to enhance Warfarin dosing decisions (Stack et al., 2016). The risks and benefits of pharmacogenetic testing in children has been considered as a way to extend the benefits of pharmagenomic-guided therapies to the pediatric population (Haga and Soloman, 2016).

The speed with which information about pharmacogenomic information is accumulating is staggering. Fortunately, tools are developing to allow information to be cataloged in a way that allows it to benefit clinical practice. One effort to catalog pharmacogenomic information is The Pharmacogenomics Knowledge Base (PharmGKB, https://www.pharmgkb.org/). This reference tool is trademarked by the Department of Health and Human Services and it provides information that includes dosing guidelines for specific genetic variants.

CODING INFORMATION:

Note: The following CPT/HCPCS codes are included below for informational purposes. Inclusion or exclusion of a CPT/HCPCS code(s) below does not signify or imply member coverage or provider reimbursement. The member's specific benefit plan determines coverage and referral requirements. All inpatient admissions require pre-authorization.

PRE-AUTHORIZATION REQUIRED
Compliance with the provision in this policy may be monitored and addressed through post-payment data analysis and/or medical review audits

Employer Health Programs (EHP) **See Specific Summary Plan Description (SPD)	Priority Partners (PPMCO) refer to COMAR guidelines and PPMCO SPD then apply policy criteria	US Family Health Plan (USFHP), TRICARE Medical Policy supersedes JHHC Medical Policy. If there is no Policy in TRICARE, apply the Medical Policy Criteria	Advantage MD, LCD and NCD Medical Policy supersedes JHHC Medical Policy. If there is no LCD or NCD, apply the Medical Policy Criteria

CPT ® CODES	DESCRIPTION
81206	BCR/ABL1 (t(9;22)) (eg, chronic myelogenous leukemia) translocation analysis; major breakpoint, qualitative or quantitative
81207	BCR/ABL1 (t(9;22)) (eg, chronic myelogenous leukemia) translocation analysis; minor breakpoint, qualitative or quantitative
81208	BCR/ABL1 (t(9;22)) (eg, chronic myelogenous leukemia) translocation analysis; other breakpoint, qualitative or quantitative

81210	BRAF (v-raf murine sarcoma viral oncogene homolog B1) (eg, colon cancer), gene analysis, V600E variant
81221	CFTR (cystic fibrosis transmembrane conductance regulator) (eg, cystic fibrosis) gene analysis; known familial variants
81225	CYP2C19 (cytochrome P450, family 2, subfamily C, polypeptide 19) (eg, drug metabolism), gene analysis, common variants (eg, *2, *3, *4, *8, *17)
81226	CYP2D6 (cytochrome P450, family 2, subfamily D, polypeptide 6) (eg, drug metabolism),
81227	CYP2C9 (cytochrome P450, family 2, subfamily C, polypeptide 9) (eg, drug metabolism), gene analysis, common variants (eg, *2, *3, *5, *6)
81235	EGFR (epidermal growth factor receptor) (eg, non-small cell lung cancer) gene analysis, common variants (eg, exon 19 LREA deletion, L858R, T790M, G719A, G719S, L861Q)
81240	F2 (prothrombin, coagulation factor II) (eg, hereditary hypercoagulability) gene analysis, 20210G>A variant
81241	F5 (coagulation Factor V) (eg, hereditary hypercoagulability) gene analysis, Leiden variant
81275	KRAS (v-Ki-ras2 Kirsten rat sarcoma viral oncogene) (eg, carcinoma) gene analysis, variants in codons 12 and 13
81287	MGMT (O-6-methylguanine-DNA methyltransferase) (eg, glioblastoma multiforme), methylation analysis
81291	MTHFR (5,10-methylenetetrahydrofolate reductase) (eg, hereditary hypercoagulability) gene analysis, common variants (eg, 677T, 1298C)
81315	PML/RARalpha, (t(15;17)), (promyelocytic leukemia/retinoic acid receptor alpha) (eg, promyelocytic leukemia) translocation analysis; common breakpoints (eg, intron 3 and intron 6), qualitative or quantitative
81316	PML/RARalpha, (t(15;17)), (promyelocytic leukemia/retinoic acid receptor alpha)
81350	UGT1A1 (UDP glucuronosyltransferase 1 family, polypeptide A1) (eg, irinotecan metabolism), gene analysis, common variants (eg, *28, *36, *37)
81355	VKORC1 (vitamin K epoxide reductase complex, subunit 1) (eg, warfarin metabolism), gene analysis, common variants (eg, -1639/3673)
81400	Molecular pathology procedure, Level 1(eg, identification of single germline variant [eg, SNP] by techniques such as restriction enzyme digestion or melt curve analysis)
81401	Molecular pathology procedure, Level 2 (eg, 2-10 SNPs, 1 methylated variant, or 1 somatic variant [typically using nonsequencing target variant analysis], or detection of a dynamic mutation disorder/triplet repeat) • ABL (c-abl oncogene 1, receptor tyrosine kinase) (eg, acquired imatinib resistance), T315I variant
81402	Molecular pathology procedure, Level 3 (eg, >10 SNPs, 2-10 methylated variants, or 2-10 somatic variants [typically using non-sequencing target variant analysis], immunoglobulin and T-cell receptor gene rearrangements, duplication/deletion variants of 1 exon, loss of heterozygosity [LOH], uniparental disomy [UPD])

81403	Molecular pathology procedure, Level 4 (eg, analysis of single exon by DNA sequence analysis, analysis of > 10 amplicons using multiplex PCR in 2 or more independent reactions, mutation scanning or duplication/deletion variants of 2-5 exons) • KRAS (v-Ki-ras2 Kirsten rat sarcoma viral oncogene) (eg, carcinoma), gene analysis, variant(s) in exon 2 MPL (myeloproliferative leukemia virus oncogene, thrombopoietin receptor, TPOR) (eg, myeloproliferative disorder), exon 10 sequence VHL (von Hippel-Lindau tumor suppressor) (eg, von Hippel-Lindau familial cancer syndrome), deletion/duplication analysis VWF (von Willebrand factor) (eg, von Willebrand disease types 2A, 2B, 2M), targeted sequence analysis (eg, exon 28)
81405	Molecular pathology procedure, level 6 (eg, analysis of 6-10 exons by DNA sequence analysis, mutation scanning or duplication/deletion variants of 11-25 exons) • KRAS (v-Ki-ras2 Kirsten rat sarcoma viral oncogene homolog) (eg, Noonan syndrome), full gene sequence • OTC (ornithine carbamoy/transferase) (eg, ornithine transcarbamylase deficiency), full gene sequence
81406	Molecular pathology procedure, Level 7 (eg, analysis of 11-25 exons by DNA sequence analysis, mutation scanning or duplication/deletion variants of 26-50 exons, cytogenomic array analysis for neoplasia) • BRAF(v-raf murine sarcoma viral oncogene homolog B1) (eg, Noonan syndrome), full gene sequence
81407	Molecular pathology procedure, Level 8 (eg, analysis of 26-50 exons by DNA sequence analysis, mutation scanning or duplication/deletion variants of >50 exons, sequence analysis of multiple genes on one platform)
81408	Molecular pathology procedure, Level 9 (eg, analysis of >50 exons in a single gene by DNA sequence analysis)
81445	Targeted genomic sequence analysis panel, solid organ neoplasm, DNA analysis, 5-50 genes (eg, ALK, BRAF, CDKN2A, EGFR, ERBB2, KIT, KRAS, NRAS, MET, PDGFRA, PDGFRB, PGR, PIK3CA, PTEN, RET), interrogation for sequence variants and copy number variants or rearrangements, if performed
81450	Targeted genomic sequence analysis panel, hematolymphoid neoplasm or disorder, DNA and RNA analysis when performed, 5-50 genes (eg, BRAF, CEBPA, DNMT3A, EZH2, FLT3, IDH1, IDH2, JAK2, KRAS, KIT, MLL, NRAS, NPM1, NOTCH1), interrogation for sequence variants, and copy number variants or rearrangements, or isoform expression or mRNA expression levels, if performed
81455	Targeted genomic sequence analysis panel, solid organ or hematolymphoid neoplasm, DNA and RNA analysis when performed, 51 or greater genes (eg, ALK, BRAF, CDKN2A, CEBPA, DNMT3A, EGFR, ERBB2, EZH2, FLT3, IDH1, IDH2, JAK2, KIT, KRAS, MLL, NPM1, NRAS, MET, NOTCH1, PDGFRA, PDGFRB, PGR, PIK3CA, PTEN, RET), interrogation for sequence variants and copy number variants or rearrangements, if performed

81479	Unlisted molecular pathology procedure • When used to report testing for a specific gene biomarker which is not otherwise reportable by a specific code and which is noted to be clinically necessary prior to initiating therapy with the drug target as noted in the section heading "Indications and Usage" of the U.S. Food and Drug Administration (FDA)-approved prescribing label.
81538	Oncology (lung), mass spectrometric 8-protein signature, including amyloid A, utilizing serum, prognostic and predictive algorithm reported as good versus poor overall survival
88271	Molecular cytogenetics; DNA probe, each (eg, FISH)
88272	Molecular cytogenetics; interphase in situ hybridization, analyze 25-99 cells
88273	Molecular cytogenetics; chromosomal in situ hybridization, analyze 10-30 cells (eg, for microdeletions)
88274	Molecular cytogenetics; interphase in situ hybridization, analyze 25-99 cells
88275	Molecular cytogenetics; interphase in situ hybridization, analyze 100-300 cells
Revenue Codes	**DESCRIPTION**
0310	Laboratory Pathology-General; Hospital; inpatient (Medicare Part B only)
0310	Laboratory Pathology-General; Hospital; outpatient

NO PRE-AUTHORIZATION REQUIRED
Compliance with the provision in this policy may be monitored and addressed through post-payment data analysis and/or medical review audits

CPT ® CODES	**DESCRIPTION**
85576	Platelet, aggregation (in vitro), each agent
86352	Cellular function assay involving stimulation (eg, mitogen or antigen) and detection of biomarker (eg, ATP)
86356	Mononuclear cell antigen, quantitative (eg, flow cytometry), not otherwise specified, each antigen
87902	Infectious agent genotype analysis by nucleic acid (DNA or RNA); Hepatitis C virus

NOT COVERED

CPT ® CODES	**DESCRIPTION**
82777	Galectin-3
HCPCS CODE	**DESCRIPTION**
G9143	Warfarin responsiveness testing by genetic technique using any method, any number of specimen(s)

ICD10 CODES ARE FOR INFORMATIONAL PURPOSES ONLY

ICD10 Codes	DESCRIPTION
	Multiple Codes

REFERENCE STATEMENT:

Analyses of the scientific and clinical references cited below were conducted and utilized by the Johns Hopkins HealthCare LLC (JHHC) Medical Policy Team during the development and implementation of this medical policy. Per NCQA standards, the Medical Policy Team will continue to monitor and review any newly published clinical evidence and adjust the references below accordingly if deemed necessary.

REFERENCES:

Aetna. (2016). Pharmacogenetic and Pharmacodynamic Testing. Medical Policy Number 0715. Retrieved: http://www.aetna.com

Calvo, E., Walko, C., Dees, E. C., & Valenzuela, B. (2016). Pharmacogenomics, pharmacokinetics, and pharmacodynamics in the era of targeted therapies. *American Society of Clinical Oncology Educational Book / ASCO.American Society of Clinical Oncology.Meeting*, Vol. 35, e175-84.

Cigna. (2017). Pharmacogenomics Testing. Medical Policy Number 0500. Retrieved: https://cignaforhcp.cigna.com

Dawed, A. Y., Zhou, K., & Pearson, E. R. (2016). Pharmacogenetics in type 2 diabetes: Influence on response to oral hypoglycemic agents. *Pharmacogenomics and Personalized Medicine*, Vol. 9, p. 17-29.

El-Qutob, D., & Raducan, I. (2016). Recent patents for the treatment of asthma. *Recent Patents on Inflammation & Allergy Drug Discovery.*

Food and Drug Administration (FDA). (2016). Table of Pharmacogenomic Biomarkers in Drug Labeling. Retrieved: http://www.fda.gov

Haga, S. B., & Solomon, B. D. (2016). Considerations of pharmacogenetic testing in children. *Pharmacogenomics*, Vol. 9, p.975-7.

Hayes, Inc. (2015). *Eleven Questions to Ask When Making Genetic Testing Coverage Decisions*. Retrieved: https://www.hayesinc.com

National Institutes of Health. (2016). National Human Genome Research Institute. *Pharmacogenomics: FAQ*. Retrieved: http://www.genome.gov

Pharmacogenomics Knowledge Base, PharmGKB: https://www.pharmgkb.org

Priority Health. (2015). Pharmacogenomic Testing. Medical Policy Number 91570-R5. Retrieved: https://www.priorityhealth.com

Rabbani, B., Nakaoka, H., Akhondzadeh, S., Tekin, M., & Mahdieh, N. (2016). Next generation sequencing: Implications in personalized medicine and pharmacogenomics. *Molecular bioSystems*, *12*(6), 1818-1830. doi:10.1039/c6mb00115g

Stack, G., & Maurice, C. B. (2016). Warfarin pharmacogenetics reevaluated: Subgroup analysis reveals a likely underestimation of the maximum pharmacogenetic benefit by clinical trials. *American Journal of Clinical Pathology,* Vol. 145, Issue 5, p. 671-686.

Teutsch, S., Tuckson, R. (2008). *Realizing the Potential of Pharmacogenomics: Opportunities and Challenges.* Dept. Health and Human Services, Report of the Secretary's Advisory Committee on Genetics, Health, and Society. Retrieved: https://repository.library.georgetown.edu

Teutsch, S, et al. (2010). Gene Patents and Licensing Practices and Their Impact on Patient Access to Genetic Tests. Report of the Secretary's Advisory Committee on Genetics, Health, and Society. Retrieved: https://repository.library.georgetown.edu