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Differential Gene Expression Patterns in HPV-Positive and HPV-Negative Oropharyngeal Carcinomas

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DIFFERENTIAL GENE EXPRESSION PATTERNS IN HPV-POSITIVE AND HPV-NEGATIVE OROPHARYNGEAL CARCINOMAS

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DEDICATION

This dissertation is a small token of gratitude to my mother and father, who've been and will always be the pillars my life.

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ABSTRACT

Head and neck (HN) cancer is the fifth most prevalent malignancy worldwide with 90% of them categorized as squamous cell carcinomas (SCC). Carcinomas of the oropharynx, pharynx and the oral cavity, comprise a subset of HNSCC and are referred to as oropharyngeal squamous cell carcinomas (OPSCC). Up to 60% of OPSCC and 25% of HNSCC are positive for high-risk human papillomavirus (HR-HPV), primarily HPV16. HPV positive and HPV negative OPSCC's are molecularly and biologically distinct with differences in risk factors, age of presentation and clinical behavior. The precise molecular signatures of each have been well studied with respect to gene expression, genetic-epigenetic modifications and mutational analysis. However, recent studies have identified HPV as a racially linked marker for OPSCC, where African American (AA) patients present with a higher percentage of HPV-negative and aggressive tumors as compared to European American (EA) patients. Thus, we aimed to study the HPV status and differential gene expression (DEG) profile of OPSCC in AA and EA patients from South Carolina, using Agilent 8x60k arrays and a dual marker system for HPV status. We characterized all the tumors into HPV-active (DNA+/E7RNA+), HPV-inactive (DNA+/E7RNA-) and HPV-negative (DNA-/RNA-) based on INNO-LiPA and RT-qPCR assays. Overall, 59% of OPSCC tissue samples tested positive for HPV DNA, while only 48% of those harbored an active HPV infection and significant differences were observed when compared by race.

We observed a higher prevalence of HPV in EA patients, both by DNA (69%) as well as by E7 RNA (39%), when compared to that of AA patients (40% and 10% respectively). Microarray analysis over a set of 36 oropharyngeal tumors and 4 normals revealed that HPV-inactive tumors have gene expression profiles distinct from those of both HPV-active and HPV-negative SCC, suggesting that HPV-inactive tumors may constitute a group of their own. The expression of a selected panel of genes was confirmed by RT-qPCR which was in concordance with our microarray data. Our RT-qPCR assays conformed to the latest MIQE guidelines and data were normalized using three reference genes through Biogazelle qbase+ software and the results were scaled to the control group (normal samples). Normalized relative quantities for each gene of interest were then calculated using qbase+. Selection of the most stably expressed candidate reference genes was done through a comprehensive study of 8 well known housekeeping/reference genes through Normfinder, BestKeeper and GeNorm. Our microarray studies and RT-qPCR assays categorized HPV-inactive tumors as a distinct entity in comparison to the HPV-negative and –active tumors by race. Also, HPV-inactive tumors clustered closer to the HPV-negative tumors with one exception, suggesting the loss of function of HPV in the former. Overall, our results confirmed that AA patients more often present with HPV-negative tumors in comparison to EA patients, and indicated that HPV-negative tumors exhibit gene expression profiles indicative of activation of epithelial mesenchymal transition, while HPV active tumors are characterized by alterations of cell cycle and growth control.

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LIST OF ABBREVIATIONS

CNV .... Copy Number Variations

CpG .... Cytosine-Phosphate-Guanosine

Cq .... Quantification Cycle

CxCaRNA .... RNA expression patterns typical for cervical carcinomas

CYC1 .... Cytochrome C-1

D4DR .... Donor 4 Differentiation Resistant

DDX3X .... DEAD (Asp-Glu-Ala-Asp) box polypeptide 3, X-linked

DEG .... Differentially Expressed Genes

E6AP .... E6 Associated Protein

EA .... European American

ECM .... Extracellular Matrix

EGFR .... Epidermal Growth Factor Receptor

EIF4A2 .... Eukaryotic Translation Initiation Factor 4A2

EMT .... Epithelial-Mesenchymal Transition

ENOX2-Var1 .... Ecto-NOX Disulfide-Thiol Exchanger 2-Variant 1

FC .... Fold Change

FDR .... False Discovery Rate

FFPE .... Formalin Fixed Paraffin Embedded

GAPDH .... Glyceraldehyde-3-Phosphate Dehydrogenase

GATA4 .... GATA Binding Protein 4

GRIA4 .... Glutamate Receptor, Ionotropic, AMPA 4

GST .... Glutathione S-transferase

HIV .... Human Immunodeficiency Virus

HLADPB1 .... Major Histocompatibility Complex, Class II, DP Beta 1

HN .... Head and Neck

HNSCC .... Head and Neck Squamous Cell Carcinoma

HOXA6 .... Homeobox A6

HPV .... Human Papillomavirus

HRAS .... Harvey Rat Sarcoma Viral Oncogene Homolog

HR-HPV .... High Risk-Human Papilomavirus

IARC .... International Agency for Research on Cancer

IGFBP3 .... Insulin-Like Growth Factor Binding Protein 3

IHC .... Immunohistochemistry

IL1B .... Interleukin 1

IRB .... Institutional Review Board

IRC .... Inter-Run Calibrator

IRF6 .... Interferon Regulatory Factor 6

IRX4 .... Iroquois Homeobox 4

ISH .... *In-situ* Hybridization

KRT15 .... Keratin 15

LCR .... Long Control Region

LiPA .... Line Probe Assay

LSCC .... Laryngeal Squamous Cell Carcinoma

LUSC .... Lung squamous cell carcinoma

MAL .... Myelin And Lymphocyte (T-Lymphocyte Maturation-Associated Protein)

MCM2 .... Minichromosome maintenance complex component 2

MET .... Mesenchymal epithelial transition factor

HGFR .... Hepatocyte Growth Factor Receptor

MHCI .... Major histocompatibility Class I receptors

MIQE .... Minimum Information for quantitative estimation

MMP10	Matrix metallopeptidase 10 (stromelysin 2)
MMP13	Matrix metallopeptidase 13 (collagenase 3)
MMP14	Matrix metallopeptidase 14 (membrane-inserted)
MMP7	Matrix metallopeptidase 7 (matrilysin)
MPG	Multiplex Human Papillomavirus Genotyping
MS	Mesenchymal
MUSC	Medical University of South Carolina
NBT	Nitro-Blue Tetrazolium Chloride
NFE2L2	Nuclear Factor (Erythroid-Derived 2)-Like 2
NHKC	Normal Human Keratinocyte
NOTCH1	Notch 1
nPCR	Nested Polymerase Chain Reaction
NRQ	Normalized Relative Quantity
OPSCC	Oropharyngeal Squamous Cell Carcinoma
ORF	Open Reading Frame
OSCC	Oral Squamous Cell Carcinoma
OSR2	Odd-Skipped Related 2
PAX9	Homo Sapiens Paired Box 9
PCLO	Piccolo Presynaptic Cytomatrix Protein
PCR	Polymerase Chain Reaction
PIK3CA	Phosphoinositde- 3-Kinase Catalytic Alpha Polypeptide
PRDM4	PR Domain Containing 4
PV	Papillomavirus
qPCR	Quantitative Polymerase Chain Reaction
RAD51B	RAD51 homolog B

Rb .... Retinoblastoma

RDML .... Real-Time PCR Data Markup Language

RIMS2 .... Regulating Synaptic Membrane Exocytosis 2

RIN .... RNA integrity number

RNA-seq .... RNA-sequencing

RQ .... Relative Quantity

RTK .... Receptor Tyrosine Kinase

RT-qPCR .... Reverse Transcription-quantitative Polymerase Chain Reaction

SCC .... Squamous Cell Carcinoma

SCLY .... Selenocysteine Lyase

SDHA .... Succinate Dehydrogenase Complex, Subunit A, Flavoprotein

SERPINB3 .... Serpin Peptidase Inhibitor, Clade B (Ovalbumin), Member 3

SOX2 .... SRY (sex determining region Y)-box 2

SPF .... Short Fragment PCR

SYNE1 .... Spectrin Repeat Containing, Nuclear Envelope 1

SYNE2 .... Spectrin Repeat Containing, Nuclear Envelope 2

TCGA .... The Cancer Genome Atlas

TGFB2 .... Transforming growth factor

TLR10 .... Toll-like receptor 10

TOP1 .... Topoisomerase (DNA) I

TP53 .... Tumor protein p53

TP63 .... Tumor Protein P63

Treg .... T-regulatory cells

TSCC .... Tonsillar Squamous Cell Carcinoma

UADT .... Upper Aero-Digestive Tract

UBE2D2...Ubiquitin-Conjugating Enzyme E2D 2

URR ....Upstream Regulatory Region

CHAPTER 1: INTRODUCTION

1.1. Head & Neck Squamous Cell Carcinoma

Head and neck (HN) cancer is the fifth most common malignancy worldwide with an annual mortality rate of 200,000[1]. About 90% of HN cancer can be classified as head & neck squamous cell carcinomas (HNSCC), while a minority are adenocarcinomas or non-epithelial tumors. HNSCC is highly heterogeneous and occurs in the stratified squamous epithelium of the upper aero-digestive tract (UADT) with common sites of presentation being the oral cavity, oropharynx, larynx and esophagus. About 75% of HNSCC are attributed to alcohol and tobacco consumption[1,2], however, more recently, high-risk human papillomavirus (HR-HPV) infection has been recognized as a cause of some HNSCC[3]. Approximately 25% of all HNSCC, and up to 60% of oropharyngeal cancers are attributed to HPV, predominantly HPV16[4–6]. Therapeutic strategies for HN cancer have evolved from mere identification and treatment of the target with surgery/radiotherapy[7]- the 'anatomic era', to the modern 'biological era' of targeted molecular therapy[8]. HPV-positive tumors have better prognosis and respond better to treatment[9,10]. However, a deeper understanding of the molecular pathogenesis of HPV positive and HPV negative OPSCC is required to increase efficacy of treatment and in turn improve the survival and quality of life of HNSCC patients.

1.2 Human Papillomavirus

While there has been a decline in the incidence of HNSCC related to alcohol and tobacco consumption, the overall incidence of HNSCC is still on the rise[1]. This increase has been attributed to a surge in the HPV related oropharyngeal squamous cell carcinoma (OPSCC) worldwide with reports of increasing incidence from Canada[10,11], the United States[12–15] and Europe[16–20]. Common risk factors of HPV associated OPSCC include number of sexual partners, oral-genital sex, oral-anal sex, and marijuana abuse[21]. The International Agency for Research on Cancer (IARC) monograph working group reported that HPV16 is one of the newest etiological factors associated with OPSCC[5,6].

HPV belongs to the *Papillomavididae* family, which contains 29 genera formed by papillomavirus (PV) types comprising papillomaviruses that infect humans (170 types)[22], non-human mammals, birds and reptiles (64, 3 and 2 types, respectively)[23]. HPV are small DNA viruses consisting of an approximately 8 Kb circular, double stranded DNA genome[24] and an icosahedral capsid. The HPV genome is divided into three main regions: 1) the noncoding upstream regulatory region (URR) or long control region (LCR) which regulates viral gene expression and holds the highest degree of variation among different HPV types. 2) The early (E1, E2, E4, E5, E6, E7) region involved with replication, oncogenesis and survival. 3) The late (L1, L2) region encoding viral capsid proteins, where the L1 open reading frame (ORF) is the most conserved gene in all PV types. A new PV type within a species is defined if there is more than 10% sequence dissimilarity of the L1 ORF from the closest type; into a subtype if homology is between 2% and 10% and a variant with less than 2% difference[25]. The overall sequence similarity between different genera of the papillomaviridae family is within 23 to 43% [25].

HPV infects basal cells of stratified squamous epithelium and replicates in cutaneous and mucosal epithelia, causing benign lesions[26]. The carcinogenic role of HR-HPV most often involves disruption of E2 transcription regulator post viral integration into the host genome and the deregulated expression of the two viral oncogenes- E6 and E7[27,28]. The E6 and E7 proteins are primarily nuclear with some cytoplasmic component reported for both proteins[29,30]. While E6 binds to and promotes degradation of the tumor suppressor, tumor protein 53 (TP53) gene product[31], E7 binds to and promotes the degradation of the cellular retinoblastoma (pRb) tumor suppressor gene product[32], thereby blocking cell cycle regulation and promoting proliferation[33]. The E7 protein by itself can produce cellular transformation and its oncogenic potential is further accentuated by the E6 protein, which however, is virtually incapable of transforming cells all by itself. The affinity of the E7 protein for pRb is higher in HR-HPV types as compared to low risk types, while low risk E6 interacts with E6 associated proteins (E6AP) but does not cause p53 degradation[34–36]. Hence, these phenomena explain the increased oncogenic potential of HR-HPV types.

1.3 Role of HPV in HNSCC

1.3.1 Biology of HPV related HNSCC

The discontinuity of the reticulated epithelium of the tonsillar crypts renders it susceptible to HPV infection[37] and is one of the possible determinants of the high prevalence of HPV-positive tumors in this anatomical region. Since viral oncoproteins are capable of transforming primary human keratinocytes[34] from either genital[38] or oral epithelia *in vitro*[39–41], they clearly play a role in disrupting cell-cycle regulatory pathways leading to a genetic progression to ano-genital cancer and, possibly, also to oral squamous cell carcinoma (OSCC)[42]. However, the exact mechanism by which HPV mediates malignant transformation of oral keratinocytes in the upper respiratory tract epithelia is still unclear[43].

HPV-positive cancers exhibit distinct phenotypic features including poor differentiation, scant keratinization and basaloid phenotype, quite different from the keratinizing morphology of HPV-negative squamous cell carcinoma (SCC)[37]. With respect to HPV, variable degrees of viral oncogene expression and integration have been observed in many case studies[43]. HPV-E7 mediated inactivation of pRb results in over expression of p16INK4A[44,45], which is often used as a surrogate marker for HPV mediated carcinogenesis[46,47]. However, high p16INK4A alone has insufficient sensitivity and specificity as a marker of HPV positivity in different mucosal sub-sites of HNSCC[48,49]. In addition to the disruption of cell cycle control and the genome instability[34,50,51] produced by HPV oncoproteins, other virus-driven mechanisms that may contribute to evasion of host immune response and tumor progression in HPV-positive tumors include antigen processing machinery defects, debilitated T helper cell response, the interplay between cluster of differentiation (CD)4+ and CD8+ T cells and lastly the presence of circulating and tumor T-regulatory cells (Treg)[37].

1.3.3 Biomarkers of HPV in HNSCC

In surgical pathology, immunohistochemistry for p16(INK4a) is a well-known surrogate marker for HPV expression in cervical cancers[46,47] and HNSCC[52].

However, the sensitivity and specificity of this protein as a biomarker for HNSCC has been highly debated[53], and with that its potential to characterize biologically active HPV-OPSCC increases in combination with DNA/RNA based assays for viral oncogenes[54–56]. Direct methods for identifying HPV infection include HPV DNA[57,58] or E6/E7 mRNA[59,60] detection via polymerase chain reaction (PCR) or in-situ Hybridization (ISH)[61]. There is a growing importance of RNA expression patterns typical for cervical carcinomas (CxCaRNA)[49,56], E6*I and E6*II[53,62,63] as a more reliable marker for active HPV infection in OPSCC[49,53,62]. The status of these biomarkers was recently assessed in combination to other established protein biomarkers of HPV mediated oncogenesis such as p16(INK4a)[53,56] , pRb[56], Cyclin D1[56] and p53 [49,64].

RNA-sequencing (RNA-seq)[65–67], is a novel tool for detecting tumor-associated DNA viruses and identifying viral integration sites in various human cancers. In a recent study of 239 HNSCC samples available in The Cancer Genome Atlas (TCGA) database, HPV transcripts were detected in 36 tumors with HPV16 (30), HPV33 (5) and HPV35 (1) as detected types. Viral integration was observed in the host genome at known chromosomal sites in 24 tumors expressing E6 and E7 oncogenic proteins. RNA-seq has achieved complete concordance in the detection of viral and viral-host transcripts in HNSCC tumors when compared to other established methods, with a ~99.9% probability of detecting at least one viral sequence in the TCGA cohort. RNA-seq can efficiently detect a frequency of viral genome transcript as low as 0.0001%[67].

However, whether or not an HPV is active (i.e. the actual role of HPV in "driving" the cancer) probably cannot be ascertained by the detection of extremely low levels of viral transcripts, and a variety of molecular markers are necessary to fully define HPV-mediated pathogenesis in a tumor. Prevalence of HPV in HNSCC/OPSCC and various assays used for determination the same are as summarized in Table 1.1.

1.3.4 Targeted Therapy

Major factors considered while treating HPV positive OPSCCs include: a) the subsets of patients with smoking and alcohol history, b) mortality due to second primary tumors, and c) genetic makeup of tumor metastasis[105]. More recently, phase I clinical trials involving intra-tumor injection of the quadrivalent vaccine-Gardasil® (HPV 6, 11, 16 and 18)[106,107] or the bivalent vaccine-Cervarix® (HPV 16, 18)[108] have been introduced as combinatorial therapies along with anticancer drugs and other vaccines in HNSCC[105]. However, one of the shortcomings in HPV mediated therapy is the lack of pre-clinical data from *in vitro* experiments.

1.4 Molecular Mechanisms of Origin of HNSCC

Gene amplification, deletions, point mutations, overexpression/inhibition and epigenetic modifications are the driving forces behind development of human cancer and these vital events are being intensely studied to understand patterns of development in head and neck cancer, particularly with respect to HPV.

Table 1.1: Prevalence of HPV in Head and Neck Cancer.
Adapted from Lajer & Buchwald, 2010

Study	Year	Type and location of lesion	Method	No. positive cases	%	HPV type
Syrjanen et al.[68]	1987	LSCC	ISH	15/116	13	11, 16, 6, 30
Syrjanen et al.[69]	1988	OSCC	ISH	6/51	12	16, 18
Chang et al.[70]	1990	OSCC	ISH/PCR	11/40	28	16, 18, 6
Zeuss et al.[71]	1991	OSCC	ISH	0/15	0	–
Holladay et al.[72]	1993	OSCC	PCR	7/37	19	16, 18
Ostwald et al.[73]	1994	OSCC	PCR/SB	16/26	62	16, 18, 6, 11
Balaram et al.[74]	1995	OSCC	PCR	67/91	74	16, 18, 6, 11
Cruz et al.[75]	1996	OSCC	PCR	19/35	55	16
Wilczynski et al.[76]	1998	TSCC	PCR	14/21	64	16, 33, 59
Van Houten et al.[77]	2001	HNSCC	PCR/E6R-PCR	20/84	24	16
Kojima et al.[78]	2002	OSCC	PCR	35/53	66	38
Sugiyama et al.[79]	2003	OSCC	PCR	30/86	35	16
Smith et al.[80]	2004	OSCC/OPSCC	RT-PCR	38/193	20	16, 18, 33
Koppikar et al.[81]	2005	OSCC	PCR	6/102	6	16, 18
Slebos et al.[82]	2006	HNSCC	RT-PCR	8/36	22	16
Luo et al.[83]	2007	OSCC	PCR based gene chip array	13/51	25	16, 18, 33, 52
Zhang et al.[84]	2008	HNSCC	ISH	10/30	33	–
Chuang et al.[85]	2008	HNSCC	RT-PCR	20/59	34	16
Simonato et al.[86]	2008	OSCC	nPCR	5/29	17	–
Luginbuhl et al.[87]	2009	TSCC	ISH	17/48	35	–
Avissar et al.[88]	2009	HNSCC	PCR	19/109	17	16

Study	Year	Type and location of lesion	Method	No. positive cases	%	HPV type
Lohavanichbutr et al.[89]	2009	OSCC/OPSCC	PCR	41/119	35	16
Khovidhunkit et al.[90]	2008	OSCC	PCR	1/65	2	–
Gudleviciene et al.[91]	2009	HNSCC	PCR	13/48	27	16
Näsman et al.[18]	2009	TSCC	PCR	43/46	93	16, 33, 35, 59
Shi et al.[92]	2009	OPSCC	PCR/RT-qPCR/ISH/IHC	73/111	66	16
Straetmans et al.[93]	2009	TSCC	ISH	33/81	41	16
Weinberger et al.[94]	2009	OPSCC	PCR/IHC	47/77	61	16
Lassen et al.[95]	2010	HNSCC	IHC	84/131	25	–
Bennett et al.[96]	2010	TSCC	PCR	9/16	56	16
Hoffmann et al.[97]	2010	TSCC	RT-PCR/IHC	21/39	53	16
Attner et al.[98]	2010	BTSCC	PCR/RT-qPCR	71/95	75	16, 33
Chernock et al.[99]	2011	HNSCC	HR-ISH/IHC	AA-3/26, 9/26 EA-94/148, 123/148	AA-11.5, 34.6 EA-63.5, 83.1	16, 18, 33, 35, 45, 51, 52, 56, 66
Castillo et al.[100]	2011	OSCC	INNO-LiPA/RT-qPCR	39/71	55	16
Schache et al.[55]	2011	OPSCC	HR-ISH/IHC/qPCR/RT-qPCR	108	15 to 57	16
Heath et al.[17]	2012	OPSCC	IHC/qPCR	31/83	37	16
Gillison et al.[14]	2012	OSCC	IHC/PCR	5579	6.7	Total 37 types (majority 16)
Liang et al.[54]	2012	HNSCC	cLIA/GST tag ELISA/MPG-SPF/IHC	488/722	72, 71	16
Bishop et al.[101]	2012	HNSCC	Hybrid capture2/ISH/IHC/qPCR	14/24	58	16
Byrd et al.[102]	2012	HNSCC	ISH/RT-qPCR	110-125/174	63-72	16

Study	Year	Type and location of lesion	Method	No. positive cases	%	HPV type
Sethi et al.[16]	2012	HNSCC	SPF10-LiPA25	385	29.4	16, 18, 31, 32, 33, 35, 45, 51, 52, 56, 6, 11, X
Hoffman et al.[53]	2012	HNSCC	MPG-PCR/LCD chip array/E6*I mRNA/ISH	22/78	28.2	16, 18
Holzinger et al.[49]	2012	OPSCC	MPG-PCR/qPCR/CxCaRNA/ISH	100/199	49-DNA, 16-viral load, 20-CxCaRNA	16, 18, 33, 35
Pannone et al.[103]	2012	OSCC/OPSCC	IHC/consensus PCR/ISH	16/56 OSCC, 6/22 OPSCC	4.7 OSCC, 30 OPSCC	16, 56, 53, 31, 44, 70
Deng et al.	2013	HNSCC	PCR/qPCR/E2-E6 ratio/RT-qPCR	54/184	29.3	16, 33, 35, 58, 67,
Paquette et al.[104]	2013		PCR (GP5+/6+, pU1-M/pU-2R) /CISH/IHC	25/51 HPV driven, 23/51 HPV passenger	49.1 HPV driven, 45.1 HPV passenger	31, 16, 18

1.4.1 Mutational Profile of HNSCC

Recent whole exome sequencing of 92 fresh frozen HNSCC samples validated 288 mutations of 39 genes ($q<0.1$)[109]. The rate of mutation in HPV positive tumors was 50% less as compared to HPV negative tumors[109]. Laryngeal cancers exhibited higher mutation rates and G → T transversion frequencies ($P=0.008$ & $P<0.0001$, respectively, rank sum tests) in HPV-negative tumors as compared to those of oropharynx and sinonasal cavity[109]. Major pathways affected by these genetic mutations involved: regulation of nuclear polarity (SYNE1 and SYNE2 in 20% and 8% of samples respectively); processes mediating calcium sensing for terminal squamous differentiation (RIMS2 and PCLO mutations in 11% and 12% of cases respectively); apoptosis related genes (CASP8 and DDX3X in 8 & 4% respectively) and genes related to squamous differentiation (NOTCH1, IRF6, and TP63). The product of TP63 promotes renewal of basal keratinocytes by a mechanism that requires down-regulation of NOTCH1 and Cyclin-dependent kinase inhibitor 2A (CDKN2A). In a separate study, alterations in PI3K-related genes were found to be common in HNSCC (e.g., PIK3CA mutations in up to 20% of tumors). PI3K is a key signaling pathway in cancer, including head and neck cancer and multiple PI3K inhibitors are currently in clinical testing for HNSCC[110,111]. Inactivating Notch1 mutations have been recently described for the first time with respect to HNSCC[112]. While sensitizing mutations affecting the intracellular domain of the epidermal growth factor receptor (EGFR) are uncommon in HNSCC[113], the majority of HPV negative HNSCC harbor inactivating mutations in tumor suppressor genes like TP53[114] and NOTCH1[112], while HPV positive tumors are described by functional inactivation of TP53 and Rb by viral oncoproteins[115,116].

A molecular circuitry of HNSCC was proposed based on the observed loss and gain of function of some crucial genes in HNSCC in relation to viral genes (Figure. 1.1). Blue depicts loss of function and red gain of function, while HPV markers are depicted in yellow and genes hypothesized to play a role in HNSCC are depicted in light blue with respective fractions of tumors harboring those features[117].

These observations cumulatively emphasize the need to develop efficiently designed targeted therapy for HPV-positive and HPV-negative cancers, and even for subsets of the two, further designated by specific mutational and gene expression profiles.

1.4.2 Genetic Modifications: CNV, Methylation, TCGA

Copy number variations (CNV) between HPV-positive and HPV-negative HNSCC tumors have been extensively studied through comparative genomic hybridization (CGH)[118].Observed patterns of genomic alterations include: a) losses at 3p11.2–26.3, 5q11.2–35.2, 18q12.1– 23 and 9p21.1– 24, and gains at 11q12.1–13.4 in HPV-negative tumors; b) gain of 18q12.1– 23 in HPV16-positive tumors[119,120]; c) similar patterns of gene loss at 13q and gain at 20q in HPV-positive uterine cervix SCC and HPV-positive HNSCC tumors[121] and d) higher number of chromosomal alterations and amplifications in HPV-negative OSCC[122].

The human genome comprises Guanine-Cytosine (GC) rich hotspots called CpG islands, primarily in the gene promoter region, whose cytosine residues are often hypermethylated by DNA methyltransferases[123,124]. This generally results in downregulation of the affected gene and, depending upon which genes are affected, may influence the development of cancer[125–128].

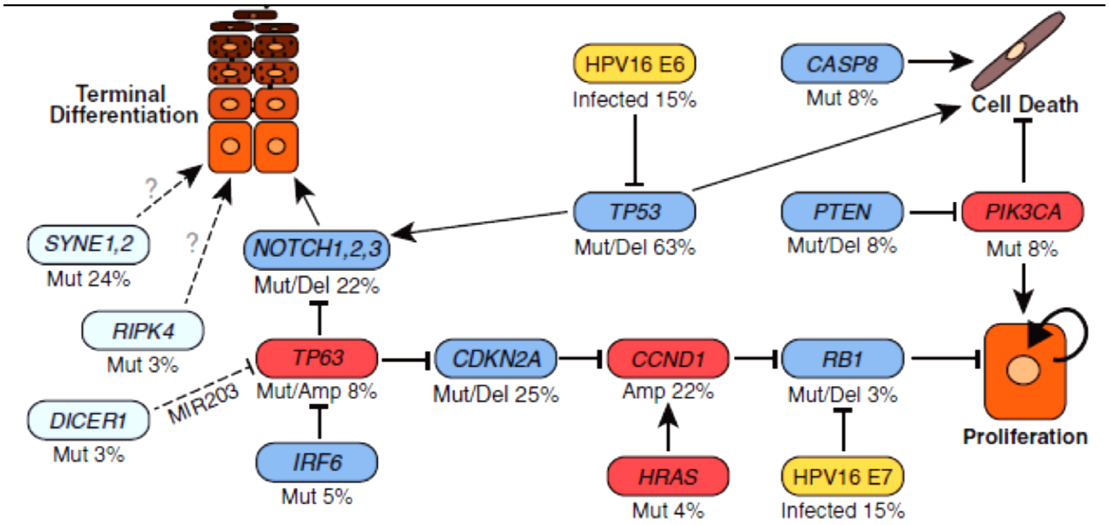

Figure 1.1: Proposed circuitry of HNSCC[109].

Darker blue- loss of function; red- gain of function; yellow- viral genes; light blue- genes putatively implicated in HNSCC. The numbers listed beneath each protein represent the percentage of tumors harboring mutations, amplifications, or deletions in the respective genes. *[Copyright License number 3245480848122]*

A recent CpG island methylome screening of 15 OPSCC tumor samples, grouped into three cohorts based on the status of viral DNA/transcripts as DNA^{-}/RNA^{-}, DNA^{+}/RNA^{-} and DNA^{+}/RNA^{+}; revealed distinct methylation signatures between HPV-driven and non HPV-driven OPSCCs[129]. Two major conclusions were as follows: 1) HPV-driven promoter methylation signature of 5 genes ($ALDH1A2^{lo}$, $OSR2^{lo}$, $GATA4^{hi}$, $GRIA4^{hi}$, and $IRX4^{hi}$) strongly correlated to the clinical outcome of OPSCC patients and 2) the presence of viral DNA alone was insufficient to explain differences in DNA methylation, thus emphasizing the potential role of active viral transcription in driving at least some of the methylation events[129]. However, the mechanism by which viral proteins direct gene silencing in HPV driven OPSCC is incompletely understood.

TCGA is a community resource project with a readily available online tool that allows researchers to search, download, and analyze data across different cancer models. Recently, TCGA identified heterogeneous gene mutation patterns in 279 HNSCC tumors due to smoking, tobacco and HPV with 15 significantly mutated genes, among them CDKN2A(p16), TP53, PIK3CA, NOTCH1, HRAS, and NFE2L2[130].

APOBEC (apolipoprotein B mRNA editing enzyme, catalytic polypeptide-like) cytidine deaminases are involved in innate immunity, RNA editing and more recently APOBEC-mediated mutagenesis was studied in human cancers including HNSCC[131]. The analysis spanned 954,247 mutations in 2,680 exomes from 14 cancer types, mostly from TCGA and depicted a rate of 58% mutations in the APOBEC gene. The study hinted towards a probable relationship between HPV and APOBEC as both cervical SCC and HNSCC were found to be enriched in APOBEC mutations. In another study involving 239 HNSCC tumors from the TCGA database, viral integration sites were identified in 24

HNSCC tumors expressing E6 and E7 oncogenes both within the viral and host genomes[67]. The viral integration was observed in chromosomes 1, 3, 5, 9, 13, 14, 15, 16, 18, 19 and 21 with majority of them involving known cancer genes like TP63, RAD51B and SERPINB3 etc[67]. While we are not quite at the point of being able to trace a true picture of all of the possible mutational avenues of HNSCC development, data are accumulating at a high rate and this classification may become possible in the near future. The next step, then, will be to connect specific mutations with molecular mechanisms that can be utilized for the design of individualized therapeutic approaches.

1.4.3 Biomarkers of HNSCC

HNC treatment involves targeting receptor tyrosine kinases (RTKs) like the EGFR[132]. However, despite EGFR overexpression in about 90% of tumors[133] the response to treatment is poor[134]. This has led to the continuing search of more RTK's that may serve as therapeutic targets. Among these, the mesenchymal epithelial transition/hepatocyte growth factor receptor (MET/HGFR), which controls growth, invasion and metastasis in cancer cells, has been recently proposed as a new therapeutic target for HNSCC in view of its crosstalk with the EGFR[135] and its potential as an inducer of cancer stem cell phenotype[136]. MET is under the control of TP53[137] and therefore should be downregulated in E6 expressing cells. This could be an important marker and driver of proliferation in HPV-negative tumors. The MET oncogene has been proposed as a therapeutic target for HNSCC[136]. However, differential expression of MET between HPV-positive and HPV-negative tumors has not yet been described. Remodeling of extracellular matrix (ECM) by matrix metalloproteinases (MMP's) plays an important role in tumor invasion and metastasis. The expression profile of proteinases involved in the HNSCC-associated degradome are specific to histopathologic characteristics such as grade, location, size and metastasis of tumor[138]. One such proteinase, a disintegrin and metalloprotease 12 (ADAM12) is positively regulated by the EGFR and its overexpression has been implicated in migration and invasion of oral squamous cell carcinoma (OSCC) cells[139]. Matrix metalloproteinases (MMP's), a family of zinc-dependent endopeptidases, degrade ECM and their overexpression has been well documented in HNSCC tumors, cell lines and cancer-associated fibroblasts[138,140–144]. More recently, HPV8 expressing transgenic mice and p16 positive cervical cancer cell lines were reported to have overexpression of MMP2, 9, 13 and 14[145,146].

Two of the important genes up-regulated in HPV positive cancers include well documented CDKN2A[111,122,147] and minichromosome maintenance complex component 2 (MCM2), whereby MCM2 has been reported as a probable biomarker to assess pre dysplastic lesions of TSCC with elevated levels in severe epithelial dysplasia as compared to advanced SCC [148].

Transforming growth factor beta-2 (TGFβ2) was recently noted as a contextual oncogene or tumor suppressor in HNSCC in view of its dichotomous role in disease progression[149]. TGFβ receptor II (TGFβRII), Smad2, and Smad4 are often downregulated during disease progression, with a concomitant upregulation of TGFβ1 ligand[150]. This deregulation has a two-fold impact which leads to more aggressive and less differentiated tumors due to receptor attenuation, and inhibition of anti-tumor immunity by TGFβ1 while activating tumor-enhancing inflammation in the microenvironment. In a recent study, BRCA1 was suggested as one of the biomarkers that may allow to predict the taxane sensitivity of HNSCC with acquired Cisplatin resistance[151]. IGFBP3 modulates the biovailability of IGF and has been reported to have anti-angiogenic property in HNSCC[152].

Homeobox genes regulate growth & differentiation during embryogenesis by coding for specific transcription factors. One such homeobox gene complex is SIX1 which is involved in organ development. Overexpression of Six1 facilitates breast cancer metastasis by inducing epithelial-mesenchymal transition (EMT)[153] and it is being referred to as a novel target for inhibiting tumorigenesis. Thus, it would be interesting to look for its role in HNSCC. Table 1.2 summarizes some of the key genes mutated and deregulated of HNSCC.

In view of current biomarkers and cellular processes of HPV and non-HPV driven HNSCC, Figure 1.2 summarizes recently proposed hallmarks of tumorigenesis in HN cancer[117]. (A) Squamous differentiation and cellular proliferation is regulated by TP63 and Notch1 in normal adult mucosa, whereby the former maintains the levels of basal differentiation markers- Keratin5/14 and the latter is responsible for differentiation into spinous and granular layers. Figure 1.2(B) depicts hallmarks of HNSCC progression. The loss of TP53 and CDKN2A, amplification of CCND1, and loss of TGFBR2/SMAD4 causes abnormal proliferation and abrogation of apoptosis[117]. However, disrupted cell cycling may still be compensated by intact differentiation and apoptotic programs. Loss of NOTCH1 and/or abnormal expression of TP63, in combination with dysregulated “survival” genes (e.g. CASP8, PIK3CA, EGFR), may remove additional barriers to tumor cell proliferation and survival[117].

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Table 1.2: Deregulated Genes in HNSCC[116,149]

Gene symbol	Gene name	Chromosomal location	Gene function	Selected downstream targets	Targeted therapeutics in cancer	HPV positive HNSCC	HPV negative HNSCC	References
TP53	Tumor protein p53	17p13.1	Tumor suppressor: "Guardian of the genome." Assists in cell cycle arrest, DNA damage repair, apoptosis, and senescence	p21, BAX and PUMA	Adenoviral-based p53 gene replacement	Degradation by E6	Somatic Mutation: 40–60%	109,112,154–160
NOTCH1	Notch1	9p34.3	Tissue-dependent role as tumor suppressor or oncogene. Important in regulation of cell differentiation, lineage commitment, embryonic development, cancer stem cell marker	Hes/Hey, p21	Gamma-secretase inhibitors studied in breast cancer		Somatic Mutation: 14–15%	109,112,161–169
HRAS	Harvey rat sarcoma viral oncogene homolog	11p15.5	Oncogene; GTP binding protein important in promoting cell proliferation and survival signaling through the Raf and PI3K pathway -	Activates Raf/MEK/ERK pathway and PI3K/Akt pathway	Inhibitors of Ras downstream effectors. Farnesyltransferase inhibitors prevent appropriate localization of Ras to the intracellular membrane. Antisense oligonucleotides (colon & pancreatic cancer)		Mutation: 4–35%	109,112,170–172

Gene symbol	Gene name	Chromosomal location	Gene function	Selected downstream targets	Targeted therapeutics in cancer	HPV positive HNSCC	HPV negative HNSCC	References
PIK3CA	Phosphoinositide-3-kinase catalytic alpha polypeptide	3q26.32	Oncogene. Catalytic subunit of PI3K. Target of Ras activation. Important in regulation of cell differentiation, lineage commitment, and embryonic development	Activates Akt and PLCgamma1	Inhibition of downstream effectors like Akt [Everolimus, MK2206]and mTOR [Rapamycin, Temsirolimus] PI3KCA inhibitors studied in breast and non-small cell lung cancer		Mutation: 6–8% Somatic Mutation: 10-20%	173–178
CDKN2A	Cyclin-dependent kinase inhibitor 2A	9p21.3	Tumor suppressor. Regulates G1 cell cycle progression to S phase	Inhibits CDK4/6	CDK inhibitors [P27600]	Overexpression	Mutation: 9% Loss of Heterozygosity:70-80%	109,112,147,173,179,180
MET	Met Proto-Oncogene (Hepatocyte Growth Factor Receptor)	7q31.2	Oncogene. proliferation, scattering, morphogenesis and survival, cancer stem cell marker	Activates RAS-ERK, PI3 kinase-AKT, or PLCgamma-PKC.	Multi-Tyrosine Kinase Inhibitor [E7050, GSK1363089]		Somatic Mutation: 14%	135,136,181–183

Gene symbol	Gene name	Chromosomal location	Gene function	Selected downstream targets	Targeted therapeutics in cancer	HPV positive HNSCC	HPV negative HNSCC	References
EGFR	Epidermal Growth Factor Receptor	7p11.2	Oncogene. Ligand binding triggers receptor homo- and/or heterodimerization and autophosphorylation on key cytoplasmic residues	Activates RAS-RAF-MEK-ERK, PI3 kinase-AKT, PLCgamma-PKC and STATs	Monoclonal antibodies: Cetuximab TKIs: [Panitumumab Nimotuzumab, Zalutumumab, Erlotinib] Multi-TKIs: [Gefitinib, Afatinib, Lapatinib, Zactima]	Overexpressed but less than HPV negatives	Gene amplification and overexpression 90% Somatic Mutation: 1-7% EGFRvIII: 42% Less mutation in caucasians	[113,132,162,184–186]

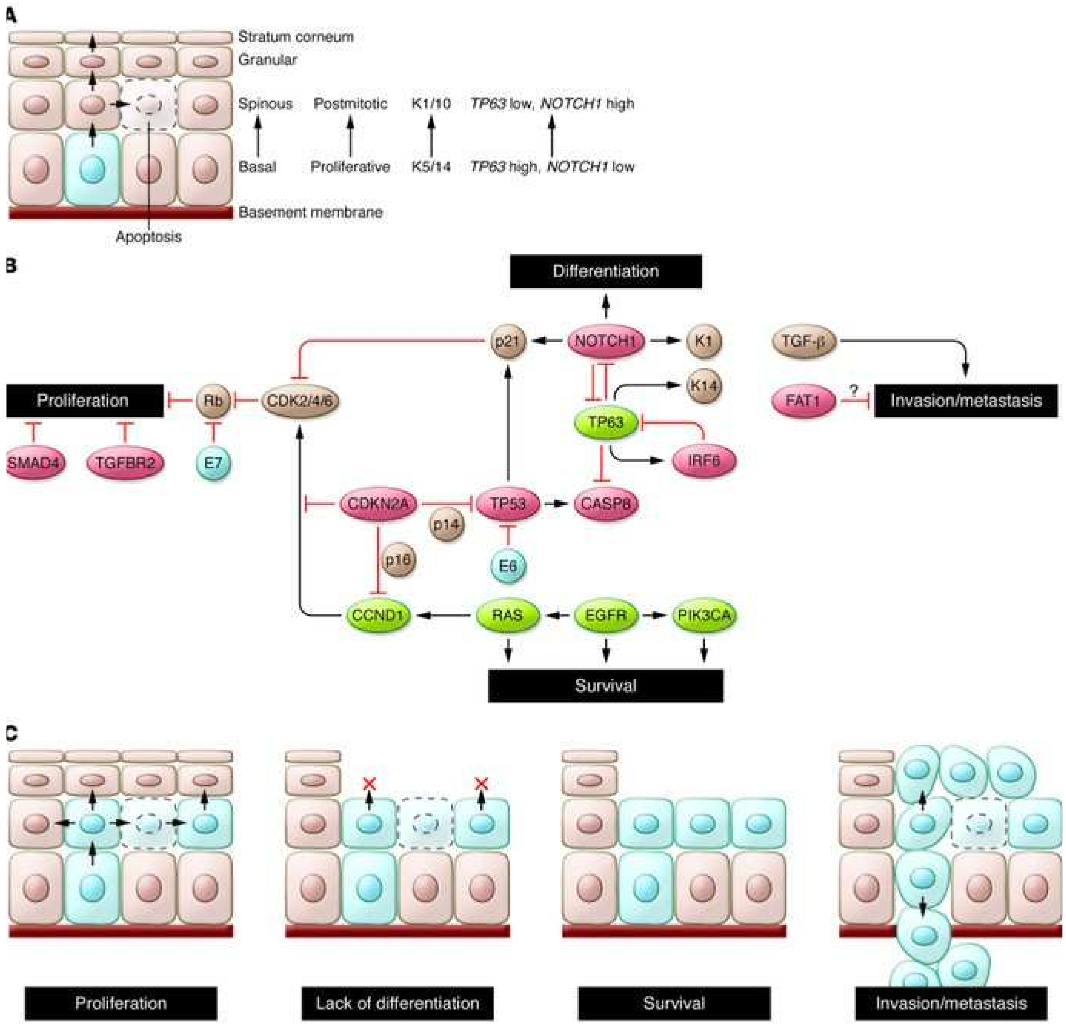


Figure 1.2: Hallmarks of HNSCC tumorigenesis[117]

(A) The normal process of squamous morphogenesis in the adult mucosa and role of two major proteins TP63 and Notch1. Light blue depicts rare stem cells in basal layer undergo terminal differentiation through asymmetric cell division. **(B)** Pathways altered in HNSCC pathogenesis. The color codes are as follows: red- putative and established tumor suppressors; green- oncogenes; brown- other relevant genes/proteins; blue- viral proteins. **(C)** Schematic of HNSCC hallmarks. The precise order of acquisition of distinct alterations is still not clear. Multiple genes (e.g. TP53, TP63 and Notch1) may play a role in more than one hallmark.

Loss of cell adhesion genes (e.g. FAT1) may permit release of cells from the mucosal lining, while invasion through the basement membrane is promoted by TGFB1 and SMAD3[117]. Figure 1.2 (C) describes the purported sequence of acquisition of alterations leading to proliferation, poor differentiation, cell survival and invasion.

1.5. Clinical and Molecular Classification of HNSCC

1.5.1 Molecular Classification

Molecular phenotypes of HPV associated OPSCC's were first categorized into three major classes based on copy number of HPV DNA and p16 expression: HPV-active (HPV16 DNA positive/p16 expressing cancers), HPV-inactive (HPV16 DNA positive/p16 non-expressing) and HPV-negative tumors (no HPV16 DNA/p16 non-expressing) [52,94].

The first ever global gene expression profiling of HPV16 E6 and E7 expressing HNSCC tumors revealed up-regulation of transcription and cell cycle specific genes in comparison to HPV-negative tumors[82]. A comparison between the expression profiles of 84 HNCs, cervical cancers and site matched normal epithelia confirmed upregulation of this subset of genes in HPV-positive HNC and cervical cancers[187]. On the other hand a novel relationship between HPV status and a set of testis-specific genes was ascertained based on upregulation of this family of genes[187].

Immunologic profiling of HPV-positive and HPV-negative OPSCC/HNSCC has revealed contrasting signatures[37] such as: enrichment of circulating CD8+ T cells in HPV-positive OPSCC resulting in better response to therapy[188], higher proportions of effector and memory T cells as compared to HPV-negative tumors[189], differential expression of major histocompatibility class I receptors (MHC I)[190] and lastly, strong adaptive immune response in HPV-positive vs. an innate immunity in HPV-negative HNSCC, which corroborates with a better survival rate in HPV-positive OPSCC patients[191].

To better describe the molecular and functional changes in different kinds of HNSCC, a more comprehensive genome wide analysis was conducted at four major functional levels viz., methylome, genome, transcriptome and miRNome[192].

1.5.2 Clinical Classification

In a recent study, integrated genomic analysis and validation methodology was employed to classify HNSCC tumors based on tumor site and histology with well-defined biological and clinical relevance[193]. Biological characteristics of highly expressed genes were considered within each group to categorize tumors as basal (BA), mesenchymal (MS), atypical (AT), and classical (CL) subtypes. These expression types were well-represented in defined experimental model systems comprising 19 esophageal and 18 upper aerodigestive tract cell lines from the Cancer Cell Line Encyclopedia[194] following the same methodology. BA and CL types were derived from their counterparts in Lung squamous cell carcinoma (LUSC)[195]; where BA types shared similar expression patterns with basal cells during early stages of development of SCC and CL types were indicative of genomic alterations like deletion of 3p and 9p, amplification of 3q, and focal amplification of both EGFR and CCND1. Thirdly, MS depicted tumors with pronounced epithelial-mesenchymal transition pathways and AT type portrayed either 9p deletion or absence of EGFR amplification. CL and AT types also expressed stem cell markers like

SOX2 and ALDH1. Lastly, these signatures were termed complementary to classifications based on HPV status and CCND1 CNV[193].

Another genome wide approach was employed to identify novel differentially methylated CpG dinucleotides found in tumors at various anatomic sites, as well as those in relation to HPV status in the oropharynx [196]. The oropharyngeal HPV-methylation study exclusively found more than twice the number of differentially methylated CpG dinucleotides in HPV positive tumors (564 loci) as compared to HPV negative tumors, arising from the same site[196]. While 74% of HPV negative CpG loci were represented in HPV positive tumors, the latter expressed an additional profile of 360 loci which were exclusive for the group itself and most of it was attributed to hypermethylation in the CpG loci of CDKN2A[64] and GALR1[197] genes.

1.6. Epidemiology of HNSCC

The global HNC incidence for OPSCC cases is high- 263,020 oral cavity, 213,179 thyroid gland, 150,677 larynx, 136,622 pharynx, and 84,441 nasopharynx cases per year [198,199]. The incidence of OPSCC is 2.5 times greater in men than in women where the age-standardized incidence rates are 13.5 versus 11.5 for males in developed and developing countries, respectively[1]. Incidence within female population are, 3.0 versus 5.1, in developed and developing countries, respectively[1]. Transmission of HPV in OPSCC occurs both sexually and asexually[15], where the incidence increases with more than 5 sexual partners[200] and in active smokers[200]. Synergistic effects of alcohol[3] and human immunodeficiency virus (HIV)-33% [201,202] have also been described.

More recently, HPV has been characterized as a risk factor based on race, life style and sexual behavior impacting survival outcomes for African American (AA) and European American (EA) patients with OPSCC [203]. The rate of HPV-associated tumors is much lower in AA patients as compared to EA patients[204,205]. Overall, AA patients tend to present with more HPV negative OPSCC and have worse prognosis as compared to both HPV-positive and HPV-negative EA patients[203,204]. South Carolina ranks third in the USA in OPSCC mortality, with most common sites of tumor growth being tongue, gums and tonsils [206]. A study from Georgia found that younger age groups, Non-Hispanic Whites and Hispanics experienced greater increases in incidence for HPV-associated sites, while HNC incidence declined for Non-Hispanic Blacks independent of HPV-association [207].

In this study, we employed gene expression profiling by microarrays, and quantitative real-time PCR to investigate the gene expression profiles of HPV-positive and HPV-negative OPSCC derived from AA or EA patients, to attempt an identification of gene expression changes that would characterize and distinguish these tumors, and provide clues as to the molecular basis of the disparate distribution and clinical behavior of the same. In this context, we implemented state-of-the-art methods for gene expression assessment by RT-qPCR.

1.7. Reverse Transcription - Quantitative Polymerase Chain Reaction

Ever-since the advent of Real-Time quantitative PCR [208,209] in 1996, the technique has been extensively implemented in quantitative estimation of gene copy number and expression analysis. This is primarily because of increased demand to support phenotypic observations with quantitative molecular data and as a supporting assay for protein expression studies [210]. Furthermore, quantitative Polymerase Chain Reaction (qPCR) based studies were becoming highly unreliable due to low experimental transparency and inconsistency between laboratories leading to failures in replication of published data [211]. The use of various statistical analysis tools, in the absence of proper guidelines for data interpretation, added to the ever-growing variability between similar studies [212]. A comparative analysis of multiple Real-Time qPCR quantification methods reported considerable differences in their performance [213]. Thus, a case for 'Minimum Information for Publication of Quantitative Real-Time PCR Experiments' guidelines was proposed to target the reliability of Real-Time PCR results [214].

1.7.1 Minimum Information for quantitative estimation (MIQE)

The MIQE (*pronounced mykee*) guidelines describe the minimum information necessary for evaluating qPCR experiments and encompasses a complete disclosure of all reagents, sequences, and analysis methods used by a researcher. These guidelines were designed in order to fully assess the validity of the protocols through a checklist of essential and desirable parameters which accompany the initial submission of a manuscript, and are later published in abbreviated form or as an online supplement. The list of essential and desired parameters is given in Table 1.3.

To remove ambiguity associated with Real Time-PCR, quantitative-PCR and Reverse Transcriptase-PCR, the term 'qPCR' was proposed for quantitative real-time PCR and 'RT-qPCR' for reverse transcription–qPCR.

Table 1.3: MIQE checklist for authors, reviewers and editors[214]

ITEM TO CHECK	IMPORTANCE
EXPERIMENTAL DESIGN	
Definition of experimental and control groups	**E**
Number within each group	**E**
Assay carried out by core lab or investigator's lab?	D
Acknowledgement of authors' contributions	D
SAMPLE	
Description	**E**
Volume/mass of sample processed	D
Microdissection or macrodissection	**E**
Processing procedure	**E**
If frozen - how and how quickly?	**E**
If fixed - with what, how quickly?	**E**
Sample storage conditions and duration (especially for FFPE # samples)	**E**
NUCLEIC ACID EXTRACTION	
Procedure and/or instrumentation	**E**
Name of kit and details of any modifications	**E**
Source of additional reagents used	D
Details of DNase or RNAse treatment	**E**
Contamination assessment (DNA or RNA)	**E**
Nucleic acid quantification	**E**
Instrument and method	**E**
Purity (A260/A280)	D
Yield	D
RNA integrity method/instrument	**E**
RIN/RQI or Cq of 3' and 5' transcripts	**E**
Electrophoresis traces	D
Inhibition testing (Cq dilutions, spike or other)	**E**
REVERSE TRANSCRIPTION	
Complete reaction conditions	**E**
Amount of RNA and reaction volume	**E**
Priming oligonucleotide (if using GSP) and concentration	**E**
Reverse transcriptase and concentration	**E**
Temperature and time	**E**
Manufacturer of reagents and catalogue numbers	D
Cqs with and without RT	D*

Storage conditions of cDNA	D
qPCR TARGET INFORMATION	
If multiplex, efficiency and LOD of each assay.	**E**
Sequence accession number	**E**
Location of amplicon	D
Amplicon length	**E**
In silico specificity screen (BLAST, etc)	**E**
Pseudogenes, retropseudogenes or other homologs?	D
Sequence alignment	D
Secondary structure analysis of amplicon	D
Location of each primer by exon or intron (if applicable)	**E**
What splice variants are targeted?	**E**
qPCR OLIGONUCLEOTIDES	
Primer sequences	**E**
RTPrimerDB Identification Number	D
Probe sequences	D**
Location and identity of any modifications	**E**
Manufacturer of oligonucleotides	D
Purification method	D
qPCR PROTOCOL	
Complete reaction conditions	**E**
Reaction volume and amount of cDNA/DNA	**E**
Primer, (probe), Mg++ and dNTP concentrations	**E**
Polymerase identity and concentration	**E**
Buffer/kit identity and manufacturer	**E**
Exact chemical constitution of the buffer	D
Additives (SYBR Green I, DMSO, etc.)	**E**
Manufacturer of plates/tubes and catalog number	D
Complete thermocycling parameters	**E**
Reaction setup (manual/robotic)	D
Manufacturer of qPCR instrument	**E**
qPCR VALIDATION	
Evidence of optimisation (from gradients)	D
Specificity (gel, sequence, melt, or digest)	**E**
For SYBR Green I, Cq of the NTC	**E**
Standard curves with slope and y-intercept	**E**
PCR efficiency calculated from slope	**E**
Confidence interval for PCR efficiency or standard error	D
r2 of standard curve	**E**

Linear dynamic range	**E**
Cq variation at lower limit	**E**
Confidence intervals throughout range	D
Evidence for limit of detection	**E**
If multiplex, efficiency and LOD of each assay.	**E**
DATA ANALYSIS	
qPCR analysis program (source, version)	**E**
Cq method determination	**E**
Outlier identification and disposition	**E**
Results of NTCs	**E**
Justification of number and choice of reference genes	**E**
Description of normalisation method	**E**
Number and concordance of biological replicates	D
Number and stage (RT or qPCR) of technical replicates	**E**
Repeatability (intra-assay variation)	E
Reproducibility (inter-assay variation, %CV)	D
Power analysis	D
Statistical methods for result significance	**E**
Software (source, version)	E
Cq or raw data submission using RDML	**D**

All essential information (E) must be submitted with the manuscript. Desirable information (D) should be submitted if available. If primers are from RTPrimerDB, information on qPCR target, oligonucleotides, protocols, and validation is available from that source[214].

(#) FFPE, formalin-fixed, paraffin-embedded; RIN, RNA integrity number; RQI, RNA quality indicator; GSP, gene-specific priming; dNTP, deoxynucleoside triphosphate[214].

(*) Assessing the absence of DNA with a no–reverse transcription assay is essential when first extracting RNA. Once the sample has been validated as DNA free, inclusion of a no–reverse transcription control is desirable but no longer essential[214].

(**) Disclosure of the probe sequence is highly desirable and strongly encouraged; however, because not all vendors of commercial predesigned assays provide this information, it cannot be an essential requirement. Use of such assays is discouraged[214].

These guidelines further accelerated the development of an XML-based real-time PCR data markup language (RDML) for the consistent reporting of real-time PCR data [215]. This consortium is active in the development of appropriate and standardized terminology, guidelines on minimum information for biological and biomedical investigations, and a flexible and universal data file structure with tools to create, process, and validate RDML files[215].

1.7.2 Normalization of RT-qPCR

Many statistical analysis tools have evolved over the past decade to accurately quantify differential expression of genes with respect to reference/housekeeping genes whose levels remain constant across varying experimental conditions[216–221]. Each tool developed to overcome the limitation of the previously existing tool whereby factors like assessment with multiple reference genes[219,220,222], primer efficiency correction[221], inter-run calibration[223], gene and sample maximization strategies[221] and tissue specific panel of reference genes[224,225] have now gained relevance[226]. While geNorm[220] was the first efficient tool to compare a panel of multiple reference genes, thus ranking them based on their stability values (M value), BestKeeper[219] could assess variation in up-to 10 reference genes in an array of 100 samples, Normfinder[227] returned top two candidate reference genes based on sample groupings and the more recent software qbase+ incorporated feature of geNorm along with other significant parameters for efficient normalization[221].

1.8. Study Rationale

Considering the limitations of present therapies to cure tumor relapse, a profound understanding of the HNSCC molecular biology and associated tumorigenicity is required to devise efficient therapeutic measures targeting specific cellular and sub-cellular signaling pathways in view of its recent etiological factor-HPV. With the unveiling of a mutational landscape, differential gene expression and an epigenetic profile of HPV driven HNSCC, other risk factors critical for efficient prognosis remain to be explored which include racial and geographical differences in a population, which is in turn guided by the genetic make-up of the individuals. This study specifically explored the molecular basis for the racial differences in prevalence and mortality rate of HNSCC between AA and EA South Carolinians.

Thus, our approach allowed us to determine whether or not HPV types other than HPV16 play an important role in HNSCC in AA, and began dissecting the molecular profiles of HNSCC in the two racial groups. This is the first study of its kind in South Carolina and includes a direct assessment of the prevalence of HPV in HNSCC, particularly AA men and women, for which there is a paucity of data.

Our study allowed us to determine whether or not HPV types other than HPV16 play an important role in HNSCC in AA, and began dissecting the molecular profiles of HNSCC in the two racial groups. With the increasing emphasis on accurate determination of HPV activity in the OPSCC tumors and observed trends of HNSCC disparities among AA and EA patients, our study delineates the patterns of HPV active, inactive and negative tumors based on viral oncogene expression.

Lastly, the differential gene expression analysis of OPSCC samples revealed that HPV-negative and HPV-inactive tumors clearly segregate from HPV-positive OPSCC in terms of GO and DEGs (both within a race and in the combined sample set).

CHAPTER 2: MATERIALS AND METHODS

2.1. Tissue Samples

This retrospective cohort study included a total of 65 fresh frozen oropharyngeal samples collected from African American and European American patients at the Medical University of South Carolina (MUSC), Charleston, SC. The tissue sample set included 56 tumor biopsies and 9 normal benign uvula or uvula and tonsil tissue samples. The study was approved by the MUSC Institutional Review Board (IRB) and USC's IRB. A written consent for the use of tissues was obtained from patients according to the MUSC Standard Tissue Collection consent.

2.2. Extraction of Nucleic Acids

A) Tissue Homogenization

Fresh frozen tissue samples were homogenized by a motor driven, handheld homogenizing system which consists of a porcelain/zirconium miniaturized mortar and pestle (CryoGrinder™, OPS diagnostics LLC, Product no.CG 08-010) and a cordless, 3.6V, three position screwdriver (Black & Decker®). The CryoGrinder™ was used along with CryoCooler™ (OPS diagnostics LLC, Product no.CG 08-07), a portable cryogenic station which maintained temperatures much below -130°C for up to 5 hours with the help of a Liquid Nitrogen absorbing Pillow (OPS diagnostics LLC, Product no.CG 08-08).

Briefly, the CryoCooler™ was disinfected with 70% Isopropyl Alcohol and the reservoir was charged with liquid nitrogen using the absorbent pillow. The level of liquid nitrogen was adjusted such as it reached 1-2cm above the perforated platform. Prior to this; spatula, pestles and mortars were decontaminated with Ambion® DNA*Zap*™ and then autoclaved at 121°C for 15mins. Post sterilization and cooling, spatula, pestles and mortars were placed on the perforated platform of the CryoCooler™ along with a sterile Petri dish (VWR® International, Catalog no. 25384-168), sterile individually wrapped disposable forceps (VWR® International, Catalog no. 97001-199), a sterile disposable scalpel (BD Biosciences, Catalog no. 371620) and a nuclease free 1.5 mLmicrofuge tube for about 15 minutes. The frozen tissue samples were handled individually with fresh gloves each time, to avoid any cross contamination and the sterile Petri dish was used as an additional platform for fragmenting the frozen tissue in the chamber of CryoCooler™. Tissue was split into two major parts; one part was used for homogenization and the other for immunohistochemical staining (see section 2.9). The size and weight of fragmented tissue was maintained under 5mm and 100mg (~ 20-50mg) respectively, for efficient grinding. The pre-cooled pestles were handled by wearing Cryo-gloves (Tempshield, Product no.11-394-322) and the screwdriver was set at maximum rotation speed for grinding of tissue fragments. Pulverized tissue was transferred to a labeled microfuge tube with the help of a sterile spatula and used for the extraction of nucleic acids.

B) TRIzol extraction

TRIzol® Reagent (Ambion®, by Life Technologies, catalog no. 15596-018) was used to simultaneously extract genomic DNA and total RNA from fresh frozen tissues according to manufacturer's instructions with an additional step of back extraction protocol for higher purity DNA. Briefly, 700ul (for <50mg tissue) or 1000ul (for 50 – 100mg tissue) of TRIzol® Reagent was added to the pulverized frozen tissue, and the mixture was incubated at room temperature for 10min. To this, 0.2mL of chloroform per ml TRIzol® Reagent was added and vortexed for 15 seconds. The homogenate was incubated at room temperature for 3 min and centrifuged at 12,000xg for 15min at 4°C. The upper aqueous phase containing the RNA was carefully transferred to a fresh nuclease-free microfuge tube. Meanwhile, the organic phase containing DNA and protein was stored at 4°C., Isopropanol (0.5ml, 100%) was added to the aqueous phase and the mixture was incubated at room temperature for 10min, followed by centrifugation at 12000xg, 4°C for 10min. The supernatant was discarded and the pellet was washed with 1 mL75% EtoH/mLof TRIzol® Reagent by centrifugation at 7,500xg, for 5min at 4°C. The RNA pellet was air-dried (not completely, it should remain translucent and not turn white) and resuspended in RNAase free water at 55-60°C for 10-15min.

For DNA Isolation, any remaining aqueous phase was removed from the organic phase by centrifuging at 12000xg for 5min at 4°C. To the interface-organic phase, 500 μl of back extraction buffer (BEB - Guanidine Thiocyanate (4 M), Sodium Citrate (50 mM), Tris (1M)) per 1 mL of TRIzol® Reagent was added for initial homogenization. The sample was vigorously mixed by inversion for 10 sec and incubated at room temperature for 10 min on a shaker, followed by a centrifugation at 12,000xg for 30 min at room temperature. The upper, aqueous phase containing DNA was transferred to a clean tube, while the interphase and organic phase were stored at 4°C for subsequent protein isolation. DNA was precipitated by adding equal volume of isopropanol/mL of TRIzol® Reagent to the samples, which were then mixed by inversion and incubated at room temperature for 10min. DNA was collected by centrifugation at 12000xg for 15min at 4°C and resultant pellet was washed with 1mL of 75% EtoH per 1mLTRIzol® Reagent as previous. Washing steps were repeated for a total of three times. DNA was resuspended in 200ul TE buffer (10mM TrisCl, 1mM Ethylenediaminetetraacetic acid, pH8) for 5-6 hours at room temperature.

After resuspension in TE buffer, additional washing steps with chloroform/isoamylalcohol (24:1) were performed to completely remove residual guanidine from the samples, and at each step phases were separated by centrifugation and the upper, aqueous phase collected. An equal volume of Chloroform:Isoamyl (CI, 24:1) was added directly to the resuspended DNA and mixed by inversion. The mixture was centrifuged at 12,000xg for 15 min. at room temperature to separate the phases. For DNA precipitation, the aqueous phase was transferred to a new tube, to which 3M Sodium Acetate pH 5.2 (10% of the volume) and 2.5 volumes of 95-100% of ethanol were added.

Total RNA was also isolated from Normal Human Keratinocyte (NHKc) and D4 Differentiation Resistant (D4DR) cells with Agilent Total RNA Isolation Mini Kit (Product no. 5185-6000) according to the manufacturer’s instructions. These two samples were used as Inter-Run Calibrators for RT-qPCR experiments and as template for primer efficiency assays.

C) Quantification of Nucleic Acids

Quality and quantity of total RNA and genomic DNA were assessed by NanoDrop 2000c UV-Vis spectrophotometer (Thermo SCIENTIFIC). The integrity of total RNA was also determined by automated capillary-electrophoresis on an Agilent 2100 BioAnalyzer (a microfluidics-based platform for quantification and quality control of nucleic acids) using the 6000 Nano Assay. Agilent 2100 Expert Software automatically yields an electropherogram of each sample which contains the RNA integrity number (RIN) and concentration along with a visual representation of the two ribosomal RNAs (18s and 28s) bands. Tumor heterogeneity and mishandling of freshly biopsied tissues during freezing procedures are probable causes for variable RIN (range N/A – 9) in human tissue samples. Thus, only RNA samples with RIN $\geq$ 6.3 were included in downstream applications such as microarrays and q-PCR.

2.3. HPV Genotyping and HPV Early Gene Expression Analysis

A) INNO-LiPA Assay

The presence of HPV DNA in the oropharyngeal tissue samples was detected by using the INNO-LiPA HPV Genotyping Extra (Innogenetics Inc., reference no. 81073) assay according to manufacturer's instructions. Briefly, genomic DNA was diluted to 5ng/µl and 2 µl were used for amplification on an Applied Biosystems GeneAmp PCR System 2700, using the INNO-LiPA HPV Genotyping Extra Amp kit (Innogenetics Inc., reference no. 81074). The INNO-LiPA HPV Genotyping Extra [228,229] (Innogenetics Inc.) assay is based on the reverse hybridization principle: specific primers (SPF10 primers [57,58] are used to amplify a 65bp fragment of the Late 1 (L1) region of the HPV genome in the presence of biotinylated dNTP's. Amplification is followed by denaturation and hybridization with type specific oligonucleotide probes which are immobilized as parallel lines on nitrocellulose strips. Additionally, primers specific for the human gene HLADPB1 (Major Histocompatibility Complex, Class II, DP Beta 1) are included as an experimental control for sample quality and extraction. Hybridization is followed by stringent washing and binding with streptavidin-conjugated alkaline phosphatase which yields a purple precipitate in the presence of the chromogen BCIP/NBT (5-bromo-4-chloro-3'-indolyphosphate p-toluidine salt/nitro-blue tetrazolium chloride). In summary, the amplification kit synthesizes the standardized biotinylated amplicons which are subsequently hybridized using a single nitrocellulose typing strip. These predesigned strips have 4 experimental control lines and 28 sequence-specific DNA probe lines for HPV types, which include 18 high-risk HPVs (16, 18, 26, 31, 33, 35, 39, 45, 51, 52, 53, 56, 58, 59, 66, 68, 73, 82), 6 low-risk HPVs (6, 11, 40, 43, 44, 54, 70), and 3 other non-classified HPVs (69, 71, 74). The test was termed satisfactory if the human DNA control probe was positive, after which hybridization results for all HPV typing probes were recorded to determine the specific type present in the sample.

B) HPV-E7 and E6/E7 Expression Analysis

The active or inactive status of HPV in the HNSCC samples was determined by type specific RT-qPCR for HPV E7 oncogene. Briefly, expression of HPV E7 oncogene was assessed for HPV 16 and 66; while for HPV 35, 52 and 58, E6/E7 junction was analyzed for expression. The primer efficiencies were calculated as given in section 2.8.

2.4. RNA Amplification and Labeling for Microarray Analysis

Thirty six OPSCC tumor samples and four normal tissue specimens (benign uvulaand normal tonsil) were considered for gene expression analysis based on their HPV status and racial background. The RIN for RNA samples included in this study was in the range of 6.3 – 8.7.

Agilent's Low Input Quick Amp Labeling Kit (Catalog no. 5190-2306) was used to generate fluorescently labeled complementary RNA (cRNA) by linear amplification of mRNA from total RNA. RNA Spike-in from Agilent One-Color RNA Spike-In Kit (Product no. 5188-5282) was used as an internal control following the manufacturer's instructions. The cRNA amplification schematic is as given in Figure 2.1. The One-Color Microarray-Based Gene Expression Analysis (Low Input Quick Amp Labeling) protocol is summarized below:

Synthesis of c-DNA

200ng of total RNA was mixed with diluted spike-in controls and primed with T7 oligo (dT) promoter primer for first strand c-DNA synthesis. The c-DNA master mix was prepared by adding 0.1M DTT, pre-warmed 5x First Strand Buffer (80°C), 10mM dNTP mix and AffinityScript RNase Block Mix in that order, and incubated with the primed RNA. Thus, first strand c-DNA synthesis was accompanied by second strand cDNA bearing the T7 promoter sequence at its 3′end.

Labeling and Amplification

The second strand c-DNA obtained from the previous step served as template for T7 RNA polymerase-dependent transcription, the product of which was labeled with Cyanine 3-CTP (Cy 3-CTP) (Perkin Elmer Life Sciences, Inc, Boston, MA, catalogue no. NEL622001KT) to generate fluorescently labeled amplified cRNA. Cyanine dyes denature in the presence of light, therefore steps involving Cy 3 were performed under low light conditions.

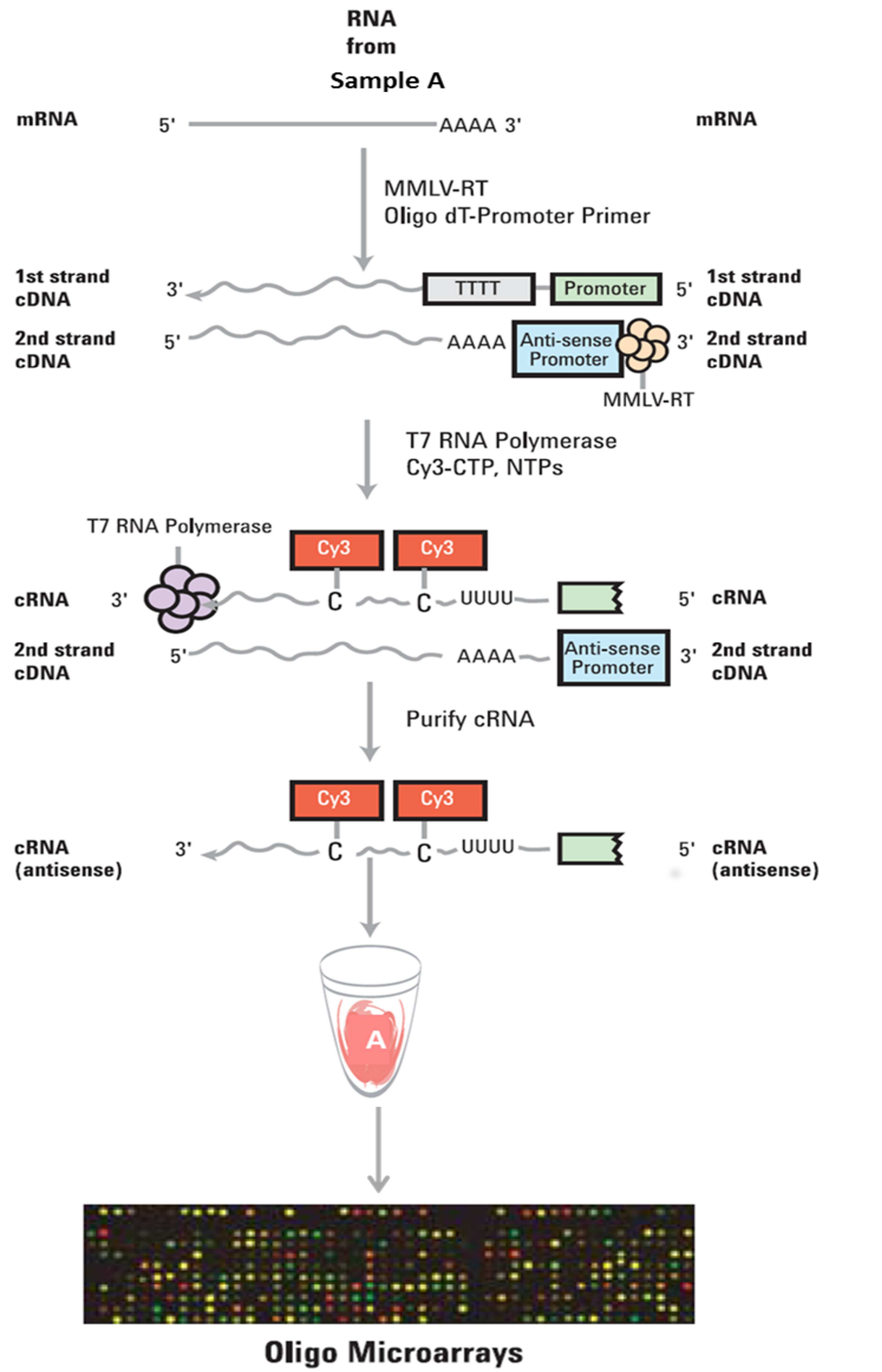


Figure 2.1: Schematic of cRNA amplification. [*Adapted from Agilent One-color Gene Expression manual, version6.5]*

Purification of Labeled Amplified cRNA

Spin columns from Qiagen's RNeasy mini kit (Catalog no. 74104) were used to remove any unincorporated Cy 3-CTP's, primers and polymerases from labeled amplified cRNA according to the manufacturer's protocol.

Quantification of cRNA

Florescent dye labeling density of Cy 3 along with the purity of nucleic acid in labeled cRNA amplicons was measured by NanoDrop 2000c UV-Vis spectrophotometer. Cy 3 dye concentration (pmol/µl), RNA absorbance ratio (260nm/280nm) and cRNA concentration (ng/µl) were determined and recorded from the microarray application of the spectrophotometer's operating software. The total yield and specific activity of each reaction were calculated as follows:

Total yield of cRNA (µg)

= {(Concentration of cRNA) x 30µl (elution volume)} / 1000

Specific Activity of fluorescent dye (pmol/µg cRNA)

= (Concentration of Cy 3 / Concentration of cRNA) x 1000

Calculated yield and specific activity of the labeled products were well above minimum recommended values for an 8-pack microarray format. Total cRNA yield for all the labeled products was 2.913 - 7.74µg (recommended minimum 0.825µg), while specific activity of cyanine dye was 8.58 – 18.35 pmol/µg cRNA (recommended minimum 6pmol/µg cRNA). All the samples were stored at -80°C until hybridization.

2.5. Microarray Hybridization and Image Acquisition

The following steps were performed under dim light conditions as they involved light sensitive fluorescent dyes. Agilent's Gene Expression Hybridization kit (Product no. 5188-5242) was used according to the manufacturer's instructions and the 8x60K microarray slides were used.

Preparation of Samples

Sample preparation steps involved fragmentation of cRNA to obtain optimum size for hybridization and a blocking agent to control nonspecific binding. For all the forty samples, 600ng of Cy 3-labeled linearly amplified cRNA was incubated with pre-warmed 10 x blocking agent (37°C), nuclease free water and 25 x fragmentation buffer in a total volume of 25 µl at 60°C for 30 min, in a PTC-100 thermal cycler (M. J. Research Inc., USA). This fragmentation reaction was stopped by adding 25µl of 2X GEx Hybridization buffer HI-RPM and the resulting hybridization mixture was mixed carefully by pipetting to avoid bubbles, centrifuged at 13,000 revolutions per minute (rpm) for 1 min and placed on ice for loading immediately.

Hybridization Assembly

The user guide (G2534-90001) from Agilent Microarray Hybridization Chamber Kit (Product no. G2534A) was referred for instructions on slide loading, assembly and disassembly of chambers. Fragmented labeled cRNA was hybridized to SurePrint G3 Human Gene Expression 8x60K v2 Microarrays (Catalog no.G4858A-039494) according to the manufacturer's protocol. The 8x60K microarrays contain eight individual arrays on one slide, each containing 60,000 oligonucleotide probes covering the entire known complement of human genes. Hybridization experiments were done in batches of 8 samples/day on a total of five microarray slides overall, to accommodate all the 40 samples. A clean gasket was placed facing up in the rectangular section of the chamber base and 40µl hybridization sample was carefully loaded in the center of each well of the slide without touching the gasket. Once all the samples were loaded onto the slide, the array slide was put facing down (numeric barcode facing up) on the gasket slide and the sandwiched assembly was clamped safely. This assembled slide chamber was placed in the rotisserie rack in a hybridization oven and incubated at 65°C with the rotator set to 10rpm for 17 hours. Meanwhile, Gene Expression Wash Buffer 2 (Catalog no. 5188-5326) was warmed overnight at 37°C to prepare for next day washing.

Washing

Prior to washing, gene expression wash buffers 1 and 2 were prepared by addingTriton X-102 (final concentration 0.005%), immediately after opening a fresh container. This is done to reduce the artifacts generated during washing of arrays. After 17 hours of hybridization, the hybridization chamber was disassembled in GE Wash Buffer 1 (Catalog no. 5188-5325) and the slide was repeatedly washed for 1 min each in separate slide staining dishes containing fresh GE Wash Buffer 1 followed by pre-warmed (37°C) GE wash buffer 2. The array slide was then dried in a coplin jar, by dipping it in 100% Acetonitrile for 30 seconds. Acetonitrile scavenges ozone, thus preventing degradation of the cyanine dye.

Scanning

After washing and drying, the slides were put in a slide holder with Agilent Ozone-Barrier Slide Cover on top (Product no. G2505-60550) and immediately scanned using a High Resolution Agilent DNA Microarray Scanner System (Catalog no. G2565CA).

AgilentG3_GX_1Color profile was selected from the control panel and scanned under green channel with scan area of 61 x 21.6 mm at 5µm resolution. The images were saved as 20bit Tagged Image File Format (TIFF) files. Post scanning, slides were exposed to nitrogen vapors in a 50mLconical tube covered with aluminium foil and stored in an orange slide box, in the dark.

2.6. Data Analysis

Data were extracted from TIFF images with Agilent Feature Extraction Software version 10.7.3, where background correction was also performed. The quality control (QC) metric set was generated post extraction and results were reviewed in three ways; project summary, QC report which included both a summary on the header and a table of metric values and QC chart returned values of each metric compared across all extractions in FE Project. In brief, QC metric helps in indentifying wash artifacts, exposure to ozone and hybridization to cRNA from degraded total RNA. Thus, any deviation from normal trends helps in closer inspection of obtained results. Proper alignment of the grid with the four corners of the array was also analyzed through QC report. Subsequently, background-corrected data was uploaded into Agilent GeneSpring GX version 11.5.1 for analysis. In this process, data were log2 transformed, quantile normalized and base line transformed using the median of all samples. Then, data were filtered by flags in such a way that 75% of the samples in at least one of the treatment groups would have a “detected” flag. Differentially expressed genes were determined by analysis of the data using the non-parametric Mann-Whitney unpaired test. Cutoff values of 0.02 and 2 were used for p-value and fold change, respectively. Gene ontology (GO), pathway analysis and hierarchical cluster analysis were also performed with GeneSpring. For the latest, Euclidean similarity metrics and Wards linkage rule[230] were used along with Kruskal-Wallis non-parametric one-way analysis of variance(ANOVA)[231] .

Top canonical pathways, upregulated and downregulated genes along with most significant biomarkers were also identified using the Ingenuity Pathway Analysis (IPA©, Ingenuity Systems Inc. 2000-2013) for differences in HPV negative OPSCC tumors between AA and EA patients.

2.7. RT-qPCR

A) c-DNA Synthesis and Quantification

In-vitro transcription

Complementary DNA (c-DNA) was synthesized from total RNA (1µg – 100ng) with iScript™ cDNA synthesis Kit (BioRad, catalogue no. 170-8890) in reaction volumes of 40µl or 60 µl per manufacturer's instructions. The reaction was conducted in an Applied Biosystems thermal cycler (Gene Amp® PCR system 2700) and c-DNA was stored at -20°C.

Ribogreen Assay

To achieve uniform template concentration for qPCR assays, c-DNA was quantified by Quant-iT™ RiboGreen® RNA Assay (Invitrogen, Reagent-A Catalog no. R11491). The Quant-iT™ RiboGreen® was originally designed for quantification of up to 1ng/mLof RNA; however, its use can be extrapolated to any single stranded nucleic acid. Ribogreen® is a fluorescent dye which binds to single stranded nucleic acids. Briefly, 7µl of freshly transcribed c-DNA was hydrolyzed with 2.1µl 1M Sodium

Hydroxide and 1.8µl 0.25M Ethylenediaminetetraacetic acid, at 70°C for 15 min and then neutralized with 3.5µl of 2M HEPES (N-(2-Hydroxyethyl) piperazine-N'-(2-ethanesulfonic acid)) buffer. High Range (1000ng/mL– 20ng/ml) assay was performed if the starting concentration of RNA was ~1 µg, while Low Range Assay (50ng/mL–1ng/mL) was performed for lower RNA concentrations. RNA standards and ribogreen dilutions were prepared for the respective assay, according to the manufacturer's protocols. The fluorescence intensities were measured from top (excitation=480nm, emission=540nm) in a 96well format with a Beckman Coulter Multimode Detector DTX-880 and the results were interpreted through Multimode Analysis Software version 3.1.0.1. All the samples were diluted to a constant concentration of 0.07ng/µl and a total of 560pg c-DNA was used per reaction in RT-qPCR.

B) Primer Design and Reaction Efficiency

Eighteen target genes were shortlisted as a validation set for differentially expressed genes by RT-qPCR assays. These genes were selected based on their well-documented or novel relevance in disease mechanism, prognosis and treatment in head and neck cancers. Eleven Reference genes (B2M, ATP5B, CYC1, GPDH, SDHA, TOP1, EIF4A2, UBE2D2, SCLY, PRDM4 and ENOX2-var1) were chosen from classic and advanced lists of Human geNorm kits (Primerdesign Lmtd.). The National Center for Biotechnology Information Reference Sequences for mRNA (NCBI RefSeq RNA) was obtained to design primers for RT-qPCR.

Primer Designing

For the target genes, primers for TGFβ2 and TP53, were as given in the online database RTPrimerDB (ID2676 and ID1186, respectively); custom oligonucleotide primers for the remaining genes were synthesized and analyzed in-silico. Primers were designed using both Real-Time PCR sciTool (Integrated DNA Technology) and Primer-BLAST software (NCBI)[232], while the analysis for hairpins, primer dimers and heterodimers was carried out through OligoAnalyzer sciTool (Integrated DNA Technology).

For Primer-BLAST software, the Refseq mRNA sequence from Homo sapiens library for each gene was entered and parameters were adjusted to a product size of 80 – 250bp with optimum primer melting temperature as 60°C (range 58 - 62°C) and maximum temp difference set at 1°C. Selection was done for primers spanning the exon-exon junction for higher primer pair specificity for a given mRNA. Under advanced parameters, primer size was set at 20 nucleotides (range 18-25) and GC content was within the range of 40 – 65% with rest of the parameters set to default values. The resultant primer pairs were shortlisted based on much lower melting temperatures of hairpin structures (≤ primer annealing Tm°C) and low free energy of heterodimers and homodimers ($\Delta G > -6$ kcal/mole).

Primer Efficiency

NHKc and D4DR c-DNA was diluted fivefold for a total of eight serial dilutions to create a standard curve of reaction efficiencies per primer pair. Briefly, each starting template was serially diluted into eight sterile microfuge tubes with nuclease-free water (USB Corp, 71786) and the resulting templates were run in triplicates/primer pair at respective annealing temperature (Tm), on a 96-well plate format. The sample standards and the dilution series were entered in the MyiQ Optical software version1 (BIO-RAD) before starting the run and the primer efficiency was noted at the completion of the experiment.

Outliers at the extreme end of the dilution curves were removed in few cases where Cq values were off the curve, as they indicated saturation of reaction or no amplification at that concentration. All the primer details are as summarized in Table 2.1 and 2.2. Primer efficiencies of only selected panel of reference genes were calculated (Table 2.2). Tumor DNA was used to calculate efficiencies for HPV primers where required (Table 2.1).

C) RT-qPCR Assays

Single color RT-qPCR assays were performed in a 96 well format using Bio-Rad's MyiQ Single Color Real-Time PCR Detection System. Bio-Rad's iQ™ SYBR® Green Supermix was used as the reaction mix and the assay was carried out on iQ™ 96-Well PCR Plates (Catalog no.223-9441), sealed with Microseal® 'B' Adhesive Seals (Catalog no.MSB-1001). The results were interpreted through MyiQ Optical software version 1 (BIO-RAD). Overall, three kinds of assays were conducted: gradient RT-qPCR to determine the ideal Tm for each primer pair, primer efficiency RT-qPCR to determine specific reaction efficiencies and differential gene expression RT-qPCR. For gradient RT-qPCR; reaction was done in duplicates with 200nm primer mix (2.5µm stock of Forward + Reverse primers), 1X SYBR® Green Supermix and nuclease-free water to make up the volume of 20µl, with 1ng NHKc /D4DR/tumor sample as template c-DNA depending on the expression of each gene in the source organism.

Table 2.1: Primer list- Target genes

Gene ID	Refseq ID	Forward Primer	Reverse Primer	Primer Efficiency (%)	Tm (°C)	Amplicon size (bp)	Template for Primer Efficiency	Design Tool
ADAM12	NM_003474.4	AACTAAGTATGTGGAGCTGGTG	GGTCTGTAAAACTTGTCAACGTG	93.1	62.7	220	Tumor Sample 3814	IDT
BRCA1	NM_007298.3	TAT CAG GGT GAA GCA GCA TCT GG	TAG AAG GCT GGC TCC CAT GC	89.4	63.4	190	NHKc	NCBI Primer Blast
CDKN2A	NM_058197	GGCACCAGAGGCAGTAACCA	TCTTTCAATCGGGGATGTCTGAGG	100.2	63.8	70	NHKc	IDT
IGFBP3	NM_000598.4	TAGTGAGTCGGAGGAAGACCG	ACGGCAGGGACCATATTCTGT	91.0	64.4	232	NHKc	Primer Blast
IL1B	NM_000576.2	AACAGATGAAGTGCTCCTTCCA	GGTGGTCGGAGATTCGTAGC	97.8	55.5	78	NHKc	Primer Blast
KRT15	NM_002275	AATGTGGAGATGGACGCAG	TGGATCATTTCTGTGTTGGAGG	81.3	64.4	170	NHKc	IDT
MAL	NM_002371	TCTGTGTTCTGCTTCGTGG	TTTTCATGGTAGTGCCTGTAGG	95.1	64.4	200	NHKc	IDT
MCM2	NM_004526.3	ATCTACGCCAAGGAGAGGGT	GCTGCCTGTCGCCATAGATT	103.1	56.1	105	NHKc	IDT
MET	NM_000245.2	GAC TCC TAC AAC CCG AAT ACT G	ATA GTG CTC CCC AAT GAA AGT AG	95.6	55.5	146	NHKc	IDT
MMP10	NM_002425	ACAAAGAAGGTAAGGGCAGTGA	GTACTTTTCTAGGTATTGCTGGGC	98.8	58.7	147	NHKc	IDT
MMP13	NM_002427.3	AAGATGCGGGGTTCCTGATG	TCGCCATGCTCCTTAATTCCA	107.0	64.4	240	D4DR	IDT
MMP14	NM_004995.3	AGCAACTTTATGGGGGTGAGT	GTTCCCGTCACAGATGTTGG	87.6	64.4	128	NHKc	IDT

MMP7	NM_002 423.3	GGAACAGGCTCAGGACT ATCTC	GCATCTCCTTGAGTTTGGC TTC	97.2	58.7	92	NHKc	IDT
NOTCH1	NM_017 617.3	TCATCAACTCACACGCC GAC	GTCTCCTCCCTGTTGTTCT GC	98.4	63.8	148	NHKc	Primer Blast
SIX1	NM_005 982.3	CAA AGG TAT GCC AAC GAA TC	CCA ATG ACA GCA ATA CAC CA	74.4	58.0	165	D4DR	Primer Blast
TGFB2	NM_003 238.3	AGA GTG CCT GAA CAA CGG ATT	CCA TTC GCC TTC TGC TCT T	96.8	62.3	117	NHKc	RTPrime rDB ID : 2676
TLR10	NM_030 956	GCTTTTGCCACCAACCT GAA	TCACATCTCCTTTTGATAG CCTTAC	94.1	63.8	107	Tumor Sample 6	IDT
TP53	NM_000 546.4	TCA ACA AGA TGT TTT GCC AAC TG	ATG TGC TGT GAC TGC TTG TAG ATG	96.0	64.6	118	NHKc	RTPrime rDB ID : 1186
HPV16 E7	NC_001 526.2	CCG GAC AGA GCC CAT TAC AAT	ACG TGT GTG CTT TGT ACG CAC	91.6	64.5	83	D4DR	[233]
HPV35 E6/7	M74117	GGT GGA CAG GTC GGT GTA TGT C	GTT GCC TCG GGT TCC AAA TC	91.5	61.5	120	Tumor DNA, HS45	[60]
HPV52 E6/7	X74481	GTT GGA CAG GGC GCT GTT C	CCT CCT CAT CTG AGC TGT CAC C	146.0	61.5	166	Tumor DNA, HS23	[60]
HPV58 E6/7	D90400	AGG GCG CTG TGC AGT GTG T	CAT CCT CGT CTG AGC TGT CAC A	92.3	61.5	172	Tumor DNA, HS23	[60]
HPV66 E7	U31794	GCACCGCAAACGGAAA TTGACCT	TGG CCG CTC CAG CAA ATG GT	110.0	55.7	96	Tumor DNA, TB 3700, 3814	NCBI Primer Blast

Table 2.2: Primer List-Reference Genes

Gene ID	Refseq ID	Forward Primer	Reverse Primer	Primer Efficiency (%)	Tm (C)	Amplicon size (bp)	Avg Cq for NHKc	Design Tool
ATP5B	NM_001686.3	TGG TAT CAA GGT TGT CGA TCT G	GGT ATA AAT CAT TGC CTT CAC GG	97.7	63.9	188	21.7	IDT
B2M	NM_004048.2	GGC ATT CCT GAA GCT GAC AG	GGA TGA AAC CCA GAC ACA TAG C	94.7	63.9	188	20.57	IDT
CYC1	NM_001916.3	TCC CAA AAC CAT ACC CCA AC	AGT AGA GAC CTT CCC GCA G	88.2	55.5	174	23.35	IDT
EIF4A2	NM_001967.3	CCA CAT TTG CTA TTT CCA TCC TG	CCA TAT AGT CTC CAA GTG CCA G	98.5	58.9	132	22.6	IDT
GAPDH	NM_002046.3	CAA TGA CCC CTT CAT TGA CC	GAC AAG CTT CCC GTT CTC AG	99.8	55.5	106	21.8	IDT
SDHA	NM_004168.2	CCC TCC AAT TAA ACC AAA CGC	GCT GAT TTT CCC ACA ACC TTC	93.2	57.5	178	23.2	IDT
TOP-1	NM_003286.2	AGT CCA AAG AGA TGA AAG TCC G	TGG GTG TAG ATT GAT GTG CTC	98.9	61.4	152	24.2	IDT
UBE2D2	NM_003339.2	TTT CCC AAC AGA TTA CCC CTT C	AAC AGA GAA CAG ATG GAC AAG AG	95.1	58.9	165	22.2	IDT
SCLY	NM_016510.5	CCC TAT GCT ATT TGG AGG TGG	TGA CCG AAT TCA GCT TCC AG	N/A	64.4	180	28.5	IDT
PRDM4	NM_012406.3	GCC TTC TGC TCT GTC TTT AAT G	GTT AGG GTG GAT GTA CTG TGG	N/A	55.4	193	26	IDT
ENOX2-Var1	NM_006375.3	CTT CTG CCA CAT TCG CTT TG	GTT TAC ACT CCC ACT CAT ACA GG	N/A	64.4	164	27.5	IDT

The plate setup for gradient PCR was modulated in the MyiQ Optical software with range set from 54°C to 64°C (Increasing temperature from Row H - Row A). For primer efficiency assays, reactions were carried out with starting template concentrations of each dilution mix in triplicates at the respective annealing temperatures with 200nm primer mix and 1X SYBR® Green Supermix, in 25µl reaction volume. Finally, for differential gene expression assays, a sample maximization strategy [221] was employed, so that all the samples for a particular gene were run on one plate. Thus, for our analysis, c-DNA derived from 49 tumor samples was used at a standardized concentration of 560pg per reaction and assays were split into two 96-well plates per gene. The reactions were carried out in duplicates with same parameters as listed above and 25µl total volume.

Two types of experimental controls were run per plate per gene, 1) NHKc and D4DR c-DNA used as the inter-run calibrators/gene and 2) NHKc c-DNA run with GAPDH primers/plate, to make sure that reaction efficiencies were constant in all wells and across different assays (A7, C2, C11, E7, F2, F11 and H7). To investigate the optimum number of reference genes for RT-qPCR normalization, eight candidate reference genes (B2M, ATP5B, CYC1, GPDH, SDHA, TOP1, EIF4A2 and UBE2D2) were shortlisted from a total batch of 11 genes, based on the similarities in expression levels in normal human keratinocytes. The assays were carried out as for differential expression of genes, keeping the experimental controls constant, throughout. Lastly, all the template c-DNA was derived from a common stock for each set of differential expression assays involving respective target and reference genes. Thus, each time a new batch of c-DNA was synthesized, an assay for reference genes was run along with the new set of target genes to maintain consistency in the post-run analysis by alleviating the experimental errors introduced with each cycle of reverse transcription and c-DNA quantification.

The cycling conditions for the RT-qPCR assays were kept constant in the MyiQ icycler software with an initial denaturation of template at 95°C for 3 min followed by 40 cycles of denaturation at 95°C for 10 sec and primer annealing at respective temperature for 1 min. The characteristics of melt curve of the amplified products were assessed by initial denaturation at 95°C for 1 min, followed by cooling at 60°C for another min and 80 cycles of 10 sec each from 60°C to 100°C with an increment of 0.5°C.

D) Data Analysis

The RT-qPCR data were analyzed by qbase+ software version 2.5, according to the instructions listed in the qbase+ manual (revised 2013-04-23). Qbase+ is an advanced, and proven model for previously defined qbase software[221]. It performs relative quantification that uses gene-specific amplification efficiencies and allows normalization with multiple reference genes. The analysis is as described below.

Extraction of Cq Data

In the 'View Post-Run Data' tab of MyiQ software, the analysis mode was set at PCR baseline subtracted curve fit option, to calculate the threshold cycle for each run. While the baseline cycles were auto-calculated, the threshold position was user defined and kept at a constant value of 70 Relative Fluorescence Unit (RFU).

Data Import

A new project file, called MUSC-HNSCC, was created by clicking the **+** sign from the qbase+ toolbar. Under the project tab, a new experiment palm was created for a group of assays with same experimental parameters, i.e. constant batch of c-DNA and identical number of runs. Thus, differential expression results for the target and reference genes of all biological replicates of sample c-DNA were included in separate experiments to maintain consistency in post-run analysis. All the post-run Cq data files (.xls format) for each run were exported from MyiQ software and imported as new runs under a predefined experiment palm in the qbase+ toolbar. Once, the files were imported, samples and targets were annotated for each run by manually entering the sample Id's and target gene names per plate. To minimize work, sample ID's were copied onto different runs with identical plate format using the 'apply run layout' function. Also, custom sample properties were listed based on HPV status and Race, in the sample properties window of the Annotations section.

Calculation Parameters

Under the Settings node of each experiment in the project explorer tree, respective icons for Calculation parameters and Quality control were selected by double clicking. In the calculation parameters window, target specific amplification efficiencies were selected along with reference genes as the normalization strategy. Thearithmetic mean of each technical replicates per sample were calculated to give a mean Cq value. All the mean Cq values were then scaled to the normals (control group). For quality control settings, exclusion parameters were set to 39 and above for Cq values such as all quantification cycle values above 39 were excluded from the analysis.

Inter-Run Calibration

The Inter-run calibration feature of qbase+ eliminates variations between runs post normalization of data. The basic concept behind this procedure is that identical sample(s) (preferably one or more) are run in each reaction plate along with the sample of interest for 'n' number of reaction plates per gene and a calibration factor is calculated based on the normalized quantity of these IRC's. In our study, tumor derived c-DNA from 49 samples were split into two 96 well plates with identical IRC's (NHKc and D4DR as IRC1 and IRC2 respectively) repeated on both the plates per gene assay. All the IRC's were annotated as IRC1, IRC1a and IRC2, IRC2a between two runs for same gene under the Inter-run Calibration tab within the intermediate results section.

Normalization of RT-qPCR

The most stable group of reference genes was selected by simultaneous analysis of the RT-qPCR data obtained from 49 oropharyngeal samples for a panel of eight reference genes. The software and tools used to analyze the data are as listed below:

Normfinder [227] is freely available software which employs novel evaluation strategy, called the "model-based approach to estimation of expression variation." The sample set should minimally contain 8 samples / group, and the number of candidates should be at least 3 for technical reasons, but 5–10 are recommended. This approach entails description of the expression values measured by RT-qPCR, separate analysis of the sample subgroups, estimation of both the intra- and the intergroup expression variation, and calculation of a candidate gene "stability value." Thus, we estimated the 'intergroup expression variations' which allowed for selection of the best suited genes and the 'intragroup variance' which provided a natural way of identifying the number of genes to include. The optimal number of genes is reached when addition of a further gene leads to a negligible reduction in the average of the gene variance estimates. This tool allowed us to identify the two most stably expressed genes to use as internal reference genes across our samples.

BestKeeper [219] is a password protected, freely available, excel based tool which is able to compare expression levels of up to ten housekeeping genes (HKGs) together with ten target genes (TGs), each in up to hundred biological samples. Descriptive statistics of the derived crossing points (CP or Ct) are computed for each HKG: the geometric mean (GM), arithmetic mean (AM), minimal (Min) and maximal (Max) value, standard deviation (SD), and coefficient of variance (CV). From the genes considered stably expressed, the *BestKeeper Index* specific for the respective sample is calculated as the geometric mean of its candidate HKGs CP values. To estimate inter-gene relations of all possible HKG pairs, numerous *pair-wise correlation analyses* were performed. Within each such correlation the *Pearson correlation coefficient* (r) and the probability p value were calculated and highly correlated HKGs were combined into an index. Then, correlation between each candidate HKG and the index was calculated, describing the relation between the index and the contributing candidate HKG by the Pearson correlation coefficient (r), coefficient of determination ($r2$) and the p-value. Thus all the reference genes were ranked based on their correlation coefficient values, with highest value signifying the most stably expressed gene.

GeNorm [220] is the most popular algorithm to find the stable reference (housekeeping) genes from a set of tested candidate reference genes in a given experimental condition. From this, a gene expression normalization factor can be calculated for each sample, based on the geometric mean of a user-defined number of reference genes. *GeNorm* has been integrated in the qbase+ qPCR data-analysis software (Biogazelle) and provides fully automated calculations, handling of missing data and ranking of candidate reference genes up to the single most stable gene. Thus, GeNorm tool was used to shortlist top three candidate reference genes based on their M value and coefficient of variation (V).

Quality Control & Results

Target specific amplification efficiencies were calculated through primer efficiency RT-qPCR assays. These user defined values were entered by selecting the 'target specific amplification efficiencies' option in the Calculation parameters window of the software. Failed replicates were excluded by deselecting the particular well for a given sample. For multiple reference gene normalization experiment, reference target stability was determined by the software, which listed genes based on their stable expression across the given dataset. The threshold values for parameters like coefficient of variation (> 0.2) and geNorm M value (> 0.75) were adjusted, such as genes with values above the threshold were considered less stable. Sample specific normalization factors indicated towards differential expression of reference genes per sample.

The final analysis flowchart is as listed: all the relative quantities per sample/gene pair were calculated scaled to the control group by following the delta Cq method. These relative quantities were converted into normalized relative quantities with the help of sample specific normalization factor, leading to normalized relative quantities per sample-gene pair. The calibration factor calculated through inter-run calibration finally converts the normalized relative quantities into cumulative normalized relative quantities.

Statistics

All the statistical analysis was as defined by the Stat wizard function in the project explorer tree in Qbase+. The goal of the analysis was selected as Mean comparison and the software then compared all the samples based on HPV status through one way ANOVA. The calculated CNRQ values were extracted as excel sheet from the software and statistical analysis was performed on selected datasets. Similar analysis was done based on racial distribution of samples with respect to HPV status by manually entering the calculated CNRQ values from the software into Graphpad Prism (version6).

Figure 2.2 describes the overall schemata of methods applied. The detailed demographics and HPV type distribution of microarray study samples is also given.

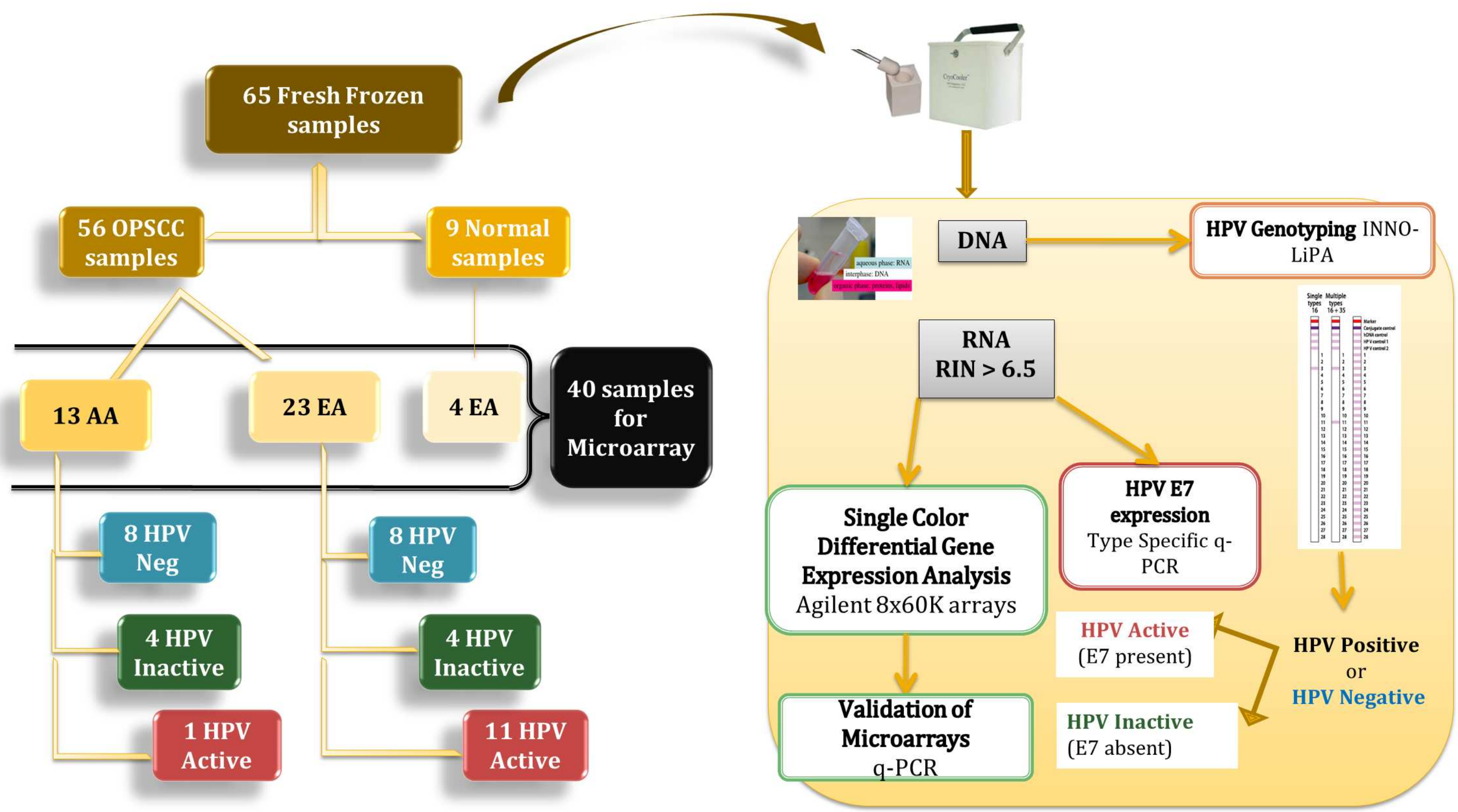


Figure 2.2: Flowchart of methods.
Clockwise from left to right: Overall sample distribution for microarray analysis. Sample processing through cryogrinder and isolation of nucleic acids. HPV typing through DNA (INNO-LiPA) and RNA (RT-qPCR) followed by gene expression analysis through Agilent 8x60k arrays. The validation of microarrays was done by RT-qPCR using qbase+ software.

CHAPTER 3: NORMALIZATION of RT-qPCR – A QUEST for OPTIMAL REFERENCE GENES

3.1. Introduction

Several advancements in Real Time-quantitative Polymerase Chain Reaction have been made in pursuit of accurate normalization[219–221,227] and uniformity in reporting results and experimental parameters[212,214,215,234]. One critical aspect of all differential gene expression studies is normalization of data to the most stably expressed reference gene/s which is specific to the respective tissues/cell lines[224,235–239]. The most popular analysis tools for identifying best candidate reference genes have been- GeNorm[220], Normfinder[227], BestKeeper[219], Delta Ct method[239] and more recently a web based tool (refFinder)[235,240] which gives a cumulative result utilizing the former tools. With respect to HNSCC, only one study so far has addressed the issue by comparing results from Normfinder and GeNorm[225].

We aimed to study a panel of commonly used reference genes and shortlist the best candidates to be used for efficient normalization of RT-qPCR assays for OPSCC tumors. For this purpose, we designed primers for eleven reference genes (B2M, ATP5B, CYC1, GAPDH, SDHA, TOP1, EIF4A2, UBE2D2, SCLY, PRDM4, ENOX2-var1) and conducted a preliminary expression analysis with NHKC c-DNA to assess normal expression levels of each gene.

3.2 Results

Eight genes (B2M, ATP5B, CYC1, GAPDH, SDHA, TOP1, EIF4A2, UBE2D2) were selected with an average Cq of 22.4 (range 20.57 – 24.2) eliminating the ones with lower expression levels. We analyzed these 8 genes by RT-qPCR with c-DNA obtained from 44 OPSCC and 4 normal tonsil/uvula tissue samples. Our study was in compliance with the recent MIQE guidelines for optimum sharing of RT-qPCR data[214]. A flowchart describing the overall methodology is given in Figure 3.1. Raw Cq values of selected 8 genes were plotted to see an overall variation in expression values (Figure 3.2). We then compared the expression levels of 8 reference genes through BestKeeper, Normfinder, GeNorm/qbase+ and compared the ranking of genes between all the five tools.

The first analysis was conducted with excel-based analysis tool- BestKeeper. The Cq values were referred to as, crossing points (CP) and the overall trend of raw CP values is as given in Figure 3.3. The inter-gene relationships of all the reference genes/housekeeping genes (HKG) were analyzed by repeated pair-wise correlation and their respective coefficients (r) and p values were determined (Table 3.1). Figure 3.4 (A & B) gives geometric means and standard deviation (SD) of each gene across 48 samples. Respective values of SD were plotted to represent the stability of all HKG's, where stability increases from left to right, in Figure 3.3 (C). A standard deviation of more than 1 makes a gene unsuitable as a reference gene for analysis, which in our data was applicable for GAPDH.

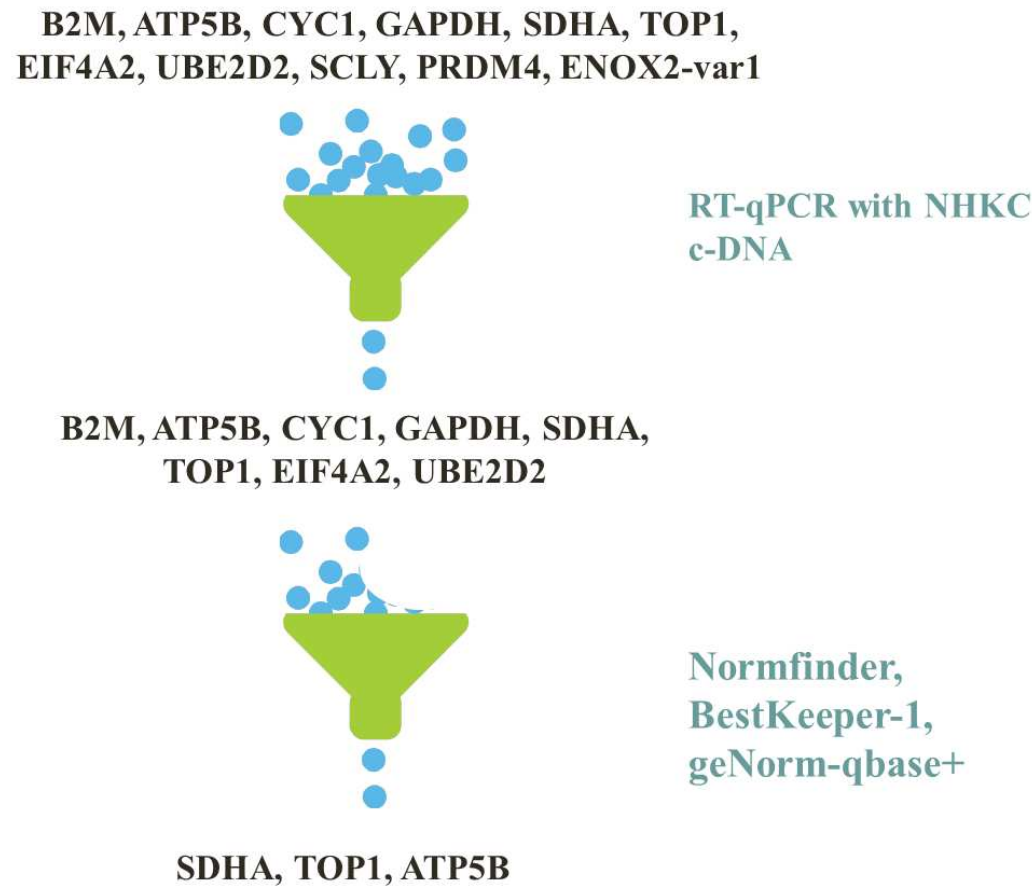


Figure 3.1: Flowchart of reference gene selection. Expression levels of 11 commonly used reference genes were assessed through NHKC c-DNA. Eight candidate reference genes with a closer range of raw Cq values were analyzed for their stability through three software- Normfinder, BestKeeper and geNorm-qbase+. Final candidates were selected as per geNorm-qbase+ analysis.

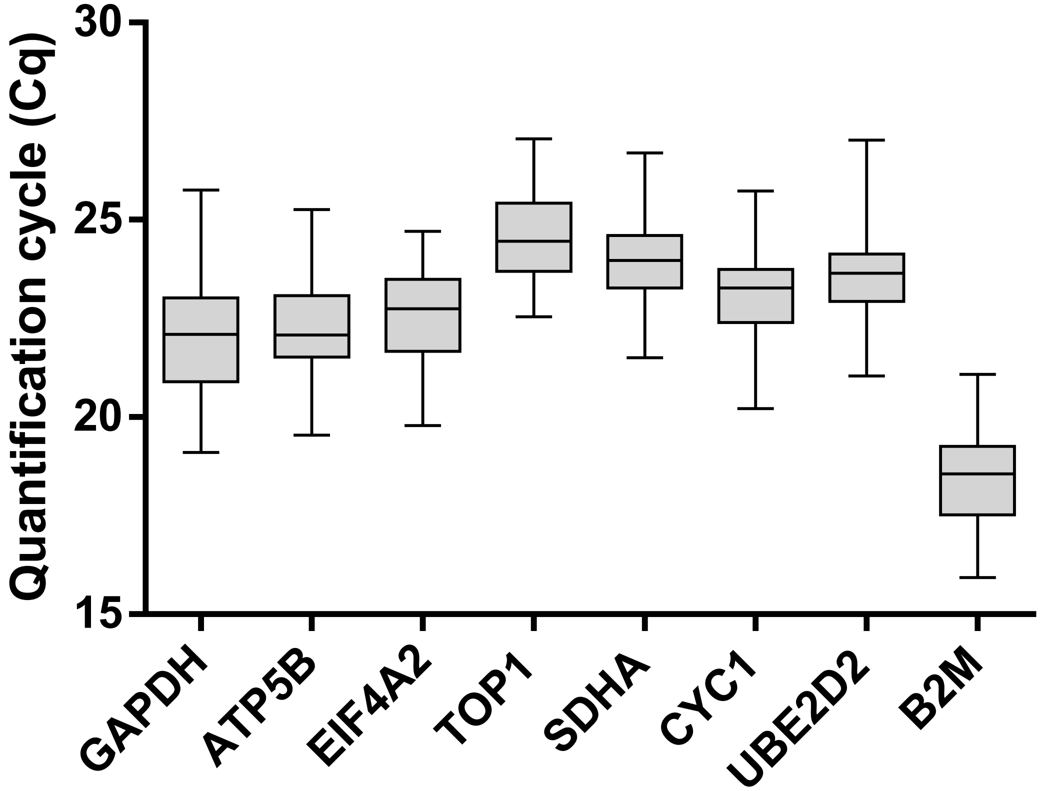


Figure 3.2: Reference gene expression of 8 genes in samples of the oral cavity and oropharynx. Raw Cq values are represented as box-whisker plot based on individual expression values in 44 tumor and 4 control samples. The range of Cq values differed from more than 7 (GAPDH) to less than 4 (TOP1) cycle numbers.

Table 3.1: Descriptive statistics of pair-wise correlation (Pearson’s correlation, r)

	GAPDH	**ATP5B**	**EIF4A2**	**TOP1**	**SDHA**	**CYC1**	**UBE2D2**	**B2M**
vs.	**HKG 1**	**HKG 2**	**HKG 3**	**HKG 4**	**HKG 5**	**HKG 6**	**HKG 7**	**HKG 8**
HKG 2	0.849	-	-	-	-	-	-	-
p-value	0.001	-	-	-	-	-	-	-
HKG 3	0.633	0.785	-	-	-	-	-	-
p-value	0.001	0.001	-	-	-	-	-	-
HKG 4	0.848	0.911	0.799	-	-	-	-	-
p-value	0.001	0.001	0.001	-	-	-	-	-
HKG 5	0.783	0.883	0.841	0.876	-	-	-	-
p-value	0.001	2.14E-16	0.001	0.001	-	-	-	-
HKG 6	0.844	0.92	0.751	0.861	0.882	-	-	-
p-value	0.001	0.001	0.001	0.001	0.001	-	-	-
HKG 7	0.592	0.776	0.681	0.751	0.76	0.695	-	-
p-value	0.001	0.001	0.001	0.001	0.001	0.001	-	-
HKG 8	0.375	0.533	0.489	0.506	0.526	0.556	0.66	-
p-value	0.009487	0.001	0.001	0.001	0.001	0.001	0.001	-

Bestkeeper correlates each gene to the other by pearson’s pairwise correlation analysis and the respective pearson’s coefficient (r) along with its p value is given for each comparison. (HKG-Housekeeping Gene)

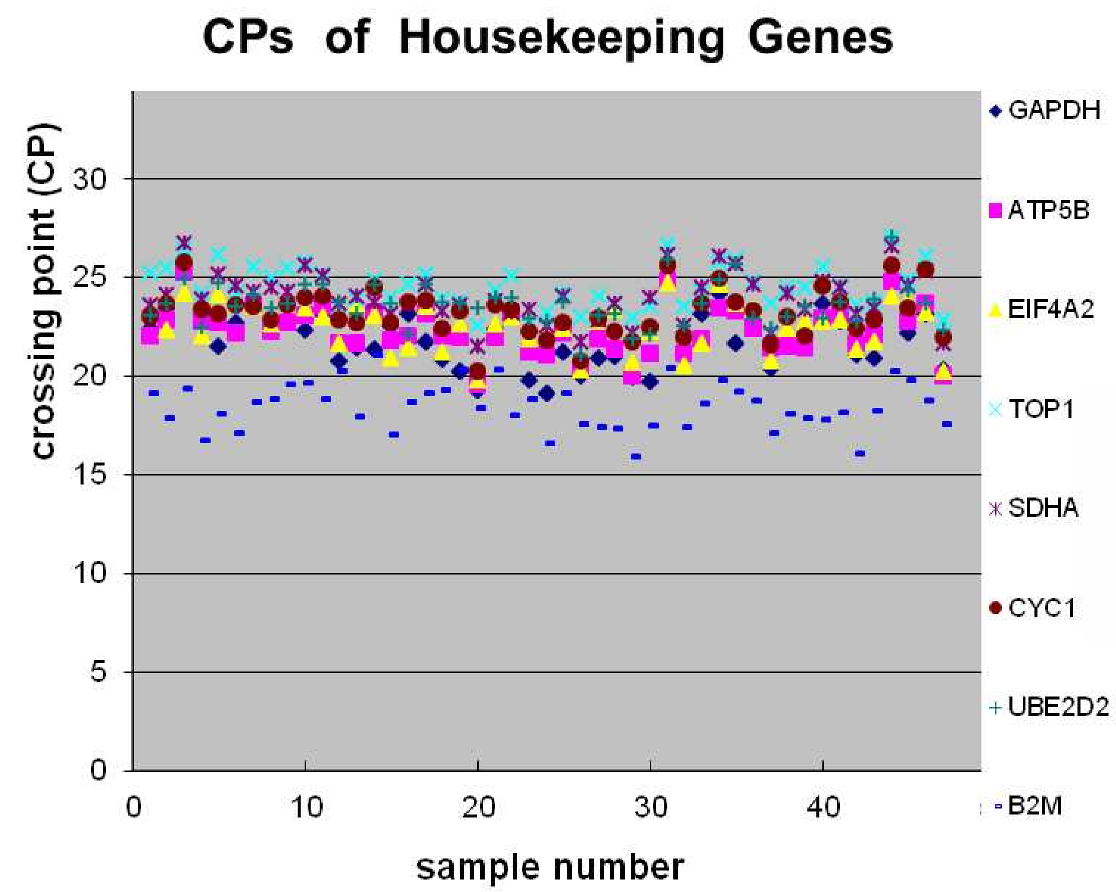


Figure 3.3: BestKeeper Analysis- CP of Housekeeping Genes
Raw threshold cycle numbers are represented as crossing points (CP) in BestKeeper analysis and the graph show the overall distribution of CP per sample per gene across the data set. The respective genes are represented with color coded signs given on the right.

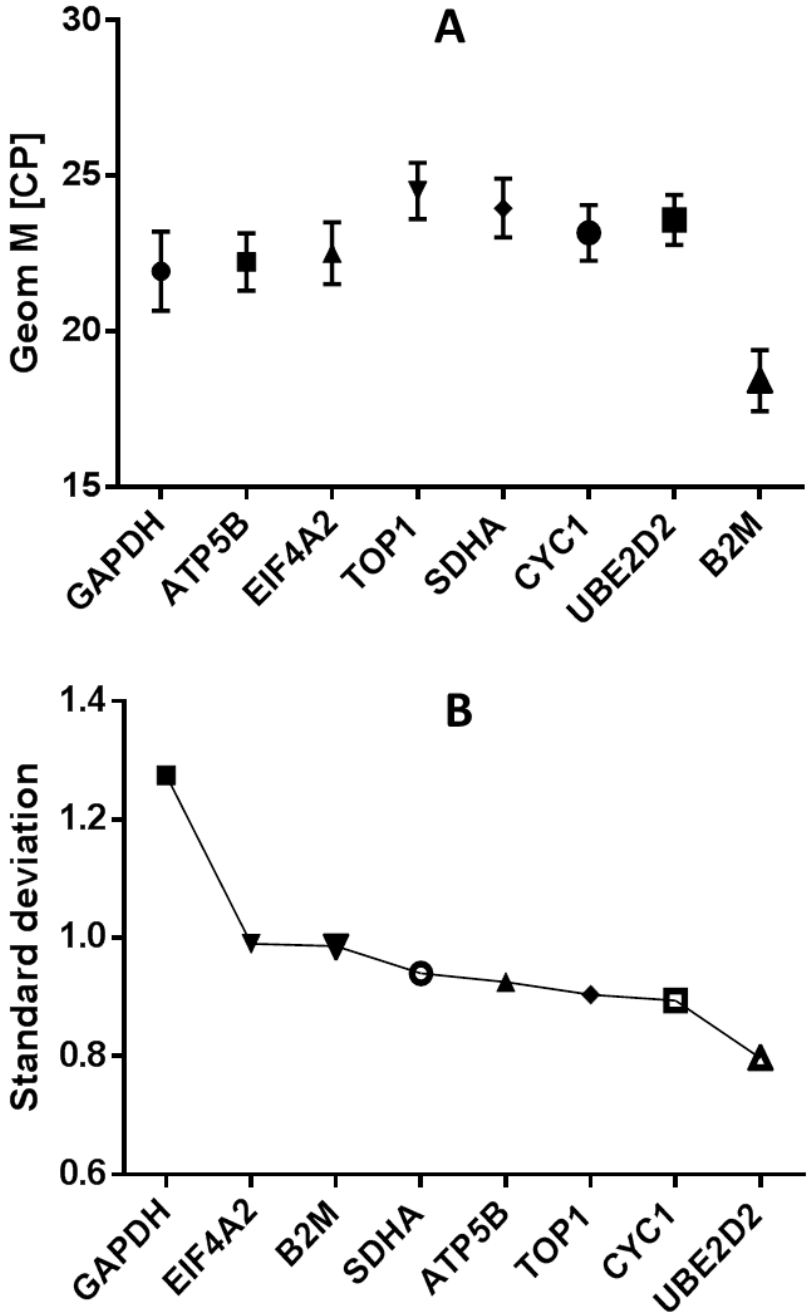


Figure 3.4: BestKeeper Analysis- Housekeeping Gene stability
A) Geometric means of all CP values per gene are given with their respective standard errors. B) Overall standard deviation of gene expression/gene. The lower the standard deviation across the sample set, more stably expressed is the reference gene.

Normfinder algorithm[227], an excel add-in, returns a stability value for each reference gene and thus ranks them based on their variation of expression across a given sample set. Figure 3.5 (A) depicts the inter-group variation of each gene, whereby the samples were grouped as HPV-active, -inactive, -negative and controls. The intra-group variations are as depicted by the error bars of each gene. The most stably expressed gene was CYC1 with a stability value of 0.140 and top two candidate reference genes with a cumulative stability value of 0.111 were, CYC1 and SDHA. The stability values of all genes are as given in Figure 3.5 (B) with the two best candidate genes highlighted in a square. The stability increases from left to right in Figure 3.5 (B).

GeNorm is now available in combination with the RT-qPCR analysis software qbase+ and we conducted our gene expression analysis on the same platform. One novel feature of GeNorm which was utilized in assessing the expression variations was the introduction of Inter-run calibration. Two samples were consistently used as IRC's and the calibration factors were calculated as a geometric mean of these two IRC's per plate per gene (Figure 3.6 (A)). The closer the values of calibration factors per gene, the less are the inter-run variations. GeNorm also ranked the given set of genes based on their stability values (M value) which is given in Figure 3.6 (B). The Stability Values of Reference genes ranged from 0.8327 – 1.8016, which is higher than the set threshold of 0.75. Figure 3.6 (C) depicts the stability values of different number of reference genes when considered together. This geNorm V values suggested that optimum number of reference genes for this analysis are 3 with top candidate being- ATP5B, SDHA and TOP1.

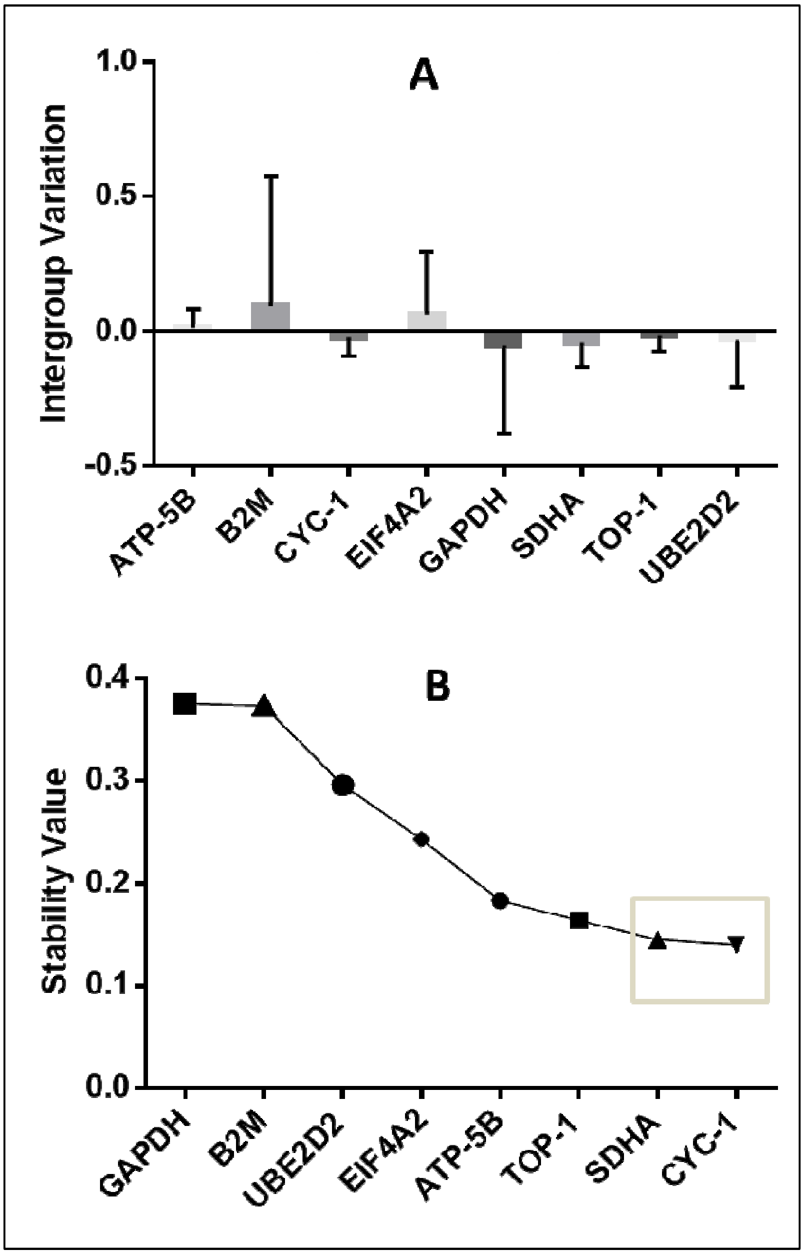


Figure 3.5: Normfinder Analysis

A) The intergroup variation of 8 reference genes across 4 major groups: HPV-active, HPV-inactive, HPV-negative and Controls. The error bars indicate intra-group variation.

B) The overall ranking of genes based on stability value. The genes are represented in the increasing order of stability from left to right.

A

Reference Target	Stability Value (M)	Coefficient of Variation (CV)	Calibration Factors (CF) Plate-1	Calibration Factors (CF) Plate-2
ATP-5B	0.8327	0.2832	1.348±0.3	1.522±0.03
B2M	1.8016	0.6112	0.133±0.004	0.066±0.001
CYC 1	0.9134	0.6870	2.017±0.053	2.252±0.033
EIF4A2	1.0363	0.4281	0.609±0.019	0.644±0.008
GAPDH	1.1473	0.5803	0.956±0.026	1.284±0.033
SDHA	0.8647	0.3149	1.190±0.080	1.336±0.011
TOP-1	0.8358	0.2765	1.306±0.04	1.412±0.025
UBE2D2	1.0918	0.7133	N/A	N/A

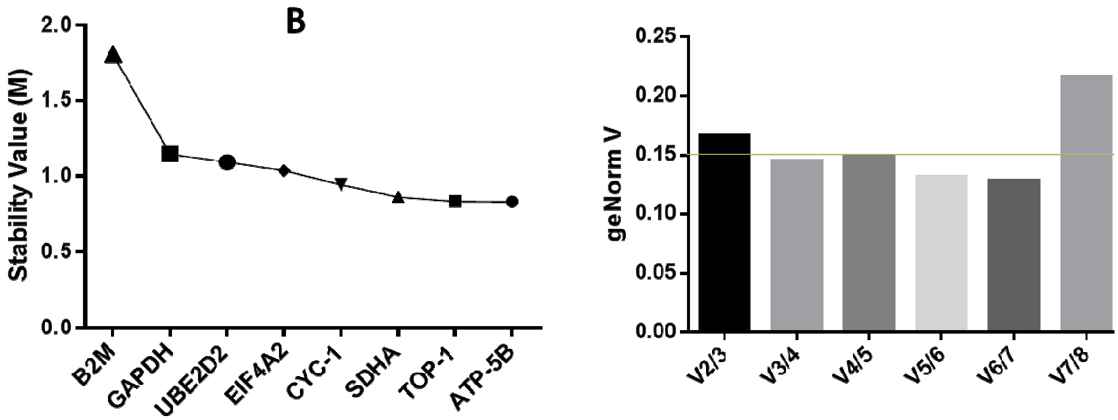


Figure 3.6: GeNorm Analysis

A) The stability values (M), coefficient of variation across the sample set and the inert-run calibration factors per plate are given for each gene, respectively. The values are as calculated by the qbase+ software.

B) Increasing order of stability of reference genes from left to right based on respective M values.

C) GeNorm returned V values for determining the optimum number of reference genes. The horizontal grey line indicates the threshold cutoff for maximum stability of reference genes. GeNorm suggested the use of geometric means of 3 reference genes-ATP5B, TOP1 and SDHA as the optimum normalization factor.

In view of the recently reported refFinder and Delta Ct method for evaluating most stable reference genes, we analyzed our data set through web-based tool refFinder and compared the gene ranking as given in Table 3.2. The RefFinder tool calculates stability values for each analysis tool (BestKeeper, Normfinder, GeNorm and Delta Ct) and returns a comprehensive ranking list of genes. The refFinder's stability values and the ranking of reference genes for GeNorm and Normfinder tools were inaccurate when compared to our previously calculated values. The Delta Ct stability values are as given by the refFinder. The genes given in bold were final candidates for normalization and depict variation in their rankings.

3.3 Discussion

There is a growing emphasis on use of multiple reference genes for efficient normalization which is a modified Pfaffl's equation and utilizes the geometric mean of the given reference genes as a normalization factor[220]. We attempted to compare the stability of a panel of 8 reference genes across 44 OPSCC tumor and 4 normal samples in pursuit of identifying the top candidates suited for normalization of our gene expression dataset. All three analysis tools indicated comparable but different results with respect to reference gene stability. While these tools utilize similar algorithms to calculate gene stability, differences might have risen due to no consideration of reaction efficiencies (in both BestKeeper and Normfinder), or inter-run variations (BestKeeper and Normfinder), or intergroup variations (Bestkeeper). GeNorm/qbase+ is an advanced algorithm which takes into account the reaction efficiencies and discrepancies involved with expression of genes measured across multiple runs. Also one additional advantage with using qbase+ over other tools is the choice of multiple reference genes for normalization.

Table 3.2: Reference Gene Ranking based on 5 tools.

Rank of Genes	BestKeeper (Std dev)	Normfinder (Stability Value)	GeNorm (M Value)	Delta Ct (Avg St dev)	refFinder (cumulative)
1	UBE2D2	CYC-1	**ATP-5B**	**ATP5B**	**ATP5B**
2	CYC1	**SDHA**	**TOP-1**	**TOP1**	CYC1
3	**TOP1**	**TOP-1**	**SDHA**	CYC1	**TOP1**
4	**ATP5B**	**ATP-5B**	CYC-1	**SDHA**	UBE2D2
5	**SDHA**	EIF4A2	EIF4A2	UBE2D2	**SDHA**
6	B2M	UBE2D2	UBE2D2	EIF4A2	EIF4A2
7	EIF4A2	B2M	GAPDH	GAPDH	GAPDH
8	GAPDH	GAPDH	B2M	B2M	B2M

Comparative analysis of reference genes as given by the web based tool- refFinder. It ranks the genes based on BestKeeper, Normfinder, GeNorm and Delta Ct algorithm and finally returns a cumulative ranking based on these 4 algorithms.

Thus, we accepted the gene ranking as given by GeNorm/qbase+ for further analysis. Also, we observed medium reference target stability (M value 0.83 – 1.80) over our sample set which is common with heterogeneous samples arising from tumors or cancer cell lines. More homogenous samples such as primary cell lines yield a higher stability of reference genes with M values below 0.75 (inbuilt threshold for GeNorm).

Relative quantities of genes can vary due to technical errors like different starting quantity or run-dependent differences besides inherent differential expression. We introduced the novel practice of quantifying our starting c-DNA template with ribogreen assay in addition to using constant amount of starting RNA for in-vitro transcription. Based on the Ribogreen assay, which quantifies single stranded c-DNA molecules, a constant amount of 560pg of cDNA was used in each reaction.

To tackle the problems of run-to-run variations in gene expression, qbase+ has incorporated a special feature of inter-run calibration. This algorithm calculates a correction factor which is employed post normalization of data and corrects the normalized relative quantities for any technical errors that might affect the final expression values. An experiment can be setup in three ways, 1) All samples on one plate, 2) All genes on one plate or 3) maximum number of samples and genes on one plate. We used the third design due to the number of samples being analyzed and thus carefully assessed inter-run calibration accordingly. Two IRC's were used per run and both the IRC's measured technical variation to the same extent in all genes with an exception of one gene where IRC could not be calculated owing to variation in number of runs. Overall, quality control of the IRC's indicated reliability of our gene expression data.

The optimum number of reference genes for our study was 3 or 4 genes and we normalized our data with geometric means of ATP5B, SDHA and TOP1 using the qbase+ software.

3.4 Conclusion

Our comparison of three major reference gene selection tools revealed discrepancies in stability of a panel of genes with very few similarities. The use of multiple tools for shortlisting reference genes might corroborate the choice of reference genes and we need to be careful in considering technical factors like reaction efficiencies, run-run errors and differences in starting concentration in our assessment. This critical observation might explain variations in gene expression studies arising from the use of different candidate reference genes. One way to minimize this error is by the use of multiple reference genes which considers the inherent differences in gene expression arising from a heterogeneous population, e.g. epithelial cancer models and cell lines. Thus, our study confirms the need of tissue and disease model specific array of reference genes for efficient normalization of gene expression.

CHAPTER 4: DIFFERENTIAL GENE EXPRESSION PATTERNS in HPV-POSITIVE and HPV-NEGATIVE OROPHARYNGEAL CARCINOMAS

4.1 Results

4.1.1 Patient demographics and HPV prevalence and activity in OPSCC samples

The demographic characteristics of tumor and normal samples and their respective HPV status are presented in Tables 4.1-3. Once the samples were analyzed for HPV, we classified them into three categories based on whether HPV DNA was present and transcribed (HPV-active), HPV DNA was present but not transcribed (HPV-inactive) or HPV DNA was not detected (HPV-negative). The prevalence of HPV, based on presence of HPV DNA, was 59% overall (Table 4.1). The RXC table confirmed the distribution of HPV-active, HPV-inactive and HPV-negative samples to be statistically significant (p value = 0.0393) by race. However, only a fraction of those (48% of the samples positive for HPV by INNO-LiPA) expressed the HPV E7 oncogene mRNA (Table 4.1). Only one of the 9 normal tissue samples was positive for HPV by INNO-LiPA (Table 4.2). HPV typing revealed the presence of HR-HPV types only, and among them HPV16 was present in about 83% of the OPSCC samples positive by INNO-LiPA (Figure 4.1 A). Other HPV types detected were HPV66, 35, 52 and 58 (Figure 4.1).

Table 4.1: Demographical characteristics and HPV status of tumor samples

Study Population		No. of Samples	HPV Negative n (%)	HPV Active n (%)	HPV Inactive n (%)	Total HPV Positive N (%)	Median Age
AA	**All**	**20**	**12 (60)**	**2 (10)**	**6 (30)**	**8 (40)**	61
	M	11	6 (54)	1 (10)	4 (36)	5 (45)	58
	F	9	6 (66)	1 (11)	2 (22)	3 (33)	61
EA	**All**	**36**	**11 (30.5)**	**14 (39)**	**11 (30.5)**	**25 (69.5)**	60
	M	29	8 (28)	14 (48)	7 (24)	21 (72)	57
	F	7	3 (43)	0	4 (57)	4 (57)	63
Total	**All**	**56**	**23 (41)**	**16 (29)**	**17 (30)**	**33 (59)**	60
	M	40	14 (35)	15 (38)	11 (27)	26 (65)	57
	F	16	9 (56)	1 (6.3)	6 (37)	7 (44)	63

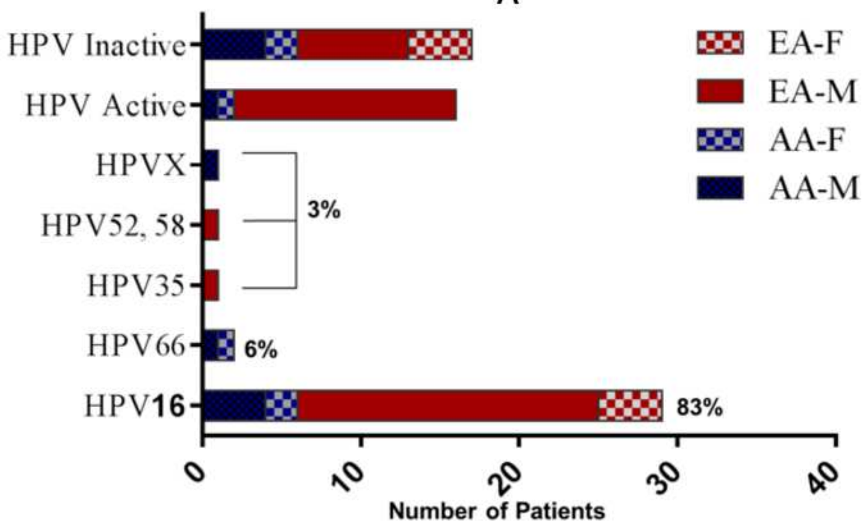
Total number of samples distributed by race and gender is given in the first two columns. This is followed by respective number of samples with HPV-negative, HPV-active and HPV-inactive status and the overall fraction of samples having HPV-positive infection by DNA. Last column depicts the group median age.

Table 4.2: Characteristics of normal tissue samples

Age	Race	Gender	Histologic Calssification	HPV DNA (INNO-LiPA)	HPV Type
49	EA	M	benign uvula	NEG	
45	EA	M	benign uvula, tonsil	NEG	
31	EA	M	benign uvula, tonsil	NEG	
49	EA	M	benign uvula, tonsil	NEG	
42	EA	M	tonsillitis, tonsil hypertrophy, benign uvula	**POS***	**16**
32	EA	F	normal tonsil	NEG	
61	EA	M	normal tonsil	NEG	
34	EA	M	normal tonsil	NEG	
30	AA	F	benign uvula, normal tonsil	NEG	

Normal tissue samples included benign uvula and tonsil samples and all but one tested negative for HPV expression. (*) Positive for HPV16 by INNO-LiPA and could not be tested for HPV activity due to low RIN.

A



B

Race	AA		EA		Total
Gender	M	F	M	F	
HPV16	4	2	19	4	29
HPV66	1	1			2
HPV35			1		1
HPV52, 58			1		1
HPV X	1				1
HPV Active	1	1	14	0	16
HPV Inactive	4	2	7	4	17

Figure 4.1: HPV type distribution in tumor samples. A) Graphical representation of different HPV types in our study population by race and gender. HPV16 was the most prominent type.

B) Number of samples expressing respective HPV type by race and gender. Overall HPV-active and HPV-Inactive samples are given in the last two rows.

4.1.2 HPV type distribution and prevalence by race

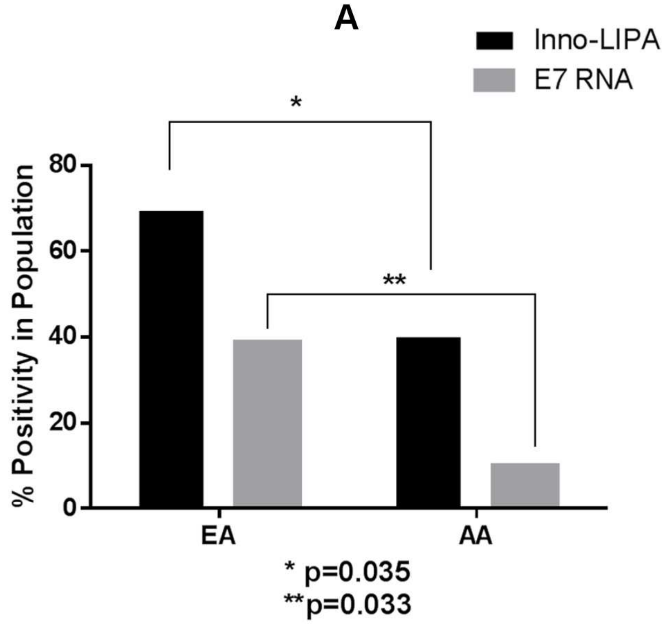
Forty percent of the samples from AA patients tested positive for HPV DNA by INNO-LiPA. However, only 10% of these expressed E7 mRNA. These numbers were much greater in samples from EA patients, 69% of which were positive for HPV DNA, with 39% of total EA patients exhibiting HPV-active infection (Figure 4.2A).

Therefore, AA patients were more likely to present with HPV negative tumors as compared to EA patients (Figure 4.2A): the odds of having a HPV-positive tumor in EA OPSCC patients in comparison with AA patients were 3.4, with a 95% confidence interval of 1.08-10.7, p=0.035. The odds of presenting with an HPV-active tumor among EA OPSCC patients in comparison with AA patients were 5.7, with 95% confidence interval 1.15-28.6, p=0.033 (Figure 4.2A).

When sample mean ages were compared by HPV status, race and gender, we observed HPV-active patients were considerably younger than HPV-negative patients (Figure 4.2B).

When compared within EA population, HPV-active patients were younger than HPV-negative patients and similar analysis could not be done within AA population as only 2 HPV-active AA patients were available and thus no statistical significance could be established in this case (Figure 4.2B).

A



B

Race	Gender	HPV-Active (n)	HPV-Inactive (n)	HPV-Negative (n)	HPV-Negative (n)
AA	F	44 (1)	66 (2)	**61** (6)	**57 (12)**
	M	34 (1)	64 (4)	**53** (6)	
EA	F	N/A (0)	64 (4)	**65** (3)	**65 (11)**
	M	**52** (14)	58 (7)	**71** (8)	

Figure 4.2: HPV prevalence in orapharyngeal cancer samples from EA and AA patients and overall incidence by age. A) HPV prevalence in EA and AA patients with higher rates in former when compared to latter. *Odds ratio for HPV DNA positivity in oropharyngeal cancer from EA vs AA patients: 3.4; 95% confidence interval: 1.08-10.7; p=0.035. ** Odds ratio for active HPV in oropharyngeal cancer from EA vs AA patients: 5.7; 95% confidence interval: 1.15-28.6; p=0.033

B) Mean age of HPV-active, HPV-inactive and HPV-negative patients segregated by race and gender. The distribution of EA HPV-active males v/s EA HPV-negative males was found to be statistically significant with p = 0.0003. Also, within HPV-negative patients, AA men were considerably younger than EA men (p = 0.0023)

4.1.3 Gene expression profiling of HPV-active, HPV-inactive and HPV-negative OPSCC samples: Lists of differentially-expressed genes

Forty RNA samples, (36 tumor and 4 normal tissue samples) of RIN $\geq$ 6.5 were included in the analysis, conducted on 8x60 K Human microarrays (Agilent Technologies). Analysis of the microarray data was conducted as described in Materials and Methods. The complete lists of differentially expressed genes obtained from seven analyses are given in Tables A.1-G.1. All the significantly altered genes with fold change of 2 and above were listed. The p value cutoff for all but the analysis in Tables G.1 was 0.02, and the latter had p value cutoff of 0.05. Corrections applied for false discovery rates (FDR) have been listed where applicable. FDR is directly proportional to the number of samples and hence it could be applied for only one analysis which contained all 36 tumors, while the rest could not be corrected for FDR due to smaller sample size. Briefly, Benjamini-Hochberg correction was applied for gene list in Table A.1, and no correction for the rest. Non-parametric tests were conducted overall with Kruskal-Wallis test for comparisons involving more than two groups and Mann-Whitney test for comparison between two groups only.

Table A.1 lists differentially expressed genes from multiple comparison of all HPV-active, -inactive and –negative tumors. The respective DEGs within total population were as follows: 692 down /1273 up in HPV-active vs HPV-inactive, 705 down /1260 up in HPV-active vs HPV-negative and 1127 down /838 up in HPV-inactive vs HPV-negative tumors. This comparison was also conducted within the EA population and a total of 1657 DEGs were observed with 752 down/ 905 up in HPV-active vs HPV-inactive, 673 down / 984 up in HPV-active vs HPV-negative and 896 down / 761 up in

HPV-inactive vs HPV-negative tumors (Table B.1). We also conducted a multiple comparison of HPV-inactive and HPV-negative tumors from both the races (Table C.1) which yielded a total of 367 DEGs. Additionally, HPV-inactive tumors from both AA and EA population were compared by race (Table G.1) and to the HPV-negative tumors (Table D.1 & E.1 respectively). On the other hand, within the AA population, 74 genes were upregulated and 96 downregulated in HPV-inactive vs HPV-negative tumors (Table D.1) and the number of differentially expressed genes within EA population were a little higher with 286 upregulated and 170 downregulated genes (Table E.1).

When compared by race, both HPV-inactive and HPV-negative tumors appeared to express differential patterns with a total of 1347 genes differentially regulated in HPV-inactive tumors from EA patients when compared to that of AA patients. Out of these, 985 were upregulated and 362 were downregulated (Table G.1). HPV-negative tumors from AA patients had 191 downregulated and 72 upregulated genes in comparison to that from EA patients (Table F.1).

4.1.4 Gene expression profiling of HPV-active, HPV-inactive and HPV-negative OPSCC samples: Unsupervised cluster analysis

Unsupervised hierarchical clustering of differentially expressed genes (DEGs) between different groups of HPV-active, -inactive and -negative samples across the two racial groups allowed for a series of observations. 1) HPV-active tumor samples, irrespective of race, segregated very clearly from the HPV-negative and HPV-inactive tumors (Figure 4.3).

2) When analyzed within the EA population, HPV-inactive tumors clustered with the HPV-negative tumors, with the exception of one tumor sample that clustered with the HPV-active tumors (Figure 4.4).

When HPV-negative and HPV-inactive tumors were compared to each other, they clearly separated by race and HPV status in an unsupervised cluster analysis, with HPV-inactive and HPV-negative tumors exhibiting distinct and separable gene expression profiles within each racial group (Figure 4.5).

Additionally, the biomarker tool of Ingenuity Pathway Analysis (IPA, Ingenuity Systems, Inc. 2000-2013) highlighted three major genes (ADAM12, IL1B, MMP14) as plausible markers for differences in HPV-negative OPSCC tumors between AA and EA patients (Table 4.3). When the data were sorted with p value 0.02 and FC 2, ADAM12 emerged as the only significant biomarker. Highlighted genes in Table 4.3 were selected for RT-qPCR based validation.

4.1.4 Gene Ontology and Ingenuity Pathway Analysis of microarray results

Gene Ontology (GO) profiles indicated that in HPV-active OPSCC samples that express E7, gene expression patterns show distinct alterations of biological processes including cell proliferation, cell cycle checkpoints and mitosis, with relatively little involvement of pathways of EMT, invasion and angiogenesis (see Figure 4.6 for representative processes). HPV-negative OPSCC samples presented the opposite picture, with alterations of gene expression pathways indicative of EMT, angiogenesis, chemotaxis and cell motility, all pointing to possible invasive behavior and metastatic potential (Figure 4.6).

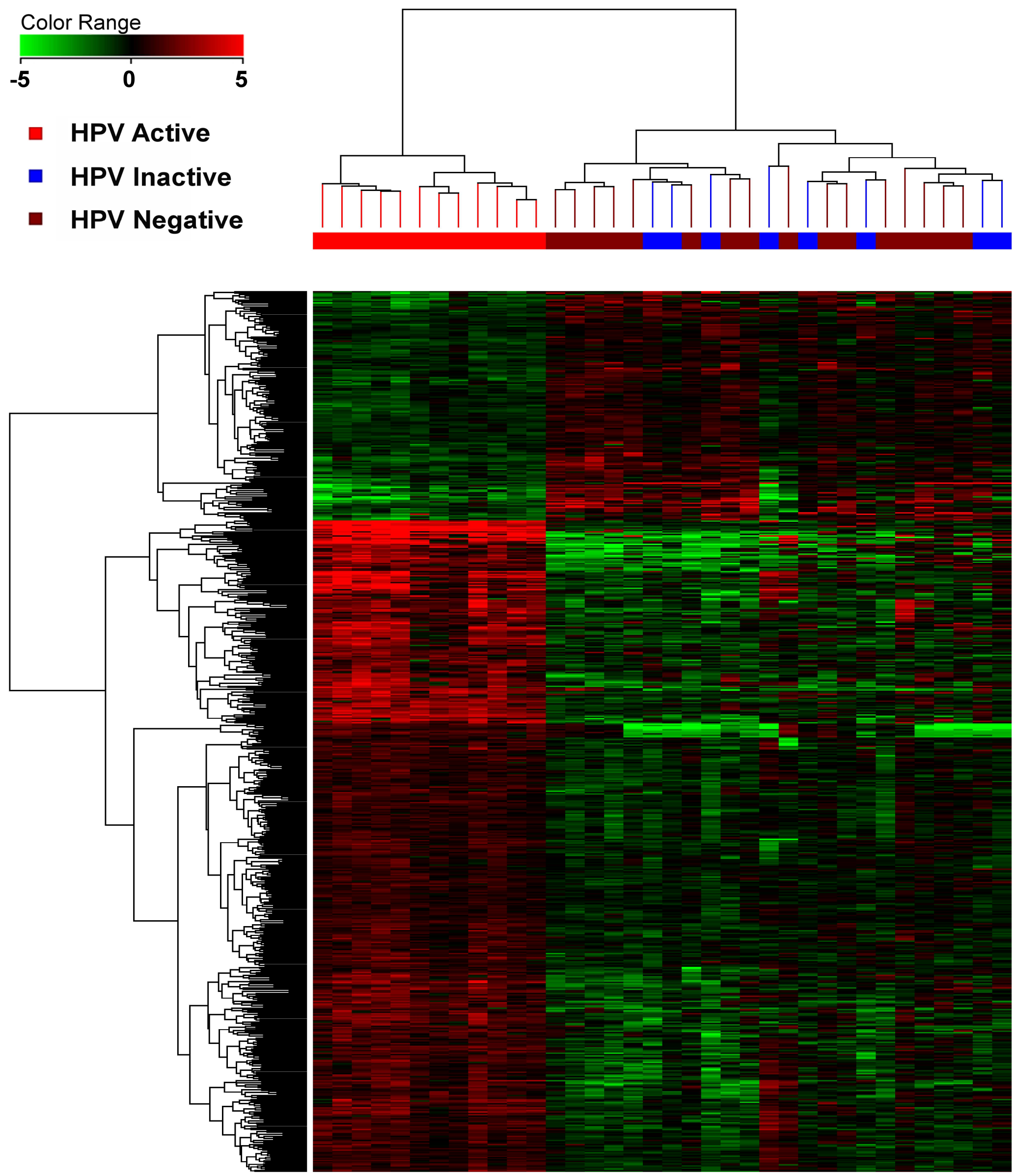


Figure 4.3: Unsupervised Hierarchical Clustering of 36 tumor samples, including HPV Active - HPV Inactive - HPV Negative tumors. Non-parametric test (Kruskal-Wallis one way anova) was used with p value and fold change cutoff 0.02 & 2, respectively. False discovery rate correction applied was Benjamini-Hochberg. Clustering conditions were Euclidean distances and Ward's variances.

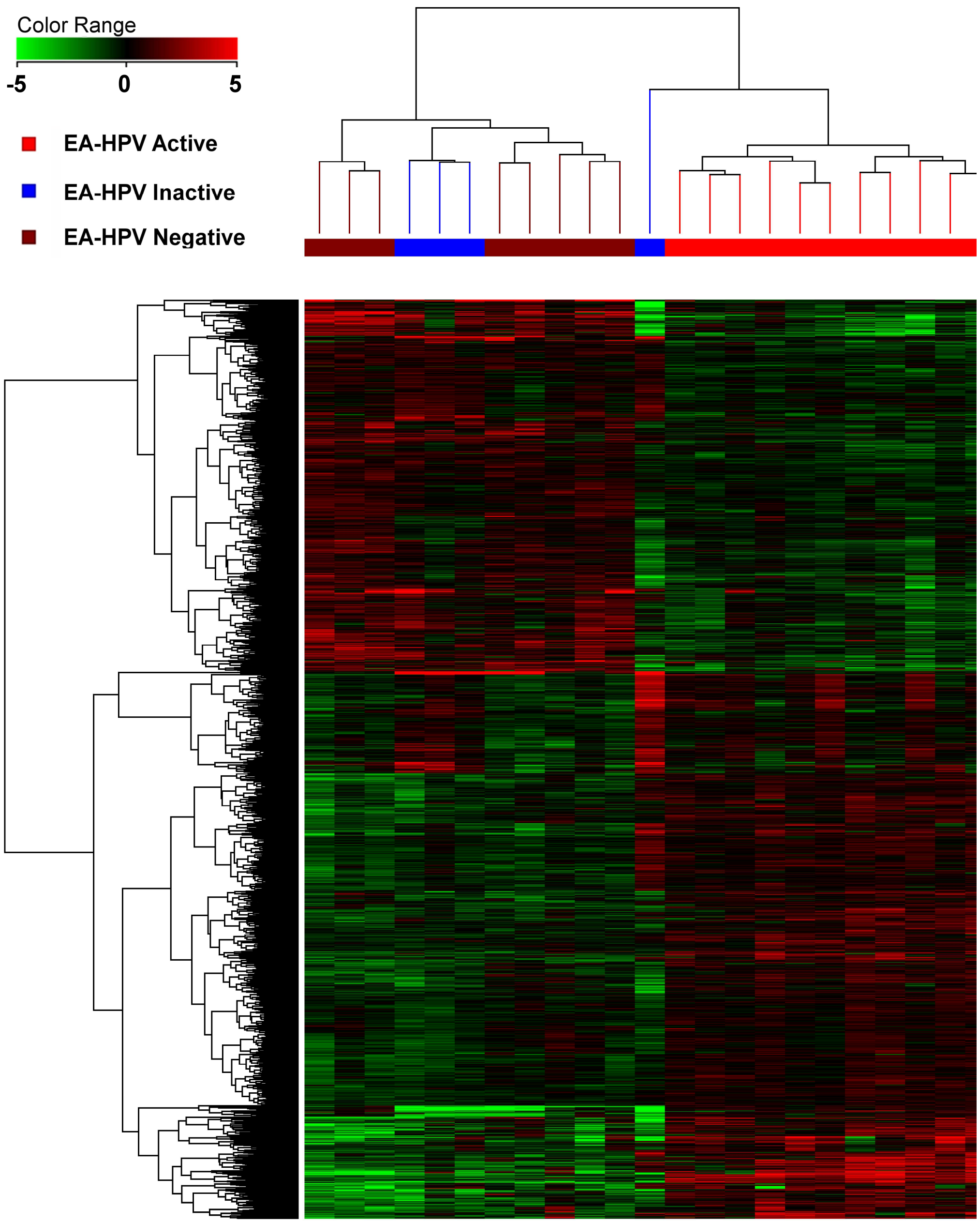


Figure 4.4: Unsupervised Hierarchical clustering of HPV Active, Inactive and Negative in European American population only. Non-parametric test (Kruskal-Wallis one way anova) was used with p value and fold change cutoff 0.02 & 2, respectively. No false discovery rate could be applied here. Clustering conditions were Euclidean distances and Ward's variances.

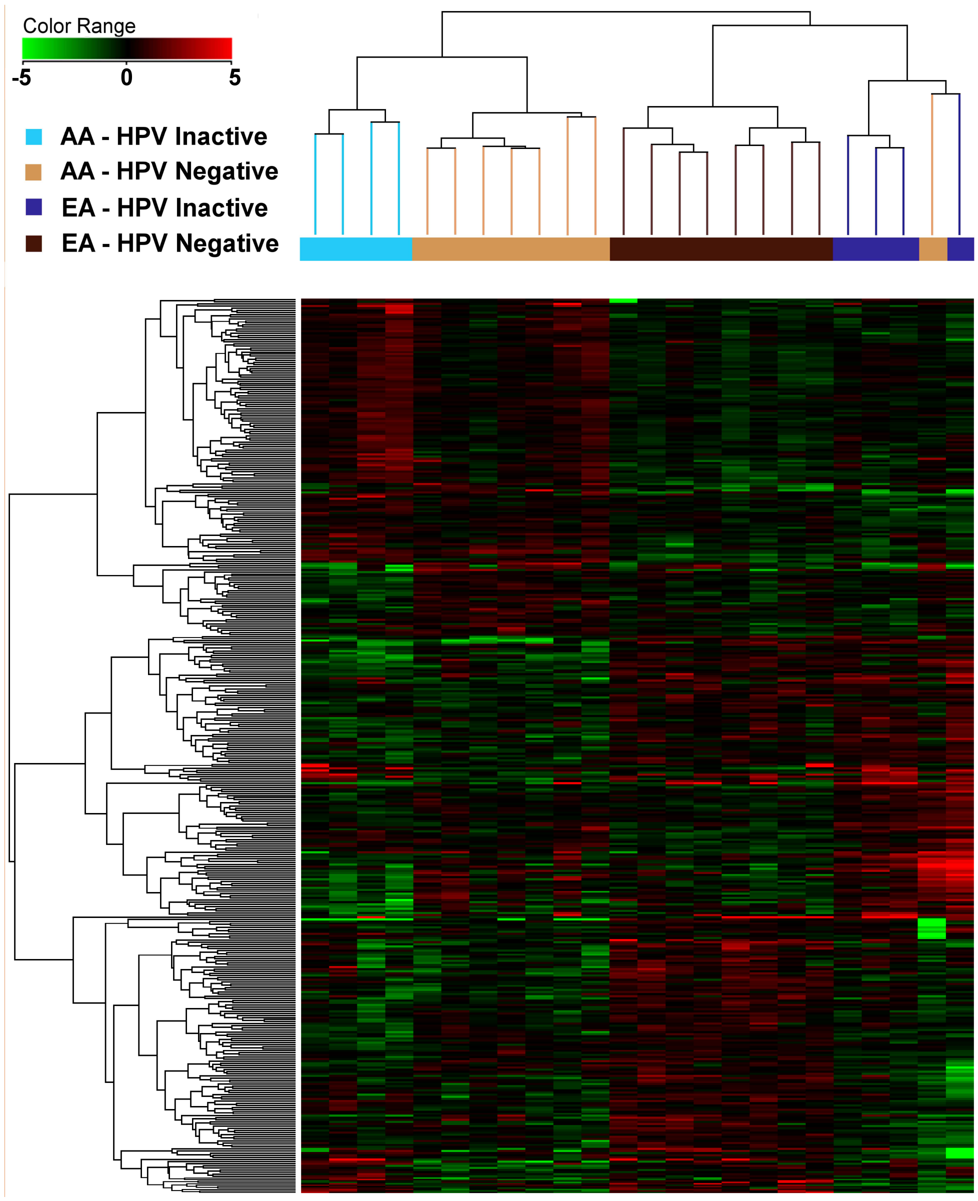


Figure 4.5: Unsupervised Hierarchical clustering of HPV Inactive v/s HPV Negative in African American and European American patients. Non-parametric test (Kruskal-Wallis one way anova) was used with p value and fold change cutoff 0.02 & 2, respectively. No false discovery rate could be applied here. Clustering conditions were Euclidean distances and Ward's variances.

In addition, a direct comparison of gene ontology biological processes between HPV-active, HPV-inactive and HPV-negative tumors from EA patients revealed that HPV-inactive tumors present with an intermediate profile which resembles, but does not completely overlap with the HPV-negative or –active tumors (Figure 4.7 and 4.8). The pathway analysis tool of genespring (Cutoff: p value 0.05, Fold Change 2) on differentially expressed genes between AA vs EA HPV-negative tumors, significantly represented TP63 transcriptional factor networks and cytokine-cytokine receptor interactions among 40 other pathways.

4.1.5 RT-qPCR analysis of selected genes in an expanded sample set

RT-qPCR assays confirmed the expression profiles of 18 selected DEGs (Figure 4.9, 4.10 and 4.11) within HPV-active, HPV-inactive and HPV-negative tumors in the 36 tumor samples used for microarray analysis and in an additional set of 13 samples, for a total of 49 samples, including 5 normal and 44 tumor samples. The mRNA expression data for genes that were significantly differentially expressed in this sample set are shown in Figures 4.8, 4.9 and 4.10. As expected, HPV-active cancers expressed significantly higher levels of CDKN2A mRNA than that of HPV-negative tumors (Figure 4.9). We detected overexpression of BRCA1 and KRT15 in HPV-active in comparison with HPV-negative tumors; MMP10 expression was lower in HPV-active tumors and there was a significant difference in the expression of MMP13 between HPV-inactive and -active tumors (Figure 4.9 and 4.10).

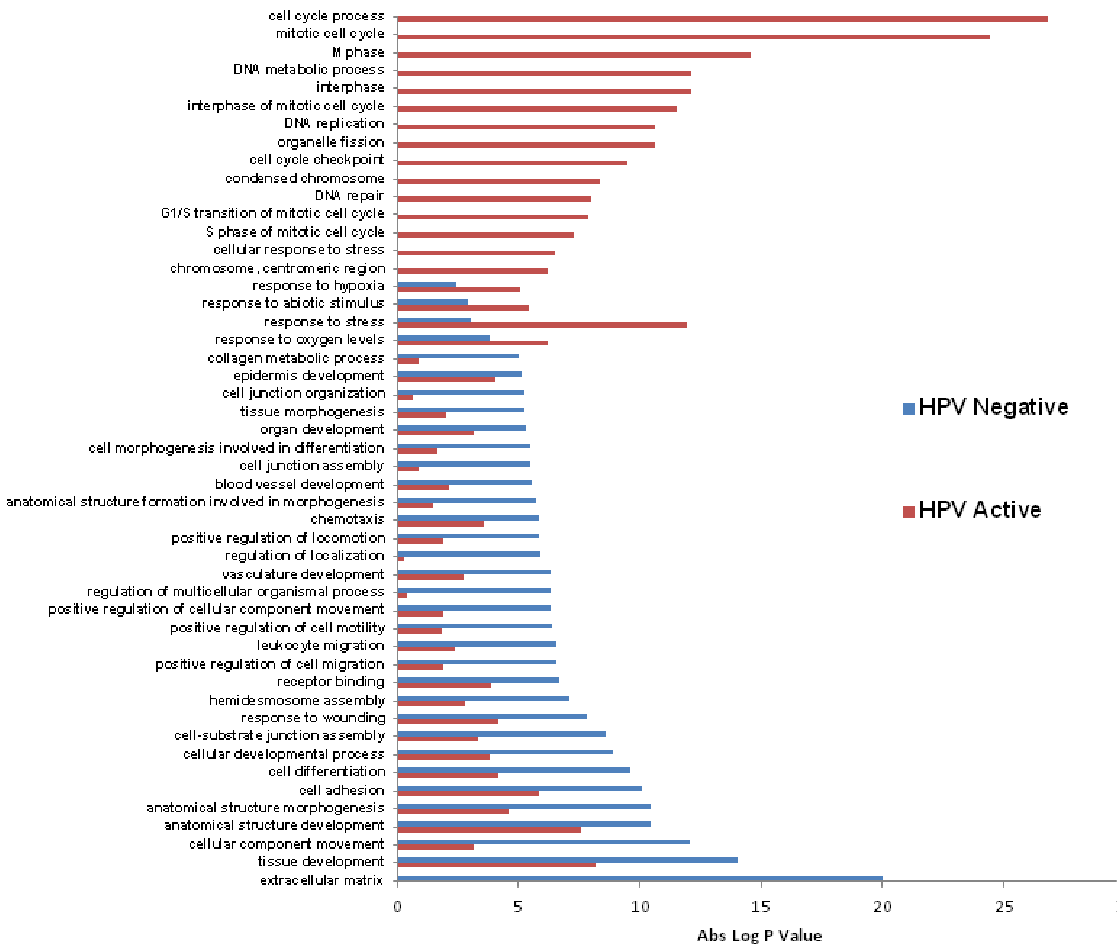


Figure 4.6: Comparison of Gene Ontology profiles of HPV Active and HPV Negative tumors. The GO profiles were generated by Genespring such as, HPV-active tumors were compared to the controls and similarly HPV-negative tumors were compared to the same control group. Absolute Log converted P (AbsLogP) values were calculated for the combined ontologies and similar relationships in both the analysis were identified. The most significantly represented ontologies were shortlisted.

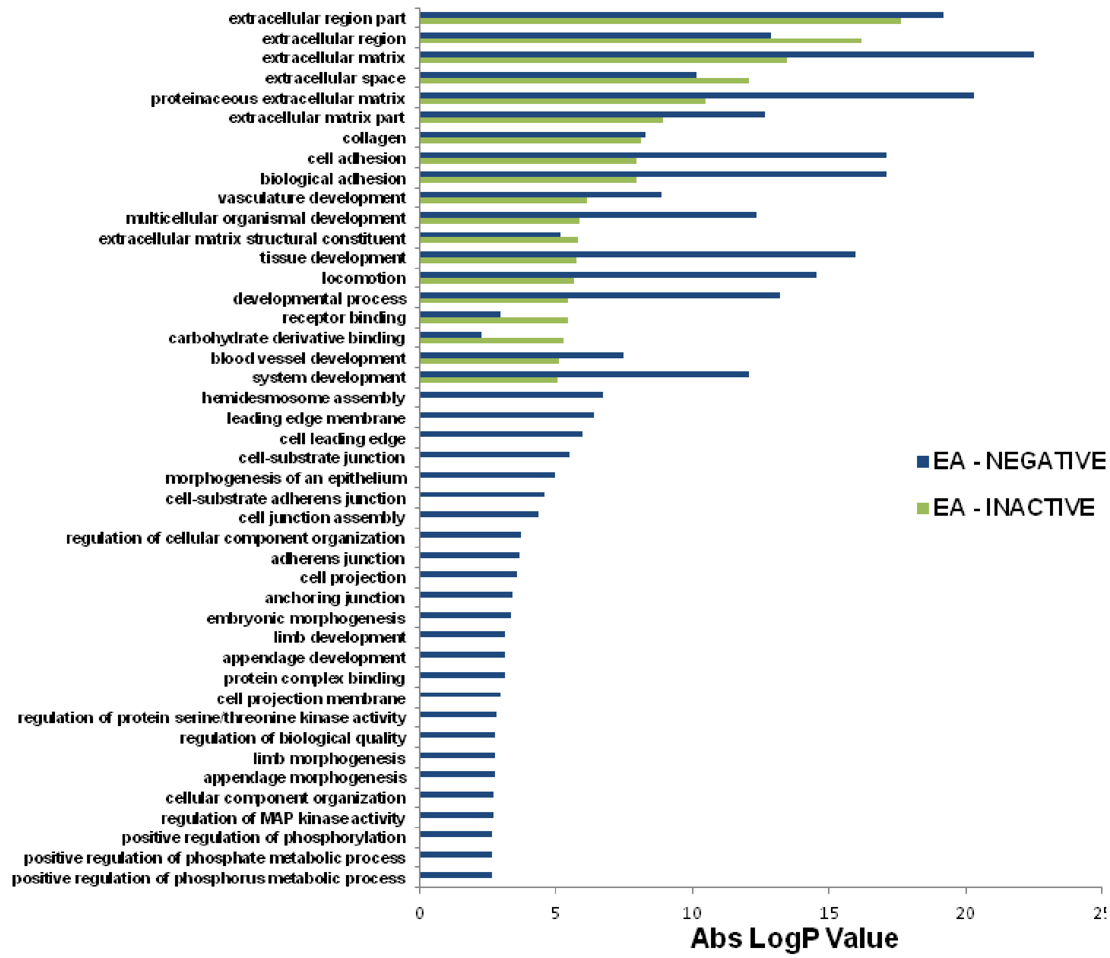


Figure 4.7: Comparison of Gene Ontology profiles from HPV Negative and HPV Inactive tumors from European American (EA) patients. The GO profiles were generated by Genespring such as, EA HPV-negative tumors were compared to EA-controls and similarly EA HPV-inactive tumors were compared to the same control group. Absolute Log converted P (AbsLogP) values were calculated for the combined ontologies and similar relationships in both the analysis were identified. The most significantly represented ontologies were shortlisted.

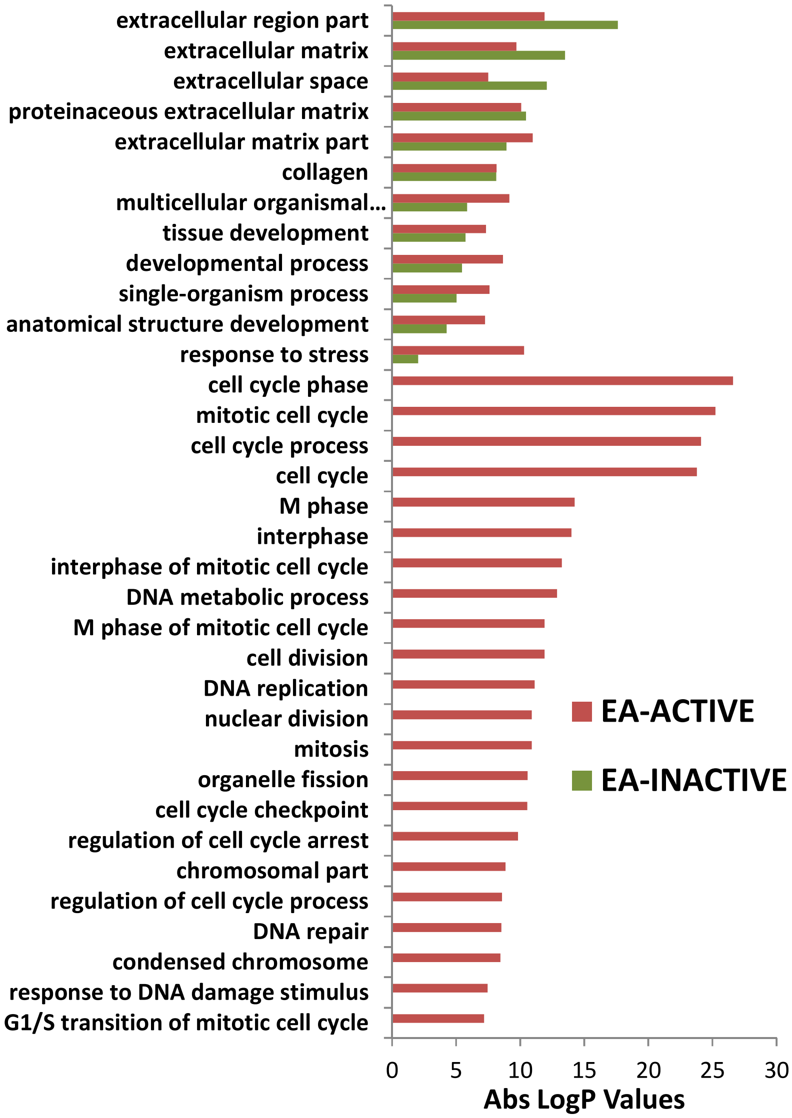


Figure 4.8: Comparison of Gene Ontology profiles from HPV-Active and HPV-Inactive tumors from European American (EA) patients. The GO profiles were generated by Genespring such as, EA HPV-active tumors were compared to EA-controls and similarly EA HPV-inactive tumors were compared to the same control group. Absolute Log converted P (AbsLogP) values were calculated for the combined ontologies and similar relationships in both the analysis were identified. The most significantly represented ontologies were shortlisted.

Table 4.3: Ingenuity Pathway Analysis: Biomarker analysis for HPV negative tumors- AA vs. EA patients

Symbol	Gene Name	Location	Family	Drug(s)	Fold Change	Biomarker Application(s)
ADAM12	ADAM metallopeptidase domain 12	Plasma Membrane	peptidase		-4.085	diagnosis
ADAMTS10	ADAM metallopeptidase with thrombospondin type 1 motif, 10	Extracellular Space	peptidase		-2.028	diagnosis
GJA1	gap junction protein, alpha 1, 43kDa	Plasma Membrane	transporter		-2.243	disease progression
IGFBP3	insulin-like growth factor binding protein 3	Extracellular Space	other		-3.025	diagnosis, disease progression, efficacy, prognosis, response to therapy, safety
IL1B	interleukin 1, beta	Extracellular Space	cytokine	IL-1 trap, canakinumab	+4.04	diagnosis, efficacy, prognosis, safety
MMP14	matrix metallopeptidase 14 (membrane-inserted)	Extracellular Space	peptidase	marimastat	-2.136	diagnosis, prognosis, unspecified application

TP53 was overexpressed in HPV-active vs -inactive tumors, and c-MET and MCM2 were overexpressed in all tumor samples with respect to controls, with a trend for the highest levels of c-MET expression in HPV-negative tumors (Figure 4.10 and 4.11).

A similar behavior was observed for ADAM12, IL1, TGF-β2 and IGFBP3 (Figure 4.9 and 4.11). HPV-active tumors had minimum levels of MAL as compared to HPV-negative and inactive tumors, while all the tumors showed downregulation of MAL as compared to controls (Figure 4.10). Figure 4.12 and 4.13 show the results of RT-qPCR for each of the selected DEGs, separated by HPV status and by race. c-MET was overexpressed in HPV-negative tumors in comparison with HPV-active tumors from EA patients (Figure 4.11). HPV-inactive and HPV-negative tumors in AA patients exhibited lover levels of c-MET RNA (Figure 4.12). A similar trend was observed for TGF-β2, with the highest levels of expression in HPV-negative tumors from EA patients (Figure 4.13). TP53 mRNA levels were high in HPV-active tumors (all of them from EA patients) and similar to normal tissue in all other HPV-status categories (Figure 4.11). Similarly, we observed significant up-regulation of RNA for the BRCA1 tumor suppressor gene in HPV-active tumors from EA patients, as compared to the HPV-negative and inactive tumors from both racial groups. In addition, expression levels of IL1B and MAL were significantly lower in HPV-negative tumors from EA patients than in HPV-negative tumors from AA patients (Figure 4.12). Summary of statistical analyses conducted on all the DEG's is given in Table 4.4 (differences by race and HPV status) and Table 4.5 (differences by HPV status alone).

Overall, the RT-qPCR results confirmed the microarray data as well as the IPA biomarker profile, and pointed to differences in gene expression between HPV-active and

HPV-negative tumors within each racial group. The concordance rate of gene regulation as observed by RT-qPCR and microarray was 95.8% for MCM2, TP53, MAL, KRT15, NOTCH1, TP53, CDKN2A, TLR10 in total tumor population, 83.3% for BRCA1, MAL, CDKN2A, NOTCH1, TP53, MMP13, MMP10, TGFB2, MET, TLR10, MCM2, KRT15 within EA population and 71.4% for IGFBP3, IL1B, ADAM12, MMP14, MMP7, MAL, MMP10 within HPV-negative tumors from AA and EA population. These data also suggest more subtle differences between HPV-negative and HPV-inactive tumors, and possibly in tumors derived from EA and AA patients. All the gene expression values were represented as Log10 transformed cumulative normalized relative quantities (Log10CNRQ).

4.2 Discussion

4.2.1 Markers and indicators of HPV-driven tumorigenesis in HNC

Human Papillomavirus is an established independent risk factor for the development of OPSCC and its detection in squamous cell carcinoma of the oral cavity has truly come of age with the advent of RNA based assays to test HPV activity. In surgical pathology, immunohistochemistry for p16(INK4a) is a well-known surrogate marker for HPV expression in cervical cancers[46,47] and HNSCC[52]. However, the sensitivity and specificity of this protein as a biomarker for HPV-driven HNSCC is highly debated[53]. This biomarker's potential to characterize biologically active HPV related OPSCC increases in combination with DNA/RNA based assays for viral oncogenes[54–56].

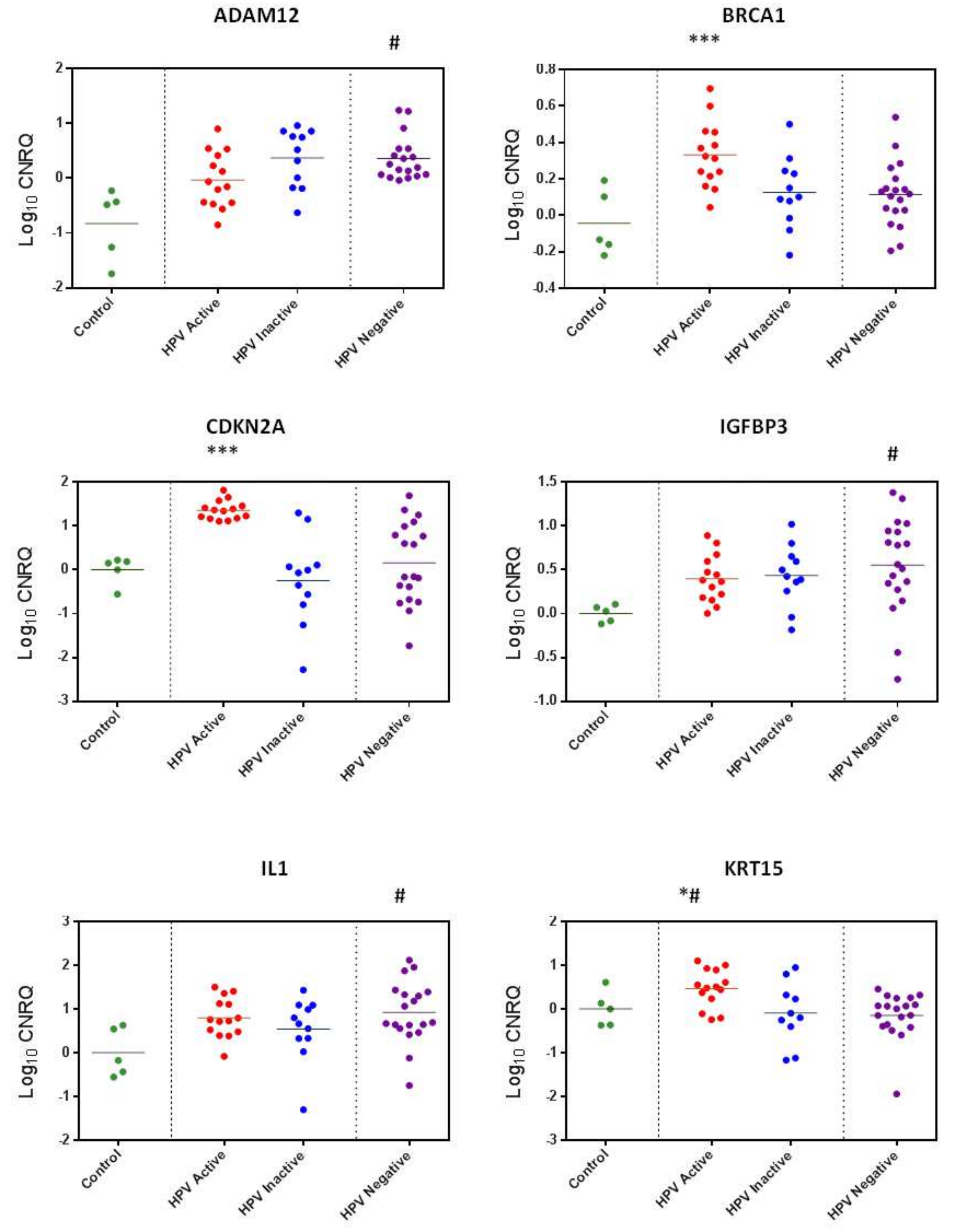


Figure 4.9: Differential expression levels of ADAM12, BRCA1, CDKN2A, IGFBP3, IL1 and KRT15. Log_{10} CNRQs calculated by normalizing data to three reference genes using qbase+. Significant relationships determined by ANOVA and tukey's multiple testing: (***) Active/Control, Active/Inactive and Active/Negative; (*#) Active/Negative; (#) Negative/Control.

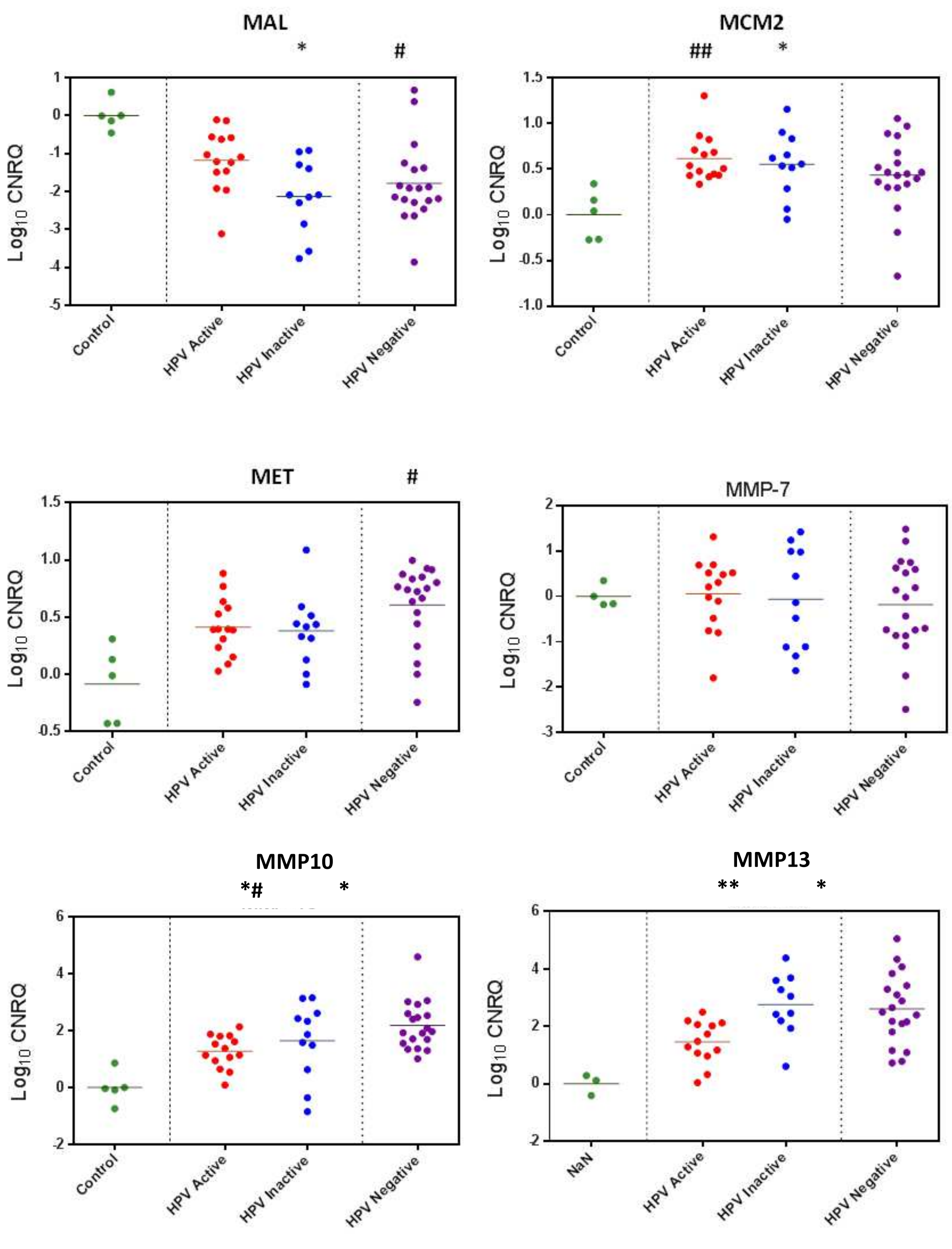


Figure 4.10: Differential expression levels of MAL, MCM2, MET, MMP7, MMP10 and MMP13. Log_{10} CNRQs calculated by normalizing data to three reference genes using qbase+. Significant relationships determined by ANOVA and tukey's multiple testing: (**) Active/Inactive; (*) Inactive/Control; (*#) Active/Negative; (#) Negative/Control, (##) Active/Control

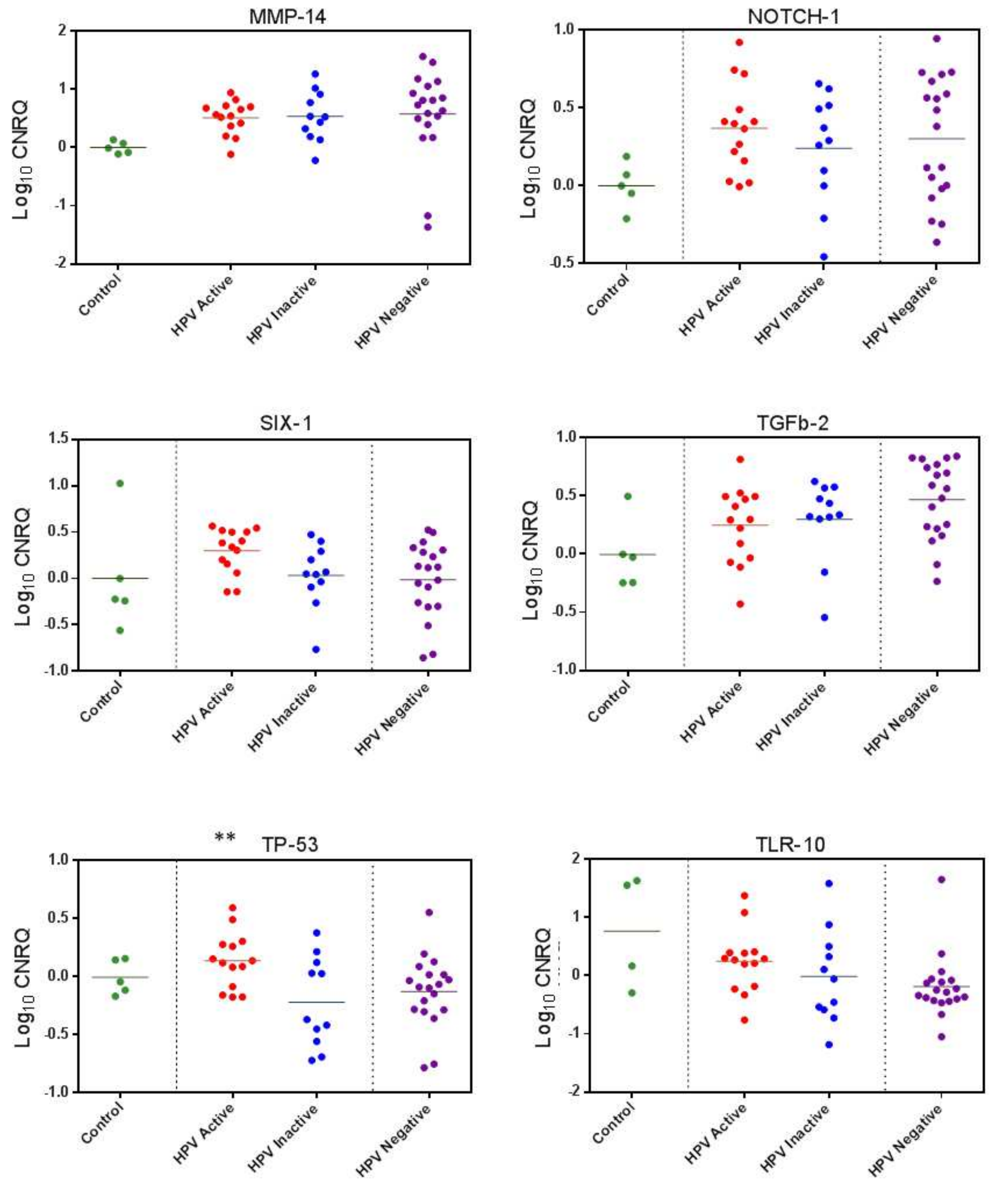


Figure 4.11: Differential expression levels of MMP14, NOTCH1, SIX1, TGFβ2, TP53 and TLR10. Log_{10} CNRQs calculated by normalizing data to three reference genes using qbase+. Significant relationships determined by ANOVA and tukey's multiple testing: (**) Active/Inactive

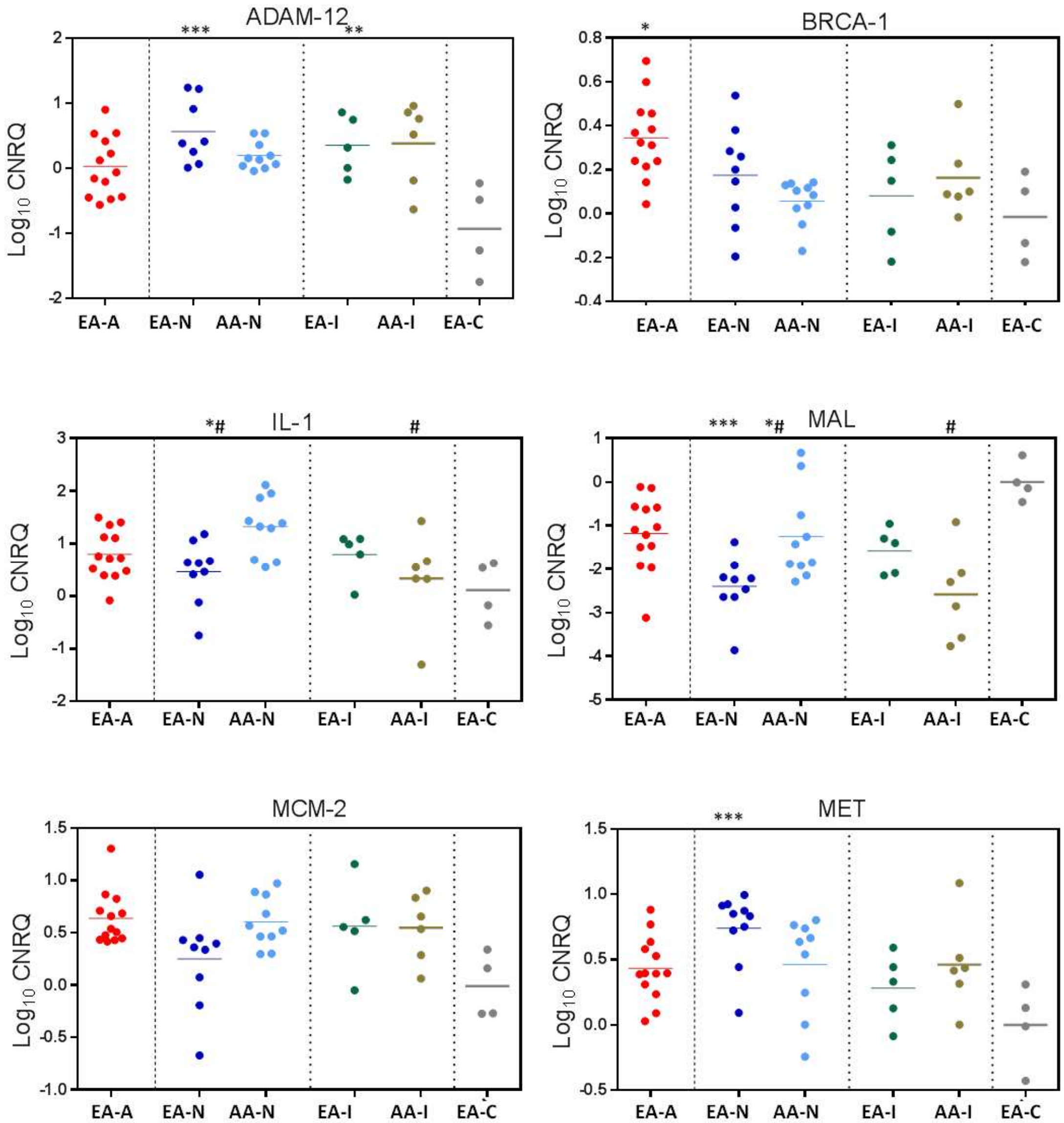


Figure 4.12: Differential expression levels of ADAM12, BRCA1, IL1, MAL, MCM2 and MET by HPV status and Race. Log_{10} CNRQs calculated by normalizing data to three reference genes using qbase+. Significant relationships determined by ANOVA and tukey's multiple testing. EA-A: European American Active, EA-N: European American Negative, EA-I European American Inactive, EA-C: European American Control. AA-N: African American Negative, AA-I: African American Inactive, (*) EA- /EA-C; (**) EA-I/EA-C; (***) EA-N/EA-C, (#) AA-N / AA-I; (*#) EA-N / AA-N.

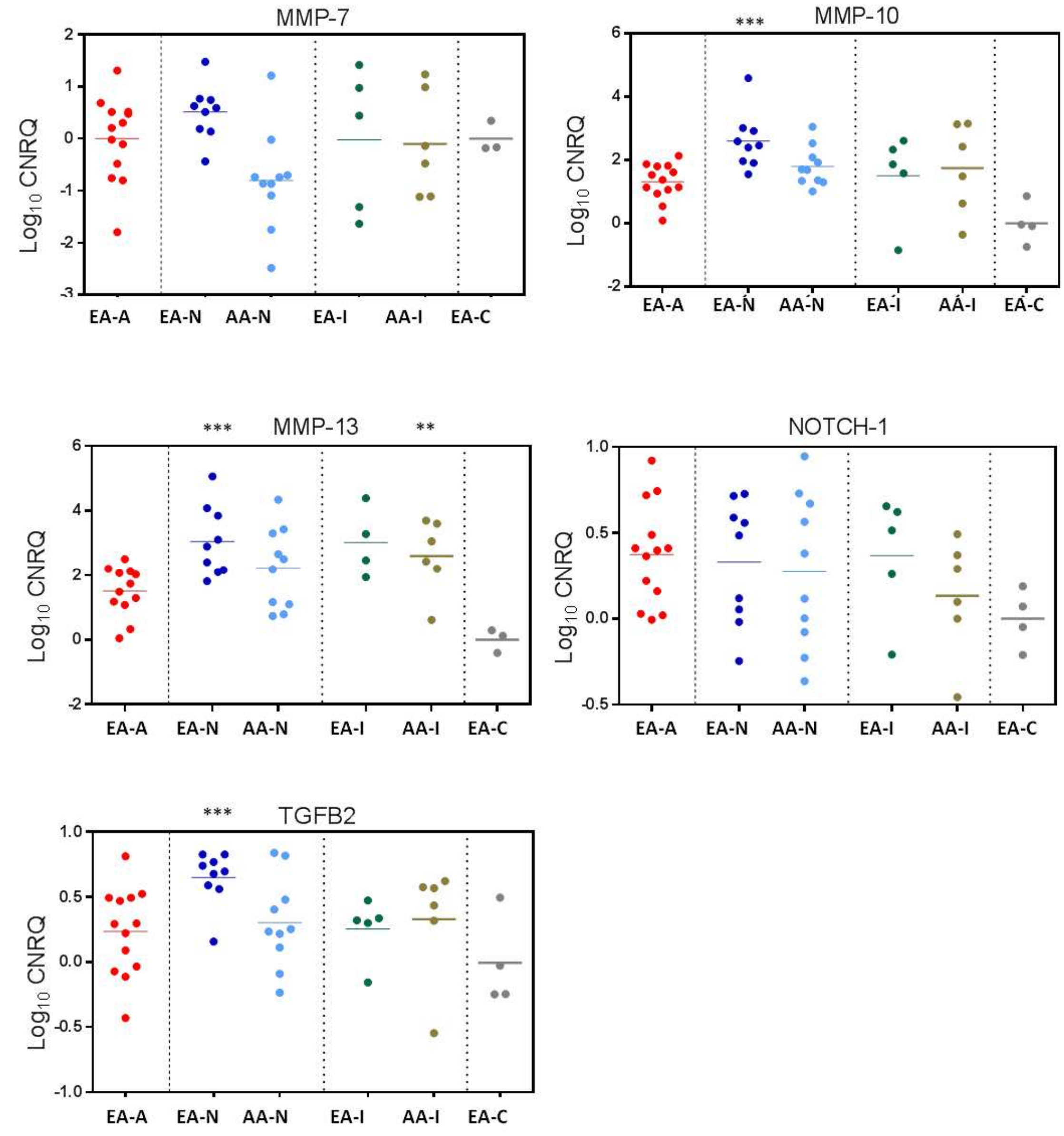


Figure 4.13: Differential expression levels of MMP7, MMP10, MMP13, NOTCH1 and TGFβ2 by HPV status and Race. Log_{10} CNRQs calculated by normalizing data to three reference genes using qbase+. Significant relationships determined by ANOVA and tukey's multiple testing. EA-A: European American Active, EA-N: European American Negative, EA-I European American Inactive, EA-C: European American Control. AA-N: African American Negative, AA-I: African American Inactive, (**) EA-I/EA-C; (***) EA-N/EA-C

Table 4.4: ANOVA Summary-by HPV status

Target Gene	p	r2	Comparison	Ratio	95% ci low	95% ci high	Significant	Value	Mean	95% value ci low	95% value ci high	Datapoints
CDKN2A	0.00	0.42										
			ACTIVE/ CONTROL	22.6	1.5	345.2	Yes	ACTIVE	22.6	17.1	30.0	14
			ACTIVE/ INACTIVE	39.9	5.8	276.5	Yes	CONTROL	1.0	0.3	3.9	4
			ACTIVE/ NEG	15.8	2.9	85.6	Yes	INACTIVE	0.6	0.1	2.7	11
			INACTIVE/ CONTROL	0.6	0.0	9.4	No	NEG	1.4	0.5	4.0	19
			NEG/ CONTROL	1.4	0.1	20.2	No					
			NEG/ INACTIVE	2.5	0.4	15.6	No					
MMP13	0.00	0.39										
			ACTIVE/ CONTROL	28.9	0.5	1723.1	No	ACTIVE	28.9	10.3	81.2	13
			ACTIVE/ INACTIVE	0.0	0.0	0.7	Yes	CONTROL	1.0	0.1	8.0	3
			ACTIVE/ NEG	0.1	0.0	0.7	Yes	INACTIVE	579.0	98.8	3393.9	10
			INACTIVE/ CONTROL	579.0	8.7	38624.8	Yes	NEG	407.6	105.5	1574.1	19
			NEG/ CONTROL	407.6	7.7	21470.5	Yes					
			NEG/ INACTIVE	0.7	0.1	8.5	No					

MMP10	0.00	0.33										
			ACTIVE/ CONTROL	18.4	0.8	436.7	No	ACTIVE	18.4	8.5	39.9	14
			ACTIVE/ INACTIVE	0.4	0.0	4.0	No	CONTROL	1.0	0.1	11.1	4
			ACTIVE/ NEG	0.1	0.0	0.9	Yes	INACTIVE	43.4	5.5	342.1	11
			INACTIVE/ CONTROL	43.4	1.7	1129.8	Yes	NEG	150.9	59.2	384.4	19
			NEG/ CONTROL	150.9	7.0	3253.3	Yes					
			NEG/ INACTIVE	3.5	0.4	28.8	No					
MAL	0.00	0.30										
			ACTIVE/ CONTROL	0.1	0.0	1.7	No	ACTIVE	0.1	0.0	0.2	14
			ACTIVE/ INACTIVE	8.8	0.9	87.7	No	CONTROL	1.0	0.2	5.2	4
			ACTIVE/ NEG	4.1	0.5	30.3	No	INACTIVE	0.0	0.0	0.0	11
			INACTIVE/ CONTROL	0.0	0.0	0.2	Yes	NEG	0.0	0.0	0.1	19
			NEG/ CONTROL	0.0	0.0	0.4	Yes					
			NEG/ INACTIVE	2.2	0.2	18.8	No					
MCM2	0.03	0.22										
			ACTIVE/ CONTROL	4.1	1.4	12.4	Yes	ACTIVE	4.1	2.9	5.8	14
			ACTIVE/ INACTIVE	1.2	0.5	2.7	No	CONTROL	1.0	0.5	2.2	5

			ACTIVE/ NEG	1.5	0.7	3.2	No	INACTIVE	3.6	2.1	6.2	11
			INACTIVE/ CONTROL	3.6	1.1	11.2	Yes	NEG	2.7	1.7	4.3	19
			NEG/ CONTROL	2.7	0.9	7.9	No					
			NEG/ INACTIVE	0.8	0.3	1.7	No					
ADAM12	0.03	0.43										
			ACTIVE/ CONTROL	4.8	0.9	25.9	No	ACTIVE	4.8	2.5	9.1	12
			ACTIVE/ INACTIVE	1.8	0.2	20.3	No	CONTROL	1.0	0.2	6.3	5
			ACTIVE/ NEG	0.3	0.0	2.0	No	INACTIVE	2.7	0.0	2083.3	2
			INACTIVE/ CONTROL	2.7	0.2	37.9	No	NEG	18.8	1.4	249.5	3
			NEG/ CONTROL	18.8	1.8	190.3	Yes					
			NEG/ INACTIVE	7.0	0.4	127.4	No					
KRT15	0.03	0.21										
			ACTIVE/ CONTROL	2.9	0.4	19.5	No	ACTIVE	2.9	1.6	5.2	14
			ACTIVE/ INACTIVE	3.7	0.9	14.6	No	CONTROL	1.0	0.2	5.6	4
			ACTIVE/ NEG	4.1	1.3	13.4	Yes	INACTIVE	0.8	0.3	2.6	10
			INACTIVE/ CONTROL	0.8	0.1	5.8	No	NEG	0.7	0.4	1.3	19
			NEG/ CONTROL	0.7	0.1	4.5	No					
			NEG/	0.9	0.2	3.3	No					

			INACTIVE									
IL1	0.06	0.17										
			ACTIVE/ CONTROL	6.3	0.8	48.7	No	ACTIVE	6.3	3.4	11.5	14
			ACTIVE/ INACTIVE	1.8	0.4	8.8	No	CONTROL	1.0	0.2	4.8	5
			ACTIVE/ NEG	0.8	0.2	3.0	No	INACTIVE	3.5	1.1	10.9	11
			INACTIVE/ CONTROL	3.5	0.4	29.1	No	NEG	8.3	3.8	18.3	19
			NEG/ CONTROL	8.3	1.1	59.7	Yes					
			NEG/ INACTIVE	2.4	0.5	10.5	No					
IGFBP3	0.11	0.14										
			ACTIVE/ CONTROL	2.5	0.7	9.3	No	ACTIVE	2.5	1.7	3.6	14
			ACTIVE/ INACTIVE	0.9	0.3	2.6	No	CONTROL	1.0	0.8	1.3	5
			ACTIVE/ NEG	0.7	0.3	1.7	No	INACTIVE	2.7	1.6	4.6	11
			INACTIVE/ CONTROL	2.7	0.7	10.6	No	NEG	3.6	1.9	6.6	19
			NEG/ CONTROL	3.6	1.0	12.8	Yes					
			NEG/ INACTIVE	1.3	0.5	3.4	No					
TLR-10	0.14	0.29										
			ACTIVE/ CONTROL	0.3	0.0	3.2	No	ACTIVE	0.3	0.1	0.7	12
			ACTIVE/	1.3	0.1	29.4	No	CONTROL	1.0	0.0	35.8	4

			INACTIVE									
			ACTIVE/ NEG	5.5	0.4	78.2	No	INACTIVE	0.2	0.0	62.6	2
			INACTIVE/ CONTROL	0.2	0.0	8.3	No	NEG	0.1	0.0	0.1	3
			NEG/ CONTROL	0.1	0.0	1.3	No					
			NEG/ INACTIVE	0.2	0.0	9.9	No					
MMP-14	0.25	0.09										
			ACTIVE/ CONTROL	3.2	0.6	18.3	No	ACTIVE	3.2	2.2	4.7	14
			ACTIVE/ INACTIVE	0.9	0.2	3.6	No	CONTROL	1.0	0.7	1.3	5
			ACTIVE/ NEG	0.9	0.3	2.8	No	INACTIVE	3.4	1.8	6.7	11
			INACTIVE/ CONTROL	3.4	0.6	20.6	No	NEG	3.8	1.6	8.7	19
			NEG/ CONTROL	3.8	0.7	20.1	No					
			NEG/ INACTIVE	1.1	0.3	3.9	No					
NOTCH1	0.32	0.08										
			ACTIVE/ CONTROL	2.3	0.7	7.7	No	ACTIVE	2.3	1.6	3.4	14
			ACTIVE/ INACTIVE	1.3	0.6	3.1	No	CONTROL	1.0	0.5	1.9	4
			ACTIVE/ NEG	1.2	0.6	2.5	No	INACTIVE	1.7	1.0	3.0	11
			INACTIVE/ CONTROL	1.7	0.5	6.0	No	NEG	2.0	1.3	3.1	19
			NEG/ CONTROL	2.0	0.6	6.4	No					

			NEG/ INACTIVE	1.2	0.5	2.6	No					
MMP-7	0.92	0.01										
			ACTIVE/ CONTROL	1.1	0.0	49.7	No	ACTIVE	1.1	0.4	3.3	14
			ACTIVE/ INACTIVE	1.3	0.1	14.5	No	CONTROL	1.0	0.2	5.6	3
			ACTIVE/ NEG	1.7	0.2	13.9	No	INACTIVE	0.9	0.1	4.9	11
			INACTIVE/ CONTROL	0.9	0.0	41.2	No	NEG	0.7	0.2	2.1	19
			NEG/ CONTROL	0.7	0.0	26.5	No					
			NEG/ INACTIVE	0.8	0.1	7.3	No					
BRCA-1	0.01	0.28										
			ACTIVE/ CONTROL	2.1	1.1	4.0	Yes	ACTIVE	2.1	1.7	2.7	14.0000
			ACTIVE/ INACTIVE	1.6	1.0	2.5	Yes	CONTROL	1.0	0.5	1.9	4.0000
			ACTIVE/ NEG	1.7	1.1	2.5	Yes	INACTIVE	1.3	1.0	1.8	11.0000
			INACTIVE/ CONTROL	1.3	0.7	2.6	No	NEG	1.3	1.1	1.6	19.0000
			NEG/ CONTROL	1.3	0.7	2.4	No					
			NEG/ INACTIVE	1.0	0.6	1.5	No					
MET	0.02	0.24										
			ACTIVE/ CONTROL	2.6	0.9	7.7	No	ACTIVE	2.6	1.9	3.6	14.0000

			ACTIVE/ INACTIVE	1.1	0.5	2.3	No	CONTROL	1.0	0.3	3.2	4.0000
			ACTIVE/ NEG	0.6	0.3	1.3	No	INACTIVE	2.4	1.5	3.9	11.0000
			INACTIVE/ CONTROL	2.4	0.8	7.3	No	NEG	4.1	2.8	6.0	19.0000
			NEG/ CONTROL	4.1	1.4	11.6	Yes					
			NEG/ INACTIVE	1.7	0.8	3.5	No					
TP-53	0.04	0.19										
			ACTIVE/ CONTROL	1.4	0.5	3.9	No	ACTIVE	1.4	1.0	1.9	14.0000
			ACTIVE/ INACTIVE	2.3	1.1	4.8	Yes	CONTROL	1.0	0.5	1.9	4.0000
			ACTIVE/ NEG	1.8	1.0	3.5	No	INACTIVE	0.6	0.3	1.1	11.0000
			INACTIVE/ CONTROL	0.6	0.2	1.8	No	NEG	0.7	0.5	1.0	19.0000
			NEG/ CONTROL	0.7	0.3	2.1	No					
			NEG/ INACTIVE	1.2	0.6	2.5	No					
TGFB-2	0.08	0.15										
			ACTIVE/ CONTROL	1.8	0.5	5.7	No	ACTIVE	1.8	1.1	2.7	14.0000
			ACTIVE/ INACTIVE	0.9	0.4	2.1	No	CONTROL	1.0	0.3	3.6	4.0000
			ACTIVE/ NEG	0.6	0.3	1.2	No	INACTIVE	2.0	1.2	3.4	11.0000
			INACTIVE/ CONTROL	2.0	0.6	6.6	No	NEG	2.9	2.0	4.2	19.0000
			NEG/	2.9	0.9	9.1	No					

			CONTROL									
			NEG/ INACTIVE	1.5	0.7	3.3	No					
SIX-1	0.28	0.20										
			ACTIVE/ CONTROL	2.1	0.6	8.0	No	ACTIVE	2.1	1.5	2.9	12.0000
			ACTIVE/ INACTIVE	2.2	0.4	12.8	No	CONTROL	1.0	0.1	13.1	4.0000
			ACTIVE/ NEG	0.9	0.2	4.0	No	INACTIVE	0.9	0.1	7.6	2.0000
			INACTIVE/ CONTROL	0.9	0.1	6.9	No	NEG	2.3	1.0	5.4	3.0000
			NEG/ CONTROL	2.3	0.4	13.2	No					
			NEG/ INACTIVE	2.4	0.3	19.6	No					

Table 4.5: ANOVA Summary-by HPV status and Race

ADAM-12						
F	6.985	Tukey's multiple comparisons test	Mean Diff.	95% CI of diff.	Significant?	Summary
P value	0.0005	EA-Control vs. EA-NEGATIVE	-1.49	-2.346 to -0.6330	Yes	***
P value summary	***	EA-Control vs. AA-NEGATIVE	-1.125	-1.953 to -0.2975	Yes	**
(P < 0.05)	Yes	EA-Control vs. EA-INACTIVE	-1.278	-2.217 to -0.3400	Yes	**
R square	0.4995	EA-Control vs. AA-INACTIVE	-1.307	-2.210 to -0.4042	Yes	**
BRCA-1						
F	4.222					
P value	0.0035					
P value summary	**	Tukey's multiple comparisons test	Mean Diff.	95% CI of diff.	Significant?	Summary
(P < 0.05)	Yes	EA-Active vs. AA-Negative	0.2886	0.05908 to 0.5182	Yes	**
R square	0.3399	EA-Active vs. EA-Control	0.36	0.04799 to 0.6721	Yes	*
KRT-15						
F	2.557					
P value	0.0424					
P value summary	*					
(P < 0.05)	Yes					
R square	0.2422					
MAL						
F	8.024	Tukey's multiple comparisons test	Mean Diff.	95% CI of diff.	Significant?	Summary

P value	0.0002	EA-Control vs. EA-NEGATIVE	2.396	0.9258 to 3.866	Yes	***
P value summary	***	EA-Control vs. AA-INACTIVE	2.585	1.006 to 4.165	Yes	***
(P < 0.05)	Yes	EA-NEGATIVE vs. AA-NEGATIVE	-1.148	-2.272 to -0.02354	Yes	*
R square	0.5253	AA-NEGATIVE vs. AA-INACTIVE	1.337	0.07383 to 2.600	Yes	*
IL-1						
F	4.25					
P value	0.0079	Tukey's multiple comparisons test	Mean Diff.	95% CI of diff.	Significant?	Summary
P value summary	**	EA-Control vs. AA-NEGATIVE	-1.218	-2.297 to -0.1398	Yes	*
(P < 0.05)	Yes	EA-NEGATIVE vs. AA-NEGATIVE	-0.8625	-1.700 to -0.02481	Yes	*
R square	0.3695	AA-NEGATIVE vs. AA-INACTIVE	0.9947	0.05324 to 1.936	Yes	*
MCM2						
F	2.845					
P value	0.0419					
P value summary	*					
(P < 0.05)	Yes					
R square	0.2818					
MET						
F	3.953					
P value	0.0051					
P value summary	**					
(P < 0.05)	Yes	Tukey's multiple comparisons test	Mean Diff.	95% CI of diff.	Significant?	Summary
R square	0.3253	EA-Control vs. EA-NEGATIVE	-0.7404	-1.274 to -0.2068	Yes	**
MMP-10						
F	4.812					
P value	0.0042	Tukey's multiple comparisons test	Mean	95% CI of diff.	Significant?	Summary

			Diff.			
P value summary	**	EA-Control vs. EA-NEGATIVE	-2.599	-4.338 to -0.8611	Yes	**
(P < 0.05)	Yes	EA-Control vs. AA-NEGATIVE	-1.8	-3.511 to -0.08888	Yes	*
R square	0.3989					
MMP-13						
F	4.641	Tukey's multiple comparisons test	Mean Diff.	95% CI of diff.	Significant?	Summary
P value	0.0056	NaN vs. EA-NEGATIVE	-3.048	-5.221 to -0.8748	Yes	**
P value summary	**	NaN vs. AA-NEGATIVE	-2.216	-4.362 to -0.07065	Yes	*
(P < 0.05)	Yes	NaN vs. EA-INACTIVE	-3.013	-5.503 to -0.5237	Yes	*
R square	0.4074	NaN vs. AA-INACTIVE	-2.596	-4.900 to -0.2908	Yes	*
TGFB2						
F	2.855					
P value	0.0266					
P value summary	*					
(P < 0.05)	Yes	Tukey's multiple comparisons test	Mean Diff.	95% CI of diff.	Significant?	Summary
R square	0.2582	EA-Negative vs. EA-Control	0.6554	0.06919 to 1.242	Yes	*

RNA expression patterns characteristic of cervical carcinomas (CxCaRNA)[49,53,56,62,63] are also being explored as markers of active HPV infection in OPSCC[49,53,62]. HPV status in formalin fixed paraffin embedded (FFPE) OPSCC specimens was recently assayed by immunohistochemical analysis of HPV linked genes such as p16INK4A, pRb, Cyclin D1 and p53. These studies determined that high p16INK4a combined with low pRb provided a reliable marker for active HPV16 infection[56]. Another study on FFPE OPSCC specimens employed a novel combinatorial strategy utilizing viral mRNA expression and in-situ hybridization for HPV DNA and mRNA, along with RT-qPCR for five genes functionally related to HPV (p53, Myc, Rb, p16 and p21). In this study, RT-qPCR and RNA *in-situ* hybridization for viral genes were found to be 100% concordant in assessing HPV status[64].

We categorized our OPSCC sample set for HPV status based on dual markers of viral DNA presence and viral RNA expression.

A recent study classified OPSCC tumors into HPV Active (DNA+RNA+), Inactive (DNA+RNA-) and Negative (DNA-RNA-) based on multiplex nested PCR for HPV E6 DNA and E6I/E1^E4 RNA[129]. Our algorithm involved INNO-LiPA based HPV DNA detection and determination of E7-E6/7 expression through RT-qPCR. Thus, tumors positive for both INNO-LiPA and E7-E6/7 RT-qPCR were classified as HPV Active, INNO-LiPA positive but E7-E6/7 RT-qPCR negative were classified as HPV Inactive and the ones which tested negative for both were classified as HPV Negative. Amongst the tumor samples that tested negative for HPV DNA by INNO-LiPA, one sample expressed HPV16 E7 mRNA and hence was categorized as HPV Active. We presume that the negative DNA result in this sample may be due to loss of the L1 ORF, perhaps a consequence of integration events. Our HPV typing and gene expression results led to two major conclusions that are concordant with recent trends: (1) the HPV status of a HNC cannot be defined solely by the presence of HPV DNA or by p16 expression patterns, rather a combination of several different markers is needed[53,5649,62]; (2) the presence of HPV DNA alone, in the absence of HPV gene expression, does not indicate a HPV-driven pathogenesis in OPSCC[94,129,204].

4.2.2 Prevalence of active HPV in OPSCC from European American and African American patients

The prevalence of HPV in our set of 56 OPSCC tumors was in agreement with previously reported trends: AA patients exhibited more HPV negative tumors as compared to EA patients[99,203–205]. HPV prevalence in African American patients has been previously studied using a variety of methods to assess HPV positivity, including the presence of HPV DNA[205], HPV DNA and p16INK4A expression[204], in-situ hybridization for HR-HPV[99] and more recently HPV16 DNA copy number[203]. However, to the best of our knowledge, no study has so far assessed the rate of HPV prevalence in AA and EA patients based on the combined presence of HPV DNA and expression of viral oncogenes. While prevalence measured by HPV DNA (INNO-LiPA) was a little less than twice in EA as compared to AA patients, the prevalence of active HPV by RNA (E7, E6/7 RT-qPCR) was four times higher in EA than in AA patients. Overall, the odds of EA patients having an HPV active cancer were 5.7 times higher than for AA patients. HPV16 was the dominant HR-HPV type detected overall, with HPV types of the alpha 9 genus (16, 35, 52 and 58) common in tumors from EA patients, and alpha 9 and alpha 10 genera (16 and 66) in AA patients. The observed trends in HPV prevalence and differential HPV type representation might derive from differences in lifestyle, sexual practices and possibly also genetic makeup of an individual which renders EA patients more susceptible to HPV infection.

4.2.3 Gene expression profiles of HPV-active, -inactive and –negative tumors in European American and African American patients

We further investigated the molecular differences among HPV-active, HPV-inactive and HPV-negative tumors from AA and EA patients by conducting differential gene expression analysis in 40 samples, 36 cancer and 4 normal. We had only one AA patient with an HPV-active tumor, and thus the analysis involving HPV active AA population was not performed.

Data are now available from landmark studies conducted to investigate the role of HPV in OPSCC with respect to gene expression patterns[82,89,147,187,192,241], genetic and epigenetic profiles[129,192,196,242,243], mutational landscape[109,112] and more recently a comprehensive study on a small set of samples targeting the four-omics: methylation, transcription, miRNA and genomic based analysis[192]. The molecular mechanisms governing HPV mediated OPSCC are better understood in view of these studies. The global CpG island differential methylation profile studied in HPV-active (DNA+/RNA+), HPV-inactive (DNA+/RNA-) and HPV-negative (DNA-/RNA-) OPSCC tumors categorized HPV-inactive group much more closer to the HPV-negatives[129] which is similar to our findings. Additionally, we could detect two (homeobox A6 (HOXA6) and Homo sapiens paired box 9 (PAX9)) of the 11 genes shortlisted from non-HPV driven tumors for massARRAY, in our DEG lists. We observed overexpression of HOXA6 and

PAX9 in HPV-active tumors when compared to HPV-negative and –inactive tumors, where HPV-inactive tumors exhibited an intermediate profile. These expression patterns can be directly related to hypermethylation of the respective gene promoters in HPV-negative tumors as listed in the previous study.

The novelty of our results lies in listing the differential expression patterns of OPSCC (HPV related and unrelated) arising in AA and EA patients. We observed that HPV-active OPSCC's segregated clearly from the HPV-inactive and HPV-negative group in the overall population. Further investigation of HPV-negative and -inactive tumors revealed clear differences between the two kinds of tumors within AA and EA patients. These observations support our hypothesis that differential patterns of gene expression distinguish not only HPV-inactive and HPV-negative tumors, but also tumors from AA and EA patients.

Hence, we can begin to define a new class of OPSCC tumors as those that harbor HPV DNA but lack expression of viral oncogenes. These HPV Inactive tumors were analyzed in comparison to HPV negative tumors within AA population, HPV negative and Active tumors within EA population and overall. Even though the HPV inactive OPSCC comprised only four tumor samples, the unsupervised hierarchical clustering of samples clustered them as a separate entity from the HPV actives entirely and somewhat from HPV negatives. We propose that such profiles indicate that HPV-inactive tumors might have originated as HPV-active, and have lost dependence on HPV during disease progression. With respect to HPV methylation studies[244], no clear understanding of the molecular and pathogenetic nuances of an "inactive" virus state is available so far.

4.2.4 Individual differentially-expressed genes that characterize HPV-active, -inactive and –negative tumors and may have relevance to pathogenesis

Recent studies have highlighted the relevance of tumor degradome components like matrix metalloproteinases (MMP's)[143,245–248] and a disintegrin and metalloproteinase domain 12 (ADAM12)[138,139] in the tumor progression of HPV negative OPSCC's. Our Microarray studies detected about 25 fold up-regulation for MMP10 and 23 fold for MMP13 in HPV-negative tumors as compared to the HPV-active tumors from EA patients while such differences were not observed in the total tumor pool, indicating that MMP's might act as a EA specific biomarker for EMT mediated disease progression in HPV negative tumors. Of note, are the differential expression profiles of MMP10[246,249,250] and MMP13 as the potential tumor and salivary biomarkers of disease progression in OSCC [246,248]. These studies emphasized that detection of MMP profile from saliva of OPSCC patients will provide us with a less invasive method to detect and monitor the growth of oral malignancies.

Within the subgroup of HPV negative tumors arising from two racial groups, we observed upregulation of ADAM12, MMP10 and MMP13, through microarray and RT-qPCR, in EA patients as compared to AA patients. We further confirmed the expression of three biomarkers (ADAM12, IL1B, MMP14), as given by IPA, through RT-qPCR. Other degradome components validated through RT-qPCR included- MMP7 and MMP14. Keratin15 was found reported as downregulated in all HNC and cervical cancers as compared to controls in a recent study[187] and our results showed similar levels of KRT15 in HPV-negative and HPV-inactive tumors as to that of controls, while an overexpression of the same was visible in HPV-active tumors.

We also assessed the expression levels of Notch1, a gene that has recently received considerable attention as an important determinant in HN carcinogenesis[109,112]. Notch1 functions as an oncogene in acute lymphoblastic leukemia[251] and tumor suppressor in HNSCC[112,161]. Notch1 dysregulation has been reported primarily due to activating point mutations of the same and differential expression patterns with respect to HNSCC haven't been reported. In a recent study, HPV16 E6 involvement overexpresses Notch1 in human keratinocytes[252]. Also, Notch1 has been implicated in proliferation and self-renewal of dental follical cells[253]. We could not observe any significant differential expression patterns for Notch1 between HPV-active and –negative tumors. However, Notch1 was found to be overexpressed in all tumors when compared to controls, while a trend of overexpression in HPV-active when compared to HPV-inactive and –negative could be faintly observed.

One interesting finding in our study samples was the significant overexpression of BRCA1 in HPV-active tumors as compared to the controls and HPV-negative tumors. A genome wide profiling of OSCC tumors revealed frequent alterations including gene amplifications within fanconi anemia related DNA damage response pathway including BRCA1[254]. BRCA1 has been reported to interact with zinc finger domain of E6 and E7 proteins *in vitro* without any proteolytic degradation of the former[255]. Thus, the overexpression of BRCA1 in HPV-active tumors when compared to HPV-negatives might explain a compensatory mechanism for E6-E7 binding of BRCA1 in the former.

The cytokine Interleukin 1-beta (IL1B) has been reported to convert normal periodontal ligament fibroblasts to tumor associated fibroblasts and further cause EMT in SCC-25 co-cultures[256] and was recently proposed as a biomarker for OSCC in unstimulated whole saliva from pre and post operation patients[257]. Overexpression of IL1B was observed in AA HPV-negative tumors in comparison to EA population, indicating a possible role of IL1B as a biomarker for HPV negative OPSCC's specific to tumors in AA patients. Myelin and lymphocyte-associated protein (MAL) is found to be down-regulated in HNSCC[258] and similar trend was observed in our set of samples with maximum down-regulation in EA HPV negative tumors as compared to AA HPV negative and EA HPV active tumors. We also validated the expression levels of an innate immunity linked gene- Toll-like Receptor 10 (TLR10) which plays a significant role in pathogen recognition and thus provides primary defense from invading pathogens. Downregulation of TLR10 was observed in HPV-active, -inactive and -negative tumors as opposed to the controls. While TP63 network and transcriptional targets of ΔNp63 isoforms were well represented in HPV negative tumors from both racial groups, the differential gene expression analysis revealed an emphasis on tumor degradome profile for OPSCC's arising from EA patients (MMP10, MMP13, ADAM12) as compared to tumor suppressor and cytokine based proliferation in AA patients (TGFβ2, IL1).

Another important biomarker considered in our analysis was c-MET oncogene. The c-MET/HGF pathway has been well studied in HNSCC with c-MET overexpression patterns are reported in 80% of cases[182,259,260] with its recent role as a potential cancer stem cell marker[136]. However, c-MET's role with respect to HPV has not yet been reported[134].

Our study indicates differential expression patterns of c-MET, with HPV negative tumors exhibiting maximum overexpression as compared to inactive and active tumors both in the general sample set and within the EA population. Additionally, HPV negative tumors arising from EA patients expressed higher levels of c-MET when compared to those of AA patients. This difference confirms the epithelial-mesenchymal transition and proliferative nature of HPV negative tumors, and also indicates that HPV negative tumors from EA patients may be driven by c-MET to a larger extent than those in AA patients.

Therefore, we propose a novel profile of differentially expressed biomarkers ($ADAM12^{hi}$, $MMP10^{hi}$, $MMP13^{hi}$, $c\text{-}MET^{hi}$, $IL1^{low}$, MAL^{low} and $TGF\beta2^{hi}$) for HPV negative tumors arising from European American vs African American patients. These biomarkers deserve further investigation as possible markers of particularly invasive, EMT-based tumor phenotypes amenable to differential therapeutic interventions.

4.3 Conclusion

In summary, our study allowed us to determine that HPV types other than HPV16 do not play an important role in OPSCC in EA or AA patients, and began dissecting the gene expression profiles of OPSCC in tumors from EA and AA patients, uncovering subtle but potentially important differences. In addition, the differential gene expression analysis of OPSCC samples revealed that HPV-negative and HPV-inactive tumors do not completely overlap in terms of gene expression profiles, suggesting that the HPV-inactive tumors may have arisen by yet a separate mechanism from both HPV-active and HPV-negative cancers. Further studies are needed, however, to fully explore this concept.

Our working hypothesis is that HPV-inactive tumors may begin as HPV-active lesions, and that in the course of tumor progression mutational events and/or epigenetic changes may re-direct the tumor development process along lines more similar to those of HPV-negative tumors. It will be of interest to assess how risk factors such as smoking and alcohol consumption behave in the patient population affected by HPV-inactive tumors.

CHAPTER 5- OVERALL DISCUSSION and FUTURE DIRECTIONS

5.1 Overall Discussion

Differential gene expression analysis of 36 OPSCC samples revealed that HPV-negative and HPV-inactive tumors clearly segregate from HPV-active OPSCC in terms of GO and DEGs (both within a Race and in the combined population). The significance of presence of viral DNA as sole criteria for HPV mediated tumorigenesis in OPSCC has been greatly subverted by growing emphasis on expression of viral oncogenes and its downstream regulators. This method of characterization results in more conclusive segregation of HPV driven tumors and our methodology for determining HPV status was in agreement with current norms.

We attempted to address a new group of HPV related OPSCC called HPV-inactive tumors with distinctive gene expression profiles within race and a somewhat intermediate ontology when compared to HPV-active and HPV-negative OPSCC's. These findings led us to hypothesize their probable origin as HPV-active tumors and a loss of dependence on HPV driven pathogenesis during later stages. Our results are in line with recent differential methylation profile of HPV-active, -inactive and negative tumors, with HPV-inactive tumors representing a more HPV-negative like profile with respect to methylation patterns. This segregation of HPV-related tumors into HPV-active and HPV-inactive will be beneficial in efficiently diagnosis and prognosis of the concerned malignancies.

5.2 Future Directions

The results from our study have opened various avenues of research and therapeutics for a novel subgroup of HPV-positive OPSCC, referred to as HPV-inactive tumors and highlighted the importance of HPV as a racially linked marker. In addition, specific molecular markers of malignancies within OPSCC tumors arising from AA and EA patients will help in addressing the issue of targeted therapeutics. The new age cancer therapeutics relies on the fundamentals of developing patient specific treatment which in turn depends on genetic, epigenetic and transcriptional profile of these tumors. Thus our study is a significant drop in the ocean of designing a definite cure for malignancies like OPSCC.

5.2.1 EGFR-MET crosstalk and p16INK4A status

EGFR overexpression and mutation patterns have been described in HNSCC[134], where constitutive activation of EGFR is well established in HPV-negative tumors[132]. It is known that a possible reason for failure of EGFR targeted therapeutics in HNSCC might be the crosstalk between MET and EGFR proteins which possibly substitutes for EGFR activity in these tumors[135]. A recent study on the association between EGFR variant III, HPV DNA, p16, c-MET, EGFR gene copy number and response to EGFR inhibitors in patients with recurrent or metastatic HNSCC detected 40% EGFR variant III mutation rate[261]. However, no clear association between role of active HPV infection and EGFR-MET expression was made as viral mRNA levels were not studied.

It would be of interest to study this profile in the given sample set, in view of c-MET expression patterns and racial distribution. Additionally, the relevance of p16INK4A as a surrogate biomarker for HPV positivity can be determined by comparing the viral oncogene expression levels to immunohistochemical analysis of the same.

5.2.2 Mutational profile of OPSCC by Race and HPV status

It would be informative to conduct a mutational analysis of 40 most commonly mutated genes in HNSCC, including MET, TP53, NOTCH1, EGFR, in these OPSCC samples and to attempt correlating mutation profiles with HPV status and gene expression profiles. This study would be done in view of currently published differential mutation profiles between HPV-positive and HPV-negative tumors from whole exome sequencing of 75 tumor-normal pairs[109], where HPV-positive tumors exhibited less mutations than HPV-negative HNSCC.

5.2.3 Host and Viral DNA methylation patterns

In view of recent studies concerning differential host DNA and viral methylation patterns from HPV-driven OPSCC[262,263], a comprehensive knowledge of methylation profile of viral DNA within the HPV–inactive tumors might help solve the puzzle as to why HPV becomes inactive in certain tumors and thus mediate HPV independent tumorigenesis. In addition, we may attempt to reproduce these mechanisms of "escape" from HPV in HPV-transformed human keratinocytes *in vitro.* We can answer the question of 'How' such HPV independence takes place in tumors by replicating these methylation patterns in-vitro and gain a deeper understanding of altered molecular pathways.

REFERENCES

1. Jemal A, Bray F, Center MM, Ferlay J, Ward E, Forman D. Global cancer statistics. *CA Cancer J Clin* 2011;61:69–90.

2. Curado MP, Boyle P. Epidemiology of head and neck squamous cell carcinoma not related to tobacco or alcohol. *Curr Opin Oncol* 2013;25:229–34.

3. Smith EM, Ritchie JM, Summersgill KF, Hoffman HT, Wang DH, Haugen TH, Turek LP. Human Papillomavirus in Oral Exfoliated Cells and Risk of Head and Neck Cancer. *JNCI J Natl Cancer Inst* 2004;96:449–55.

4. Ramqvist T, Dalianis T. Oropharyngeal cancer epidemic and human papillomavirus. *Emerg Infect Dis* 2010;16:1671–7.

5. Bouvard V, Baan R, Straif K, Grosse Y, Secretan B, Ghissassi F El, Benbrahim-Tallaa L, Guha N, Freeman C, Galichet L, Cogliano V. A review of human carcinogens—Part B: biological agents. *Lancet Oncol* 2009;10:321–2.

6. Boscolo-Rizzo P, Del Mistro A, Bussu F, Lupato V, Baboci L, Almadori G, DA Mosto MC, Paludetti G. New insights into human papillomavirus-associated head and neck squamous cell carcinoma. *Acta Otorhinolaryngol Ital* 2013;33:77–87.

7. Crile G. III. On the Technique of Operations upon the Head and Neck. *Ann Surg* 1906;44:842–50.

8. Bose P, Brockton NT, Dort JC. Head and neck cancer: from anatomy to biology. *Int J Cancer* 2013;

9. Braakhuis BJM, Brakenhoff RH, Meijer CJLM, Snijders PJF, Leemans CR. Human papilloma virus in head and neck cancer: the need for a standardised assay to assess the full clinical importance. *Eur J Cancer* 2009;45:2935–9.

10. Nichols AC, Dhaliwal SS, Palma D a, Basmaji J, Chapeskie C, Dowthwaite S, Franklin JH, Fung K, Kwan K, Wehrli B, Howlett C, Siddiqui I, et al. Does HPV type affect outcome in oropharyngeal cancer? *J Otolaryngol Head Neck Surg* 2013;42:9.

11. Auluck A, Hislop G, Bajdik C, Poh C, Zhang L, Rosin M. Trends in oropharyngeal and oral cavity cancer incidence of human papillomavirus (HPV)-related and HPV-unrelated sites in a multicultural population: the British Columbia experience. *Cancer* 2010;116:2635–44.

12. Kurdgelashvili G, Dores GM, Srour S a, Chaturvedi AK, Huycke MM, Devesa SS. Incidence of potentially human papillomavirus-related neoplasms in the United States, 1978 to 2007. *Cancer* 2013;119:2291–9.

13. Chaturvedi AK, Engels E a, Pfeiffer RM, Hernandez BY, Xiao W, Kim E, Jiang B, Goodman MT, Sibug-Saber M, Cozen W, Liu L, Lynch CF, et al. Human papillomavirus and rising oropharyngeal cancer incidence in the United States. *J Clin Oncol* 2011;29:4294–301.

14. Gillison ML, Broutian T, Pickard RKL, Tong Z, Xiao W, Kahle L, Graubard BI, Chaturvedi AK. Prevalence of oral HPV infection in the United States, 2009-2010. *JAMA* 2012;307:693–703.

15. D'Souza G, Kreimer AR, Viscidi R, Pawlita M, Fakhry C, Koch WM, Westra WH, Gillison ML. Case-control study of human papillomavirus and oropharyngeal cancer. *N Engl J Med* 2007;356:1944–56.

16. Sethi S, Ali-Fehmi R, Franceschi S, Struijk L, van Doorn L-J, Quint W, Albashiti B, Ibrahim M, Kato I. Characteristics and survival of head and neck cancer by HPV status: a cancer registry-based study. *Int J Cancer* 2012;131:1179–86.

17. Heath S, Willis V, Allan K, Purdie K, Harwood C, Shields P, Simcock R, Williams T, Gilbert DC. Clinically significant human papilloma virus in squamous cell carcinoma of the head and neck in UK practice. *Clin Oncol (R Coll Radiol)* 2012;24:e18–23.

18. Näsman A, Attner P, Hammarstedt L, Du J, Eriksson M, Giraud G, Ahrlund-Richter S, Marklund L, Romanitan M, Lindquist D, Ramqvist T, Lindholm J, et al. Incidence of human papillomavirus (HPV) positive tonsillar carcinoma in Stockholm, Sweden: an epidemic of viral-induced carcinoma? *Int J cancer J Int du cancer* 2009;125:362–6.

19. Anderson CE, McLaren KM, Rae F, Sanderson RJ, Cuschieri KS. Human papilloma virus in squamous carcinoma of the head and neck: a study of cases in south east Scotland. *J Clin Pathol* 2007;60:439–41.

20. Braakhuis BJM, Visser O, Leemans CR. Oral and oropharyngeal cancer in The Netherlands between 1989 and 2006: Increasing incidence, but not in young adults. *Oral Oncol* 2009;45:e85–9.

21. Cardesa A, Nadal A. Carcinoma of the head and neck in the HPV era. *Acta Dermatovenerol Alp Panonica Adriat* 2011;20:161–73.

22. De Villiers E-M. Cross-roads in the classification of papillomaviruses. *Virology* 2013;

23. Bernard H-U, Burk RD, Chen Z, van Doorslaer K, zur Hausen H, de Villiers E-M. Classification of papillomaviruses (PVs) based on 189 PV types and proposal of taxonomic amendments. *Virology* 2010;401:70–9.

24. Favre M. Structural polypeptides of rabbit, bovine, and human papillomaviruses. *J Virol* 1975;15:1239–47.

25. De Villiers E-M, Fauquet C, Broker TR, Bernard H-U, zur Hausen H. Classification of papillomaviruses. *Virology* 2004;324:17–27.

26. Bienkowska-Haba M, Sapp M. The cytoskeleton in papillomavirus infection. *Viruses* 2011;3:260–71.

27. Baker CC, Phelps WC, Lindgren V, Braun MJ, Gonda MA, Howley PM. Structural and transcriptional analysis of human papillomavirus type 16 sequences in cervical carcinoma cell lines. *J Virol* 1987;61:962–71.

28. Schwarz E, Freese UK, Gissmann L, Mayer W, Roggenbuck B, Stremlau A, zur Hausen H. Structure and transcription of human papillomavirus sequences in cervical carcinoma cells. *Nature* 1985;314:111–4.

29. Howie HL, Katzenellenbogen RA, Galloway DA. Papillomavirus E6 proteins. *Virology* 2009;384:324–34.

30. McLaughlin-Drubin ME, Münger K. The human papillomavirus E7 oncoprotein. *Virology* 2009;384:335–44.

31. Scheffner M, Werness BA, Huibregtse JM, Levine AJ, Howley PM. The E6 oncoprotein encoded by human papillomavirus types 16 and 18 promotes the degradation of p53. *Cell* 1990;63:1129–36.

32. Dyson N, Howley PM, Münger K, Harlow E. The human papilloma virus-16 E7 oncoprotein is able to bind to the retinoblastoma gene product. *Science* 1989;243:934–7.

33. Münger K, Baldwin A, Edwards KM, Hayakawa H, Nguyen CL, Owens M, Grace M, Huh K. Mechanisms of human papillomavirus-induced oncogenesis. *J Virol* 2004;78:11451–60.

34. Moody C a, Laimins L a. Human papillomavirus oncoproteins: pathways to transformation. *Nat Rev Cancer* 2010;10:550–60.

35. Gage JR, Meyers C, Wettstein FO. The E7 proteins of the nononcogenic human papillomavirus type 6b (HPV-6b) and of the oncogenic HPV-16 differ in retinoblastoma protein binding and other properties. *J Virol* 1990;64:723–30.

36. Münger K, Werness BA, Dyson N, Phelps WC, Harlow E, Howley PM. Complex formation of human papillomavirus E7 proteins with the retinoblastoma tumor suppressor gene product. *EMBO J* 1989;8:4099–105.

37. Andersen A, Sølling AS, Ovesen T, Rusan M. The interplay between HPV and host immunity in head and neck squamous cell carcinoma. *Acta Otorhinolaryngol Ital* 2013;

38. Werness BA, Münger K, Howley PM. Role of the human papillomavirus oncoproteins in transformation and carcinogenic progression. *Important Adv Oncol* 1991;:3–18.

39. Al-Bakkal G, Ficarra G, McNeill K, Eversole LR, Sterrantino G, Birek C. Human papilloma virus type 16 E6 gene expression in oral exophytic epithelial lesions as detected by in situ rtPCR. *Oral Surg Oral Med Oral Pathol Oral Radiol Endod* 1999;87:197–208.

40. Shin KH, Min BM, Cherrick HM, Park NH. Combined effects of human papillomavirus-18 and N-methyl-N'-nitro-N-nitrosoguanidine on the transformation of normal human oral keratinocytes. *Mol Carcinog* 1994;9:76–86.

41. Kim MS, Shin KH, Baek JH, Cherrick HM, Park NH. HPV-16, tobacco-specific N-nitrosamine, and N-methyl-N'-nitro-N-nitrosoguanidine in oral carcinogenesis. *Cancer Res* 1993;53:4811–6.

42. Campisi G, Panzarella V, Giuliani M, Lajolo C, Fede ODI, Falaschini S, Liberto CDI, Scully C, Muzio LLO, Di Fede O, Di Liberto C, Lo Muzio L. Human papillomavirus: its identity and controversial role in oral oncogenesis, premalignant and malignant lesions (review). *Int J Oncol* 2007;30:813–23.

43. Miller DL, Puricelli MD, Stack MS. Virology and molecular pathogenesis of HPV (human papillomavirus)-associated oropharyngeal squamous cell carcinoma. *Biochem J* 2012;443:339–53.

44. Khleif SN, DeGregori J, Yee CL, Otterson GA, Kaye FJ, Nevins JR, Howley PM. Inhibition of cyclin D-CDK4/CDK6 activity is associated with an E2F-mediated induction of cyclin kinase inhibitor activity. *Proc Natl Acad Sci U S A* 1996;93:4350–4.

45. Li Y, Nichols MA, Shay JW, Xiong Y. Transcriptional repression of the D-type cyclin-dependent kinase inhibitor p16 by the retinoblastoma susceptibility gene product pRb. *Cancer Res* 1994;54:6078–82.

46. Klaes R, Friedrich T, Spitkovsky D, Ridder R, Rudy W, Petry U, Dallenbach-Hellweg G, Schmidt D, von Knebel Doeberitz M. Overexpression of p16(INK4A) as a specific marker for dysplastic and neoplastic epithelial cells of the cervix uteri. *Int J Cancer* 2001;92:276–84.

47. Von Knebel Doeberitz M. New molecular tools for efficient screening of cervical cancer. *Dis Markers* 2001;17:123–8.

48. Wilson DD, Rahimi AS, Saylor DK, Stelow EB, Jameson MJ, Shonka DC, Reibel JF, Levine P a, Read PW. P16 Not a Prognostic Marker for Hypopharyngeal Squamous Cell Carcinoma. *Arch Otolaryngol Head Neck Surg* 2012;138:556–61.

49. Holzinger D, Schmitt M, Dyckhoff G, Benner A, Pawlita M, Bosch FX. Viral RNA patterns and high viral load reliably define oropharynx carcinomas with active HPV16 involvement. *Cancer Res* 2012;72:4993–5003.

50. White AE, Livanos EM, Tlsty TD. Differential disruption of genomic integrity and cell cycle regulation in normal human fibroblasts by the HPV oncoproteins. *Genes Dev* 1994;8:666–77.

51. Duensing S, Münger K. Mechanisms of genomic instability in human cancer: insights from studies with human papillomavirus oncoproteins. *Int J Cancer* 2004;109:157–62.

52. Weinberger PM, Yu Z, Haffty BG, Kowalski D, Harigopal M, Brandsma J, Sasaki C, Joe J, Camp RL, Rimm DL, Psyrri A. Molecular classification identifies a subset of human papillomavirus--associated oropharyngeal cancers with favorable prognosis. *J Clin Oncol* 2006;24:736–47.

53. Hoffmann M, Tribius S, Quabius ES, Henry H, Pfannenschmidt S, Burkhardt C, Görögh T, Halec G, Hoffmann AS, Kahn T, Röcken C, Haag J, et al. HPV DNA, E6*I-mRNA expression and p16INK4A immunohistochemistry in head and neck cancer - how valid is p16INK4A as surrogate marker? *Cancer Lett* 2012;323:88–96.

54. Liang C, Marsit CJ, McClean MD, Nelson HH, Christensen BC, Haddad RI, Clark JR, Wein RO, Grillone G a, Houseman EA, Halec G, Waterboer T, et al. Biomarkers of HPV in head and neck squamous cell carcinoma. *Cancer Res* 2012;72:5004–13.

55. Schache AG, Liloglou T, Risk JM, Filia A, Jones TM, Sheard J, Woolgar J a, Helliwell TR, Triantafyllou A, Robinson M, Sloan P, Harvey-Woodworth C, et al.

Evaluation of human papilloma virus diagnostic testing in oropharyngeal squamous cell carcinoma: sensitivity, specificity, and prognostic discrimination. *Clin Cancer Res* 2011;17:6262–71.

56. Holzinger D, Flechtenmacher C, Henfling N, Kaden I, Grabe N, Lahrmann B, Schmitt M, Hess J, Pawlita M, Bosch FX. Identification of oropharyngeal squamous cell carcinomas with active HPV16 involvement by immunohistochemical analysis of the retinoblastoma protein pathway. *Int J Cancer* 2013;133:1389–99.

57. Kleter B, van Doorn LJ, ter Schegget J, Schrauwen L, van Krimpen K, Burger M, ter Harmsel B, Quint W. Novel short-fragment PCR assay for highly sensitive broad-spectrum detection of anogenital human papillomaviruses. *Am J Pathol* 1998;153:1731–9.

58. Kleter B, van Doorn LJ, Schrauwen L, Molijn A, Sastrowijoto S, ter Schegget J, Lindeman J, ter Harmsel B, Burger M, Quint W. Development and clinical evaluation of a highly sensitive PCR-reverse hybridization line probe assay for detection and identification of anogenital human papillomavirus. *J Clin Microbiol* 1999;37:2508–17.

59. Smeets SJ, Hesselink AT, Speel E-JM, Haesevoets A, Snijders PJF, Pawlita M, Meijer CJLM, Braakhuis BJM, Leemans CR, Brakenhoff RH. A novel algorithm for reliable detection of human papillomavirus in paraffin embedded head and neck cancer specimen. *Int J Cancer* 2007;121:2465–72.

60. Dictor M, Warenholt J. Single-tube multiplex PCR using type-specific E6/E7 primers and capillary electrophoresis genotypes 21 human papillomaviruses in neoplasia. *Infect Agent Cancer* 2011;6:1.

61. Krane JF. Role of cytology in the diagnosis and management of HPV-associated head and neck carcinoma. *Acta Cytol* 2013;57:117–26.

62. Halec G, Schmitt M, Dondog B, Sharkhuu E, Wentzensen N, Gheit T, Tommasino M, Kommoss F, Bosch FX, Franceschi S, Clifford G, Gissmann L, et al. Biological activity of probable/possible high-risk human papillomavirus types in cervical cancer. *Int J Cancer* 2013;132:63–71.

63. Vormwald-Dogan V, Fischer B, Bludau H, Freese UK, Gissmann L, Glitz D, Schwartz E, Dürst M. Sense and antisense transcripts of human papillomavirus type 16 in cervical cancers. *J Gen Virol* 1992;73 (Pt 7):1833–8.

64. Gao G, Chernock RD, Gay H a, Thorstad WL, Zhang TR, Wang H, Ma X-J, Luo Y, Lewis JS, Wang X. A novel RT-PCR method for quantification of human papillomavirus transcripts in archived tissues and its application in oropharyngeal cancer prognosis. *Int J Cancer* 2013;132:882–90.

65. Wang Z, Gerstein M, Snyder M. RNA-Seq: a revolutionary tool for transcriptomics. *Nat Rev Genet* 2009;10:57–63.

66. Chen Y, Yao H, Thompson EJ, Tannir NM, Weinstein JN, Su X. VirusSeq: software to identify viruses and their integration sites using next-generation sequencing of human cancer tissue. *Bioinformatics* 2013;29:266–7.

67. Khoury JD, Tannir NM, Williams MD, Chen Y, Yao H, Zhang J, Thompson EJ, Meric-Bernstam F, Medeiros LJ, Weinstein JN, Su X. Landscape of DNA Virus Associations across Human Malignant Cancers: Analysis of 3,775 Cases Using RNA-Seq. *J Virol* 2013;87:8916–26.

68. Syrjänen S, Syrjänen K, Mäntyjärvi R, Collan Y, Kärjä J. Human papillomavirus DNA in squamous cell carcinomas of the larynx demonstrated by in situ DNA hybridization. *ORL J Otorhinolaryngol Relat Spec* 1987;49:175–86.

69. Syrjänen SM, Syrjänen KJ, Happonen RP. Human papillomavirus (HPV) DNA sequences in oral precancerous lesions and squamous cell carcinoma demonstrated by in situ hybridization. *J Oral Pathol* 1988;17:273–8.

70. Chang F, Syrjänen S, Nuutinen J, Kärjä J, Syrjänen K. Detection of human papillomavirus (HPV) DNA in oral squamous cell carcinomas by in situ hybridization and polymerase chain reaction. *Arch Dermatol Res* 1990;282:493–7.

71. Zeuss MS, Miller CS, White DK. In situ hybridization analysis of human papillomavirus DNA in oral mucosal lesions. *Oral Surg Oral Med Oral Pathol* 1991;71:714–20.

72. Holladay EB, Gerald WL. Viral gene detection in oral neoplasms using the polymerase chain reaction. *Am J Clin Pathol* 1993;100:36–40.

73. Ostwald C, Muller P, Barten M, Rutsatz K, Sonnenburg M, Milde-Langosch K, Loning T. Human papillomavirus DMA in oral squamous cell carcinomas and normal mucosa. *J Oral Pathol Med* 1994;23:220–5.

74. Balaram P, Nalinakumar KR, Abraham E, Balan A, Hareendran NK, Bernard H-U, Chan S-Y. Human papillomaviruses in 91 oral cancers from indian betel quid chewers—high prevalence and multiplicity of infections. *Int J Cancer* 1995;61:450–4.

75. Cruz IB, Snijders PJ, Steenbergen RD, Meijer CJ, Snow GB, Walboomers JM, van der Waal I. Age-dependence of human papillomavirus DNA presence in oral squamous cell carcinomas. *Eur J Cancer B Oral Oncol* 1996;32B:55–62.

76. Wilczynski SP, Lin BT, Xie Y, Paz IB. Detection of human papillomavirus DNA and oncoprotein overexpression are associated with distinct morphological patterns of tonsillar squamous cell carcinoma. *Am J Pathol* 1998;152:145–56.

77. Van Houten VM, Snijders PJ, van den Brekel MW, Kummer JA, Meijer CJ, van Leeuwen B, Denkers F, Smeele LE, Snow GB, Brakenhoff RH. Biological evidence that human papillomaviruses are etiologically involved in a subgroup of head and neck squamous cell carcinomas. *Int J Cancer* 2001;93:232–5.

78. Kojima A, Maeda H, Sugita Y, Tanaka S, Kameyama Y. Human papillomavirus type 38 infection in oral squamous cell carcinomas. *Oral Oncol* 2002;38:591–6.

79. Sugiyama M, Bhawal UK, Dohmen T, Ono S, Miyauchi M, Ishikawa T. Detection of human papillomavirus-16 and HPV-18 DNA in normal, dysplastic, and malignant oral epithelium. *Oral Surg Oral Med Oral Pathol Oral Radiol Endod* 2003;95:594–600.

80. Smith EM, Ritchie JM, Summersgill KF, Klussmann JP, Lee JH, Wang D, Haugen TH, Turek LP. Age, sexual behavior and human papillomavirus infection in oral cavity and oropharyngeal cancers. *Int J Cancer* 2004;108:766–72.

81. Koppikar P, deVilliers E-M, Mulherkar R. Identification of human papillomaviruses in tumors of the oral cavity in an Indian community. *Int J Cancer* 2005;113:946–50.

82. Slebos RJC, Yi Y, Ely K, Carter J, Evjen A, Zhang X, Shyr Y, Murphy BM, Cmelak AJ, Burkey BB, Netterville JL, Levy S, et al. Gene expression differences associated with human papillomavirus status in head and neck squamous cell carcinoma. *Clin Cancer Res* 2006;12:701–9.

83. Luo C-W, Roan C-H, Liu C-J. Human papillomaviruses in oral squamous cell carcinoma and pre-cancerous lesions detected by PCR-based gene-chip array. *Int J Oral Maxillofac Surg* 2007;36:153–8.

84. Zhang MQ, El-Mofty SK, DÃ¡vila RM. Detection of human papillomavirus-related squamous cell carcinoma cytologically and by in situ hybridization in fine-needle aspiration biopsies of cervical metastasis: a tool for identifying the site of an occult head and neck primary. *Cancer* 2008;114:118–23.

85. Chuang AY, Chuang TC, Chang S, Zhou S, Begum S, Westra WH, Ha PK, Koch WM, Califano JA. Presence of HPV DNA in convalescent salivary rinses is an adverse prognostic marker in head and neck squamous cell carcinoma. *Oral Oncol* 2008;44:915–9.

86. Simonato LE, Garcia JF, Sundefeld MLMM, Mattar NJ, Veronese L a, Miyahara GI. Detection of HPV in mouth floor squamous cell carcinoma and its correlation

with clinicopathologic variables, risk factors and survival. *J Oral Pathol Med* 2008;37:593–8.

87. Luginbuhl A, Sanders M, Spiro JD. Prevalence, morphology, and prognosis of human papillomavirus in tonsillar cancer. *Ann Otol Rhinol Laryngol* 2009;118:742–9.

88. Avissar M, McClean MD, Kelsey KT, Marsit CJ. MicroRNA expression in head and neck cancer associates with alcohol consumption and survival. *Carcinogenesis* 2009;30:2059–63.

89. Lohavanichbutr P, Houck J, Fan W, Yueh B, Mendez E, Futran N, Doody DR, Upton MP, Farwell DG, Schwartz SM, Zhao LP, Chen C. Genomewide gene expression profiles of HPV-positive and HPV-negative oropharyngeal cancer: potential implications for treatment choices. *Arch Otolaryngol Head Neck Surg* 2009;135:180–8.

90. Khovidhunkit SP, Buajeeb W, Sanguansin S, Poomsawat S, Weerapradist W. Detection of human papillomavirus in oral squamous cell carcinoma, leukoplakia and lichen planus in Thai patients. *Asian Pac J Cancer Prev* 9:771–5.

91. Gudleviciene Z, Smailyte G, Mickonas A, Pikelis A. Prevalence of human papillomavirus and other risk factors in Lithuanian patients with head and neck cancer. *Oncology* 2009;76:205–8.

92. Shi W, Kato H, Perez-Ordonez B, Pintilie M, Huang S, Hui A, O'Sullivan B, Waldron J, Cummings B, Kim J, Ringash J, Dawson LA, et al. Comparative prognostic value of HPV16 E6 mRNA compared with in situ hybridization for human oropharyngeal squamous carcinoma. *J Clin Oncol* 2009;27:6213–21.

93. Straetmans JMJ a a, Olthof N, Mooren JJ, de Jong J, Speel E-JM, Kremer B. Human papillomavirus reduces the prognostic value of nodal involvement in tonsillar squamous cell carcinomas. *Laryngoscope* 2009;119:1951–7.

94. Weinberger PM, Yu Z, Kountourakis P, Sasaki C, Haffty BG, Kowalski D, Merkley MA, Rimm DL, Camp RL, Psyrri A. Defining molecular phenotypes of human papillomavirus-associated oropharyngeal squamous cell carcinoma: validation of three-class hypothesis. *Otolaryngol neck Surg Off J Am Acad Otolaryngol Neck Surg* 2009;141:382–9.

95. Lassen P, Eriksen JG, Hamilton-Dutoit S, Tramm T, Alsner J, Overgaard J. HPV-associated p16-expression and response to hypoxic modification of radiotherapy in head and neck cancer. *Radiother Oncol* 2010;94:30–5.

96. Antonsson A, Spurr TP, Chen AC, Francis GD, McMillan NAJ, Saunders NA, Law M, Bennett IC. High prevalence of human papillomaviruses in fresh frozen breast cancer samples. *J Med Virol* 2011;83:2157–63.

97. Hoffmann M, Ihloff AS, Görögh T, Weise JB, Fazel A, Krams M, Rittgen W, Schwarz E, Kahn T. p16(INK4a) overexpression predicts translational active human papillomavirus infection in tonsillar cancer. *Int J Cancer* 2010;127:1595–602.

98. Attner P, Du J, Näsman A, Hammarstedt L, Ramqvist T, Lindholm J, Marklund L, Dalianis T, Munck-Wikland E. The role of human papillomavirus in the increased incidence of base of tongue cancer. *Int J Cancer* 2010;126:2879–84.

99. Chernock RD, Zhang Q, El-Mofty SK, Thorstad WL, Lewis JS. Human papillomavirus-related squamous cell carcinoma of the oropharynx: a comparative study in whites and African Americans. *Arch Otolaryngol Head Neck Surg* 2011;137:163–9.

100. Castillo A, Koriyama C, Higashi M, Anwar M, Bukhari MH, Carrascal E, Mancilla L, Okumura H, Matsumoto M, Sugihara K, Natsugoe S, Eizuru Y, et al. Human papillomavirus in upper digestive tract tumors from three countries. *World J Gastroenterol* 2011;17:5295–304.

101. Bishop J a, Maleki Z, Valsamakis A, Ogawa T, Chang X, Pai SI, Westra WH. Application of the hybrid capture 2 assay to squamous cell carcinomas of the head and neck: a convenient liquid-phase approach for the reliable determination of human papillomavirus status. *Cancer Cytopathol* 2012;120:18–25.

102. Byrd JK, Wilhoit CST, Fordham MT, Reeves TD, McCrackan TR, Nguyen SA, Sutkowski N, Gillespie MB. Predicting HPV Status in Head and Neck Cancer: The Predictive Value of Sociodemographic and Disease Characteristics. *Arch Otolaryngol Head Neck Surg* 2012;138:1155–9.

103. Pannone G, Rodolico V, Santoro A, Lo Muzio L, Franco R, Botti G, Aquino G, Pedicillo MC, Cagiano S, Campisi G, Rubini C, Papagerakis S, et al. Evaluation of a combined triple method to detect causative HPV in oral and oropharyngeal squamous cell carcinomas: p16 Immunohistochemistry, Consensus PCR HPV-DNA, and In Situ Hybridization. *Infect Agent Cancer* 2012;7:4.

104. Paquette C, Evans MF, Meer SS, Rajendran V, Adamson CS-C, Cooper K. Evidence That Alpha-9 Human Papillomavirus Infections are a Major Etiologic Factor for Oropharyngeal Carcinoma in Black South Africans. *Head Neck Pathol* 2013;

105. Lui VWY, Grandis JR. Primary chemotherapy and radiation as a treatment strategy for HPV-positive oropharyngeal cancer. *Head Neck Pathol* 2012;6 Suppl 1:S91–7.

106. FUTURE II Study Group. Quadrivalent vaccine against human papillomavirus to prevent high-grade cervical lesions. *N Engl J Med* 2007;356:1915–27.

107. Villa LL, Costa RLR, Petta C a, Andrade RP, Ault K a, Giuliano AR, Wheeler CM, Koutsky L a, Malm C, Lehtinen M, Skjeldestad FE, Olsson S-E, et al. Prophylactic quadrivalent human papillomavirus (types 6, 11, 16, and 18) L1 virus-like particle vaccine in young women: a randomised double-blind placebo-controlled multicentre phase II efficacy trial. *Lancet Oncol* 2005;6:271–8.

108. Szarewski A. Cervarix®: a bivalent vaccine against HPV types 16 and 18, with cross-protection against other high-risk HPV types. *Expert Rev Vaccines* 2012;11:645–57.

109. Stransky N, Egloff AM, Tward AD, Kostic AD, Cibulskis K, Sivachenko A, Kryukov G V, Lawrence MS, Sougnez C, McKenna A, Shefler E, Ramos AH, et al. The mutational landscape of head and neck squamous cell carcinoma. *Science* 2011;333:1157–60.

110. Nichols AC, Palma DA, Chow W, Tan S, Rajakumar C, Rizzo G, Fung K, Kwan K, Wehrli B, Winquist E, Koropatnick J, Mymryk JS, et al. High Frequency of Activating PIK3CA Mutations in Human Papillomavirus-Positive Oropharyngeal Cancer. *JAMA Otolaryngol Head Neck Surg* 2013;139:617–22.

111. Hunt JL, Barnes L, Lewis JS, Mahfouz ME, Slootweg PJ, Thompson LDR, Cardesa A, Devaney KO, Gnepp DR, Westra WH, Rodrigo JP, Woolgar J a, et al. Molecular diagnostic alterations in squamous cell carcinoma of the head and neck and potential diagnostic applications. *Eur Arch Otorhinolaryngol* 2013;

112. Agrawal N, Frederick MJ, Pickering CR, Bettegowda C, Chang K, Li RJ, Fakhry C, Xie T-X, Zhang J, Wang J, Zhang N, El-Naggar AK, et al. Exome sequencing of head and neck squamous cell carcinoma reveals inactivating mutations in NOTCH1. *Science* 2011;333:1154–7.

113. Loeffler-Ragg J, Witsch-Baumgartner M, Tzankov A, Hilbe W, Schwentner I, Sprinzl GM, Utermann G, Zwierzina H. Low incidence of mutations in EGFR kinase domain in Caucasian patients with head and neck squamous cell carcinoma. *Eur J Cancer* 2006;42:109–11.

114. Van Houten VMM, Tabor MP, van den Brekel MWM, Kummer JA, Denkers F, Dijkstra J, Leemans R, van der Waal I, Snow GB, Brakenhoff RH. Mutated p53 as a molecular marker for the diagnosis of head and neck cancer. *J Pathol* 2002;198:476–86.

115. Braakhuis BJM, Snijders PJF, Keune W-JH, Meijer CJLM, Ruijter-Schippers HJ, Leemans CR, Brakenhoff RH. Genetic patterns in head and neck cancers that contain or lack transcriptionally active human papillomavirus. *J Natl Cancer Inst* 2004;96:998–1006.

116. Loyo M, Li RJ, Bettegowda C, Pickering CR, Frederick MJ, Myers JN, Agrawal N. Lessons learned from next-generation sequencing in head and neck cancer. *Head Neck* 2013;35:454–63.

117. Rothenberg SM, Ellisen LW. The molecular pathogenesis of head and neck squamous cell carcinoma. *J Clin Invest* 2012;122:1951–7.

118. Ehrich M, Nelson MR, Stanssens P, Zabeau M, Liloglou T, Xinarianos G, Cantor CR, Field JK, van den Boom D. Quantitative high-throughput analysis of DNA methylation patterns by base-specific cleavage and mass spectrometry. *Proc Natl Acad Sci U S A* 2005;102:15785–90.

119. Dahlgren L, Mellin H, Wangsa D, Heselmeyer-Haddad K, Björnestål L, Lindholm J, Munck-Wikland E, Auer G, Ried T, Dalianis T. Comparative genomic hybridization analysis of tonsillar cancer reveals a different pattern of genomic imbalances in human papillomavirus-positive and -negative tumors. *Int J Cancer* 2003;107:244–9.

120. Smeets SJ, Braakhuis BJM, Abbas S, Snijders PJF, Ylstra B, van de Wiel MA, Meijer GA, Leemans CR, Brakenhoff RH. Genome-wide DNA copy number alterations in head and neck squamous cell carcinomas with or without oncogene-expressing human papillomavirus. *Oncogene* 2006;25:2558–64.

121. Wilting SM, Smeets SJ, Snijders PJF, van Wieringen WN, van de Wiel MA, Meijer GA, Ylstra B, Leemans CR, Meijer CJLM, Brakenhoff RH, Braakhuis BJM, Steenbergen RDM. Genomic profiling identifies common HPV-associated chromosomal alterations in squamous cell carcinomas of cervix and head and neck. *BMC Med Genomics* 2009;2:32.

122. Klussmann JP, Mooren JJ, Lehnen M, Claessen SMH, Stenner M, Huebbers CU, Weissenborn SJ, Wedemeyer I, Preuss SF, Straetmans JMJAA, Manni JJ, Hopman AHN, et al. Genetic signatures of HPV-related and unrelated oropharyngeal carcinoma and their prognostic implications. *Clin Cancer Res* 2009;15:1779–86.

123. Pradhan S. Recombinant Human DNA (Cytosine-5) Methyltransferase. I. EXPRESSION, PURIFICATION, AND COMPARISON OF DE NOVO AND MAINTENANCE METHYLATION. *J Biol Chem* 1999;274:33002–10.

124. Szyf M, Detich N. Regulation of the DNA methylation machinery and its role in cellular transformation. *Prog Nucleic Acid Res Mol Biol* 2001;69:47–79.

125. Costello JF, Plass C. Methylation matters. *J Med Genet* 2001;38:285–303.

126. Feinberg AP. Cancer epigenetics takes center stage. *Proc Natl Acad Sci U S A* 2001;98:392–4.

127. Costello JF, Frühwald MC, Smiraglia DJ, Rush LJ, Robertson GP, Gao X, Wright F a, Feramisco JD, Peltomäki P, Lang JC, Schuller DE, Yu L, et al. Aberrant CpG-island methylation has non-random and tumour-type-specific patterns. *Nat Genet* 2000;24:132–8.

128. Jones P a, Baylin SB. The fundamental role of epigenetic events in cancer. *Nat Rev Genet* 2002;3:415–28.

129. Kostareli E, Holzinger D, Bogatyrova O, Hielscher T, Wichmann G, Keck M, Lahrmann B, Grabe N, Flechtenmacher C, Schmidt CR, Seiwert T, Dyckhoff G, et al. HPV-related methylation signature predicts survival in oropharyngeal squamous cell carcinomas. *J Clin Invest* 2013;123:2488–501.

130. Discovery C, April PO. TCGA Sees Heterogeneity in Head and Neck Cancers. *Cancer Discov* 2013;3:475–6.

131. Roberts SA, Lawrence MS, Klimczak LJ, Grimm SA, Fargo D, Stojanov P, Kiezun A, Kryukov G V, Carter SL, Saksena G, Harris S, Shah RR, et al. An APOBEC cytidine deaminase mutagenesis pattern is widespread in human cancers. *Nat Genet* 2013;45:970–6.

132. Uribe P, Gonzalez S. Epidermal growth factor receptor (EGFR) and squamous cell carcinoma of the skin: molecular bases for EGFR-targeted therapy. *Pathol Res Pract* 2011;207:337–42.

133. Chung CH, Parker JS, Karaca G, Wu J, Funkhouser WK, Moore D, Butterfoss D, Xiang D, Zanation A, Yin X, Shockley WW, Weissler MC, et al. Molecular classification of head and neck squamous cell carcinomas using patterns of gene expression. *Cancer Cell* 2004;5:489–500.

134. Burtness B, Bauman JE, Galloway T. Novel targets in HPV-negative head and neck cancer: overcoming resistance to EGFR inhibition. *Lancet Oncol* 2013;14:e302–9.

135. Karamouzis M V, Konstantinopoulos P a, Papavassiliou AG. Targeting MET as a strategy to overcome crosstalk-related resistance to EGFR inhibitors. *Lancet Oncol* 2009;10:709–17.

136. Sun S, Wang Z. Head neck squamous cell carcinoma c-Met$^+$ cells display cancer stem cell properties and are responsible for cisplatin-resistance and metastasis. *Int J Cancer* 2011;129:2337–48.

137. Hwang C-I, Matoso A, Corney DC, Flesken-Nikitin A, Körner S, Wang W, Boccaccio C, Thorgeirsson SS, Comoglio PM, Hermeking H, Nikitin AY. Wild-type p53 controls cell motility and invasion by dual regulation of MET expression. *Proc Natl Acad Sci U S A* 2011;108:14240–5.

138. Stokes A, Joutsa J, Ala-Aho R, Pitchers M, Pennington CJ, Martin C, Premachandra DJ, Okada Y, Peltonen J, Grénman R, James H a, Edwards DR, et al. Expression profiles and clinical correlations of degradome components in the tumor microenvironment of head and neck squamous cell carcinoma. *Clin Cancer Res* 2010;16:2022–35.

139. Rao VH, Kandel A, Lynch D, Pena Z, Marwaha N, Deng C, Watson P, Hansen L a. A positive feedback loop between HER2 and ADAM12 in human head and neck cancer cells increases migration and invasion. *Oncogene* 2012;31:2888–98.

140. Luukkaa M, Vihinen P, Kronqvist P, Vahlberg T, Pyrhönen S, Kähäri V-M, Grénman R. Association between high collagenase-3 expression levels and poor prognosis in patients with head and neck cancer. *Head Neck* 2006;28:225–34.

141. Dünne a a, Mandic R, Falkenberg S, Dalchow C V, Sesterhenn a M, Werner J a. RT-PCR expression profiling of matrix metalloproteinases and their specific inhibitors in cell lines and fresh biopsies of squamous cell carcinomas of the head and neck. *In Vivo* 2005;19:943–8.

142. O-Charoenrat P, Rhys-Evans PH, Eccles SA. Expression of matrix metalloproteinases and their inhibitors correlates with invasion and metastasis in squamous cell carcinoma of the head and neck. *Arch Otolaryngol Head Neck Surg* 2001;127:813–20.

143. Johansson N, Airola K, Grénman R, Kariniemi AL, Saarialho-Kere U, Kähäri VM. Expression of collagenase-3 (matrix metalloproteinase-13) in squamous cell carcinomas of the head and neck. *Am J Pathol* 1997;151:499–508.

144. Rosenthal EL, McCrory A, Talbert M, Carroll W, Magnuson JS, Peters GE. Expression of proteolytic enzymes in head and neck cancer-associated fibroblasts. *Arch Otolaryngol Head Neck Surg* 2004;130:943–7.

145. Akgül B, Pfefferle R, Marcuzzi GP, Zigrino P, Krieg T, Pfister H, Mauch C. Expression of matrix metalloproteinase (MMP)-2, MMP-9, MMP-13, and MT1-MMP in skin tumors of human papillomavirus type 8 transgenic mice. *Exp Dermatol* 2006;15:35–42.

146. Faber A, Sauter A, Hoedt S, Hoermann K, Erben P, Hofheinz R-D, Sommer U, Stern-Straeter J, Schultz DJ. Alteration of MMP-2 and -14 expression by imatinib in HPV-positive and -negative squamous cell carcinoma. *Oncol Rep* 2012;28:172–8.

147. Martinez I, Wang J, Hobson KF, Ferris RL, Khan S a. Identification of differentially expressed genes in HPV-positive and HPV-negative oropharyngeal squamous cell carcinomas. *Eur J Cancer* 2007;43:415–32.

148. Li J, Feng C, Lu Y, Li H, Tu Z, Liao G, Liang C. mRNA expression of the DNA replication-initiation proteins in epithelial dysplasia and squamous cell carcinoma of the tongue. *BMC Cancer* 2008;8:395.

149. Howard JD, Lu B, Chung CH. Therapeutic targets in head and neck squamous cell carcinoma: identification, evaluation, and clinical translation. *Oral Oncol* 2012;48:10–7.

150. Muro-Cacho CA, Rosario-Ortiz K, Livingston S, Muñoz-Antonia T. Defective transforming growth factor beta signaling pathway in head and neck squamous cell carcinoma as evidenced by the lack of expression of activated Smad2. *Clin Cancer Res* 2001;7:1618–26.

151. Saiki Y, Ogawa T, Shiga K, Sunamura M, Kobayashi T, Horii A. A Human Head and Neck Squamous Cell Carcinoma Cell Line with Acquired cis-Diamminedichloroplatinum-Resistance Shows Remarkable Upregulation of BRCA1 and Hypersensitivity to Taxane. *Int J Otolaryngol* 2011;2011:521852.

152. Oh S-H, Kim W-Y, Lee O-H, Kang J-H, Woo J-K, Kim J-H, Glisson B, Lee H-Y. Insulin-like growth factor binding protein-3 suppresses vascular endothelial growth factor expression and tumor angiogenesis in head and neck squamous cell carcinoma. *Cancer Sci* 2012;103:1259–66.

153. Radisky DC. Defining a role for the homeoprotein Six1 in EMT and mammary tumorigenesis. *J Clin Invest* 2009;119:2528–31.

154. Skinner HD, Sandulache VC, Ow TJ, Meyn RE, Yordy JS, Beadle BM, Fitzgerald AL, Giri U, Ang KK, Myers JN. TP53 disruptive mutations lead to head and neck cancer treatment failure through inhibition of radiation-induced senescence. *Clin Cancer Res* 2012;18:290–300.

155. El-Deiry WS. Regulation ofp53downstream genes. *Semin Cancer Biol* 1998;8:345–57.

156. Miyashita T, Reed JC. Tumor suppressor p53 is a direct transcriptional activator of the human bax gene. *Cell* 1995;80:293–9.

157. Vogelstein B, Lane D, Levine a J. Surfing the p53 network. *Nature* 2000;408:307–10.

158. Khuri FR, Nemunaitis J, Ganly I, Arseneau J, Tannock IF, Romel L, Gore M, Ironside J, MacDougall RH, Heise C, Randlev B, Gillenwater AM, et al. a

controlled trial of intratumoral ONYX-015, a selectively-replicating adenovirus, in combination with cisplatin and 5-fluorouracil in patients with recurrent head and neck cancer. *Nat Med* 2000;6:879–85.

159. Nemunaitis J, Clayman G, Agarwala SS, Hrushesky W, Wells JR, Moore C, Hamm J, Yoo G, Baselga J, Murphy B a, Menander K a, Licato LL, et al. Biomarkers Predict p53 Gene Therapy Efficacy in Recurrent Squamous Cell Carcinoma of the Head and Neck. *Clin Cancer Res* 2009;15:7719–25.

160. Nemunaitis J, Nemunaitis J. Head and neck cancer: response to p53-based therapeutics. *Head Neck* 2011;33:131–4.

161. Nicolas M, Wolfer A, Raj K, Kummer JA, Mill P, van Noort M, Hui C, Clevers H, Dotto GP, Radtke F. Notch1 functions as a tumor suppressor in mouse skin. *Nat Genet* 2003;33:416–21.

162. Troy JD, Weissfeld JL, Youk AO, Thomas S, Wang L, Grandis JR. Expression of EGFR, VEGF, and NOTCH1 Suggest Differences in Tumor Angiogenesis in HPV-Positive and HPV-Negative Head and Neck Squamous Cell Carcinoma. *Head Neck Pathol* 2013;

163. Dotto GP. Notch tumor suppressor function. *Oncogene* 2008;27:5115–23.

164. Hombach-Klonisch S, Paranjothy T, Wiechec E, Pocar P, Mustafa T, Seifert A, Zahl C, Gerlach KL, Biermann K, Steger K, Hoang-Vu C, Schulze-Osthoff K, et al. Cancer stem cells as targets for cancer therapy: selected cancers as examples. *Arch Immunol Ther Exp (Warsz)* 2010;56:165–80.

165. Ellisen LW, Bird J, West DC, Soreng AL, Reynolds TC, Smith SD, Sklar J. TAN-1, the human homolog of the Drosophila Notch gene, is broken by chromosomal translocations in T lymphoblastic neoplasms. *Cell* 1991;66:649–61.

166. Felthaus O, Ettl T, Gosau M, Driemel O, Brockhoff G, Reck A, Zeitler K, Hautmann M, Reichert TE, Schmalz G, Morsczeck C. Cancer stem cell-like cells from a single cell of oral squamous carcinoma cell lines. *Biochem Biophys Res Commun* 2011;407:28–33.

167. Curry CL, Reed LL, Golde TE, Miele L, Nickoloff BJ, Foreman KE. Gamma secretase inhibitor blocks Notch activation and induces apoptosis in Kaposi's sarcoma tumor cells. *Oncogene* 2005;24:6333–44.

168. Fortini ME. Gamma-secretase-mediated proteolysis in cell-surface-receptor signalling. *Nat Rev Mol Cell Biol* 2002;3:673–84.

169. NCT00756717. Study Of MK-0752 In Combination With Tamoxifen Or Letrozole to Treat Early Stage Breast Cancer.

170. Paterson IC, Eveson JW, Prime SS. Molecular changes in oral cancer may reflect aetiology and ethnic origin. *Eur J Cancer B Oral Oncol* 1996;32B:150–3.

171. Bos JL. ras oncogenes in human cancer: a review. *Cancer Res* 1989;49:4682–9.

172. Downward J. Targeting RAS signalling pathways in cancer therapy. *Nat Rev Cancer* 2003;3:11–22.

173. Lechner M, Frampton GM, Fenton T, Feber A, Palmer G, Jay A, Pillay N, Forster M, Cronin MT, Lipson D, Miller VA, Brennan TA, et al. Targeted next-generation sequencing of head and neck squamous cell carcinoma identifies novel genetic alterations in HPV+ and HPV- tumors. *Genome Med* 2013;5:49.

174. Matthaios D, Zarogoulidis P, Balgouranidou I, Chatzaki E, Kakolyris S. Molecular pathogenesis of pancreatic cancer and clinical perspectives. *Oncology* 2011;81:259–72.

175. Rogers SJ, Box C, Harrington KJ, Nutting C, Rhys-Evans P, Eccles SA. The phosphoinositide 3-kinase signalling pathway as a therapeutic target in squamous cell carcinoma of the head and neck. *Expert Opin Ther Targets* 2005;9:769–90.

176. Bjornsti M-A, Houghton PJ. The TOR pathway: a target for cancer therapy. *Nat Rev Cancer* 2004;4:335–48.

177. Castellano E, Downward J. Role of RAS in the regulation of PI 3-kinase. *Curr Top Microbiol Immunol* 2010;346:143–69.

178. Sliva D. Signaling pathways responsible for cancer cell invasion as targets for cancer therapy. *Curr Cancer Drug Targets* 2004;4:327–36.

179. Morgan DO. Principles of CDK regulation. *Nature* 1995;374:131–4.

180. Reed a L, Califano J, Cairns P, Westra WH, Jones RM, Koch W, Ahrendt S, Eby Y, Sewell D, Nawroz H, Bartek J, Sidransky D. High frequency of p16 (CDKN2/MTS-1/INK4A) inactivation in head and neck squamous cell carcinoma. *Cancer Res* 1996;56:3630–3.

181. Molinolo AA, Hewitt SM, Amornphimoltham P, Keelawat S, Rangdaeng S, Meneses García A, Raimondi AR, Jufe R, Itoiz M, Gao Y, Saranath D, Kaleebi GS, et al. Dissecting the Akt/mammalian target of rapamycin signaling network: emerging results from the head and neck cancer tissue array initiative. *Clin Cancer Res* 2007;13:4964–73.

182. Knowles LM, Stabile LP, Egloff AM, Rothstein ME, Thomas SM, Gubish CT, Lerner EC, Seethala RR, Suzuki S, Quesnelle KM, Morgan S, Ferris RL, et al.

HGF and c-Met participate in paracrine tumorigenic pathways in head and neck squamous cell cancer. *Clin Cancer Res* 2009;15:3740–50.

183. Sierra JR, Tsao M-S. c-MET as a potential therapeutic target and biomarker in cancer. *Ther Adv Med Oncol* 2011;3:S21–35.

184. Hama T, Yuza Y, Suda T, Saito Y, Norizoe C, Kato T, Moriyama H, Urashima M. Functional mutation analysis of EGFR family genes and corresponding lymph node metastases in head and neck squamous cell carcinoma. *Clin Exp Metastasis* 2012;29:19–25.

185. Weichselbaum RR, Dunphy EJ, Beckett MA, Tybor AG, Moran WJ, Goldman ME, Vokes EE, Panje WR. Epidermal growth factor receptor gene amplification and expression in head and neck cancer cell lines. *Head Neck* 1989;11:437–42.

186. Clinical Trials of FDA-Approved Drugs for Targeted Therapies - National Cancer Institute [Internet]. [cited 2013 Sep 23];Available from: http://www.cancer.gov/cancertopics/understandingcancer/targetedtherapies/fda-approveddrugs

187. Pyeon D, Newton M a, Lambert PF, den Boon J a, Sengupta S, Marsit CJ, Woodworth CD, Connor JP, Haugen TH, Smith EM, Kelsey KT, Turek LP, et al. Fundamental differences in cell cycle deregulation in human papillomavirus-positive and human papillomavirus-negative head/neck and cervical cancers. *Cancer Res* 2007;67:4605–19.

188. Wansom D, Light E, Worden F, Prince M, Urba S, Chepeha DB, Cordell K, Eisbruch A, Taylor J, D'Silva N, Moyer J, Bradford CR, et al. Correlation of cellular immunity with human papillomavirus 16 status and outcome in patients with advanced oropharyngeal cancer. *Arch Otolaryngol Head Neck Surg* 2010;136:1267–73.

189. Turksma A, Bontkes H, van den Heuvel H, de Gruijl T, von Blomberg B, Braakhuis B, Leemans C, Bloemena E, Meijer C, Hooijberg E. Effector memory T-cell frequencies in relation to tumour stage, location and HPV status in HNSCC patients. *Oral Dis* 2013;19:577–84.

190. Näsman A, Romanitan M, Nordfors C, Grün N, Johansson H, Hammarstedt L, Marklund L, Munck-Wikland E, Dalianis T, Ramqvist T. Tumor infiltrating CD8+ and Foxp3+ lymphocytes correlate to clinical outcome and human papillomavirus (HPV) status in tonsillar cancer. *PLoS One* 2012;7:e38711.

191. Thurlow JK, Peña Murillo CL, Hunter KD, Buffa FM, Patiar S, Betts G, West CML, Harris AL, Parkinson EK, Harrison PR, Ozanne BW, Partridge M, et al. Spectral clustering of microarray data elucidates the roles of microenvironment

remodeling and immune responses in survival of head and neck squamous cell carcinoma. *J Clin Oncol* 2010;28:2881–8.

192. Jung a. C, Job S, Ledrappier S, Macabre C, Abecassis J, de Reynies a., Wasylyk B. A Poor Prognosis Subtype of HNSCC Is Consistently Observed across Methylome, Transcriptome, and miRNome Analysis. *Clin Cancer Res* 2013;19:4174–84.

193. Walter V, Yin X, Wilkerson MD, Cabanski CR, Zhao N, Du Y, Ang MK, Hayward MC, Salazar AH, Hoadley K a, Fritchie K, Sailey CG, et al. Molecular subtypes in head and neck cancer exhibit distinct patterns of chromosomal gain and loss of canonical cancer genes. *PLoS One* 2013;8:e56823.

194. Barretina J, Caponigro G, Stransky N, Venkatesan K, Margolin AA, Kim S, Wilson CJ, Lehár J, Kryukov G V, Sonkin D, Reddy A, Liu M, et al. The Cancer Cell Line Encyclopedia enables predictive modelling of anticancer drug sensitivity. *Nature* 2012;483:603–7.

195. Wilkerson MD, Yin X, Hoadley KA, Liu Y, Hayward MC, Cabanski CR, Muldrew K, Miller CR, Randell SH, Socinski MA, Parsons AM, Funkhouser WK, et al. Lung squamous cell carcinoma mRNA expression subtypes are reproducible, clinically important, and correspond to normal cell types. *Clin Cancer Res* 2010;16:4864–75.

196. Lleras R, Smith R V, Adrien LR, Schlecht NF, Burk RD, Harris T, Childs G, Prystowsky MB, Belbin TJ. Unique DNA Methylation Loci Distinguish Anatomic Site and HPV Status in Head and Neck Squamous Cell Carcinoma. *Clin Cancer Res* 2013;

197. Kanazawa T, Misawa K, Carey TE. Galanin receptor subtypes 1 and 2 as therapeutic targets in head and neck squamous cell carcinoma. *Expert Opin Ther Targets* 2010;14:289–302.

198. Joseph AW, D'Souza G. Epidemiology of human papillomavirus-related head and neck cancer. *Otolaryngol Clin North Am* 2012;45:739–64.

199. Ferlay J, Shin H-R, Bray F, Forman D, Mathers C, Parkin DM. Estimates of worldwide burden of cancer in 2008: GLOBOCAN 2008. *Int J Cancer* 2010;127:2893–917.

200. Gillison ML, D'Souza G, Westra W, Sugar E, Xiao W, Begum S, Viscidi R. Distinct risk factor profiles for human papillomavirus type 16-positive and human papillomavirus type 16-negative head and neck cancers. *J Natl Cancer Inst* 2008;100:407–20.

201. Falter Ii KJ, Frimer M, Lavy D, Samuelson R, Shahabi S. Human papillomavirusassociated cancers as acquired immunodeficiency syndrome defining illnesses. *Rare Tumors* 2013;5:93–4.

202. Beachler DC, D'souza G. Oral human papillomavirus infection and head and neck cancers in HIV-infected individuals. *Curr Opin Oncol* 2013;

203. Worsham MJ, Stephen JK, Chen KM, Mahan M, Schweitzer V, Havard S, Divine G. Improved survival with HPV among African Americans with oropharyngeal cancer. *Clin Cancer Res* 2013;19:2486–92.

204. Weinberger PM, Merkley MA, Khichi SS, Lee JR, Psyrri A, Jackson LL, Dynan WS. Human papillomavirus-active head and neck cancer and ethnic health disparities. *Laryngoscope* 2010;120:1531–7.

205. Settle K, Posner MR, Schumaker LM, Tan M, Suntharalingam M, Goloubeva O, Strome SE, Haddad RI, Patel SS, Cambell E V, Sarlis N, Lorch J, et al. Racial survival disparity in head and neck cancer results from low prevalence of human papillomavirus infection in black oropharyngeal cancer patients. *Cancer Prev Res (Phila)* 2009;2:776–81.

206. Yen KL, Horner M-JD, Reed SG, Daguise VG, Bolick-aldrich SW, Young MRI, Day TA, Wood PA, Hebert JR, Epidemiology CTRD. Head and neck cancer disparities in South Carolina: descriptive epidemiology, early detection, and special programs. *J S C Med Assoc* 2006;102:192–200.

207. Cole L, Polfus L, Peters ES. Examining the incidence of human papillomavirus-associated head and neck cancers by race and ethnicity in the U.S., 1995-2005. *PLoS One* 2012;7:e32657.

208. Heid C a, Stevens J, Livak KJ, Williams PM. Real time quantitative PCR. *Genome Res* 1996;6:986–94.

209. Gibson UE, Heid C a, Williams PM. A novel method for real time quantitative RT-PCR. *Genome Res* 1996;6:995–1001.

210. Taylor S, Wakem M, Dijkman G, Alsarraj M, Nguyen M. A practical approach to RT-qPCR-Publishing data that conform to the MIQE guidelines. *Methods* 2010;50:S1–5.

211. Bustin S a. Quantification of mRNA using real-time reverse transcription PCR (RT-PCR): trends and problems. *J Mol Endocrinol* 2002;29:23–39.

212. Bustin S a. Why the need for qPCR publication guidelines?--The case for MIQE. *Methods* 2010;50:217–26.

213. Karlen Y, McNair A, Perseguers S, Mazza C, Mermod N. Statistical significance of quantitative PCR. *BMC Bioinformatics* 2007;8:131.

214. Bustin S a, Benes V, Garson J a, Hellemans J, Huggett J, Kubista M, Mueller R, Nolan T, Pfaffl MW, Shipley GL, Vandesompele J, Wittwer CT. The MIQE guidelines: minimum information for publication of quantitative real-time PCR experiments. *Clin Chem* 2009;55:611–22.

215. Lefever S, Hellemans J, Pattyn F, Przybylski DR, Taylor C, Geurts R, Untergasser A, Vandesompele J. RDML: structured language and reporting guidelines for real-time quantitative PCR data. *Nucleic Acids Res* 2009;37:2065–9.

216. Livak KJ, Schmittgen TD. Analysis of relative gene expression data using real-time quantitative PCR and the 2(-Delta Delta C(T)) Method. *Methods San Diego Calif* 2001;25:402–8.

217. Pfaffl MW. A new mathematical model for relative quantification in real-time RT–PCR. *Nucleic Acids Res* 2001;29:e45.

218. Pfaffl MW, Horgan GW, Dempfle L. Relative expression software tool (REST) for group-wise comparison and statistical analysis of relative expression results in real-time PCR. *Nucleic Acids Res* 2002;30:e36.

219. Pfaffl MW, Tichopad A, Prgomet C, Neuvians TP. Determination of stable housekeeping genes, differentially regulated target genes and sample integrity: BestKeeper--Excel-based tool using pair-wise correlations. *Biotechnol Lett* 2004;26:509–15.

220. Vandesompele J, De Preter K, Pattyn F, Poppe B, Van Roy N, De Paepe A, Speleman F. Accurate normalization of real-time quantitative RT-PCR data by geometric averaging of multiple internal control genes. *Genome Biol* 2002;3:RESEARCH0034.

221. Hellemans J, Mortier G, De Paepe A, Speleman F, Vandesompele J. qBase relative quantification framework and software for management and automated analysis of real-time quantitative PCR data. *Genome Biol* 2007;8:R19.

222. Andersen CL. The model based approach to estimation of expression variation. :1–16.

223. Vermeulen J, Pattyn F, De Preter K, Vercruysse L, Derveaux S, Mestdagh P, Lefever S, Hellemans J, Speleman F, Vandesompele J. External oligonucleotide standards enable cross laboratory comparison and exchange of real-time quantitative PCR data. *Nucleic Acids Res* 2009;37:e138.

224. Penna I, Vella S, Gigoni A, Russo C, Cancedda R, Pagano A. Selection of candidate housekeeping genes for normalization in human postmortem brain samples. *Int J Mol Sci* 2011;12:5461–70.

225. Lallemant B, Evrard A, Combescure C, Chapuis H, Chambon G, Raynal C, Reynaud C, Sabra O, Joubert D, Hollande F, Lallemant J-G, Lumbroso S, et al. Reference gene selection for head and neck squamous cell carcinoma gene expression studies. *BMC Mol Biol* 2009;10:78.

226. Derveaux S, Vandesompele J, Hellemans J. How to do successful gene expression analysis using real-time PCR. *Methods* 2010;50:227–30.

227. Andersen CL, Jensen JL, Ørntoft TF. Normalization of real-time quantitative reverse transcription-PCR data: a model-based variance estimation approach to identify genes suited for normalization, applied to bladder and colon cancer data sets. *Cancer Res* 2004;64:5245–50.

228. Steinau M, Onyekwuluje JM, Scarbrough MZ, Unger ER, Dillner J, Zhou T. Performance of commercial reverse line blot assays for human papillomavirus genotyping. *J Clin Microbiol* 2012;50:1539–44.

229. Eklund C, Zhou T, Dillner J. Global proficiency study of human papillomavirus genotyping. *J Clin Microbiol* 2010;48:4147–55.

230. Jr JW. Hierarchical grouping to optimize an objective function. *J Am Stat Assoc* 1963;

231. Kruskal WH, Wallis WA. Use of Ranks in One-Criterion Variance Analysis. *J Am Stat Assoc* 1952;47:583–621.

232. Ye J, Coulouris G, Zaretskaya I, Cutcutache I, Rozen S, Madden TL. Primer-BLAST: a tool to design target-specific primers for polymerase chain reaction. *BMC Bioinformatics* 2012;13:134.

233. Lamarcq L, Deeds J, Ginzinger D, Perry J, Padmanabha S, Smith-McCune K. Measurements of human papillomavirus transcripts by real time quantitative reverse transcription-polymerase chain reaction in samples collected for cervical cancer screening. *J Mol Diagn* 2002;4:97–102.

234. Bustin S a, Beaulieu J-F, Huggett J, Jaggi R, Kibenge FSB, Olsvik P a, Penning LC, Toegel S. MIQE précis: Practical implementation of minimum standard guidelines for fluorescence-based quantitative real-time PCR experiments. *BMC Mol Biol* 2010;11:74.

235. Jacob F, Guertler R, Naim S, Nixdorf S, Fedier A, Hacker NF, Heinzelmann-Schwarz V. Careful selection of reference genes is required for reliable

performance of RT-qPCR in human normal and cancer cell lines. *PLoS One* 2013;8:e59180.

236. Saviozzi S, Cordero F, Lo Iacono M, Novello S, Scagliotti G V, Calogero R a. Selection of suitable reference genes for accurate normalization of gene expression profile studies in non-small cell lung cancer. *BMC Cancer* 2006;6:200.

237. Kowalewska M, Danska-Bidzinska A, Bakula-Zalewska E, Bidzinski M. Identification of suitable reference genes for gene expression measurement in uterine sarcoma and carcinosarcoma tumors. *Clin Biochem* 2012;45:368–71.

238. Guo Y, Chen J, Yang S, Fu X, Zhang Z, Chen K, Huang Y, Li Y, Xie Y, Mao Y. Selection of reliable reference genes for gene expression study in nasopharyngeal carcinoma. *Acta Pharmacol Sin* 2010;31:1487–94.

239. Silver N, Best S, Jiang J, Thein SL. Selection of housekeeping genes for gene expression studies in human reticulocytes using real-time PCR. *BMC Mol Biol* 2006;7:33.

240. Zhang B. refFinder [Internet]. Available from: http://www.leonxie.com/referencegene.php

241. Schlecht NF, Burk RD, Adrien L, Dunne A, Kawachi N, Sarta C, Chen Q, Brandwein-Gensler M, Prystowsky MB, Childs G, Smith R V, Belbin TJ. Gene expression profiles in HPV-infected head and neck cancer. *J Pathol* 2007;213:283–93.

242. Richards KL, Zhang B, Baggerly KA, Colella S, Lang JC, Schuller DE, Krahe R. Genome-Wide Hypomethylation in Head and Neck Cancer Is More Pronounced in HPV-Negative Tumors and Is Associated with Genomic Instability. *PLoS One* 2009;4:7.

243. Biron VL, Mohamed A, Hendzel MJ, Alan Underhill D, Seikaly H. Epigenetic differences between human papillomavirus-positive and -negative oropharyngeal squamous cell carcinomas. *J Otolaryngol Head Neck Surg* 2012;41 Suppl 1:S65–70.

244. Johannsen E, Lambert PF. Epigenetics of human papillomaviruses. *Virology* 2013;:1–8.

245. Mashhadiabbas F, Mahjour F, Mahjour SB, Fereidooni F, Hosseini FS. The immunohistochemical characterization of MMP-2, MMP-10, TIMP-1, TIMP-2, and podoplanin in oral squamous cell carcinoma. *Oral Surg Oral Med Oral Pathol Oral Radiol* 2012;114:240–50.

246. Stott-Miller M, Houck JR, Lohavanichbutr P, Méndez E, Upton MP, Futran ND, Schwartz SM, Chen C. Tumor and salivary matrix metalloproteinase levels are strong diagnostic markers of oral squamous cell carcinoma. *Cancer Epidemiol Biomarkers Prev* 2011;20:2628–36.

247. Chiang W-C, Wong Y-K, Lin S-C, Chang K-W, Liu C-J. Increase of MMP-13 expression in multi-stage oral carcinogenesis and epigallocatechin-3-gallate suppress MMP-13 expression. *Oral Dis* 2006;12:27–33.

248. Lallemant B, Evrard A, Combescure C, Chapuis H, Chambon G, Raynal C, Reynaud C, Sabra O, Joubert D, Hollande F, Lallemant J-G, Lumbroso S, et al. Clinical relevance of nine transcriptional molecular markers for the diagnosis of head and neck squamous cell carcinoma in tissue and saliva rinse. *BMC Cancer* 2009;9:370.

249. Liu H, Qin Y-R, Bi J, Guo A, Fu L, Guan X-Y. Overexpression of matrix metalloproteinase 10 is associated with poor survival in patients with early stage of esophageal squamous cell carcinoma. *Dis Esophagus* 2012;25:656–63.

250. Tsang RK-Y, Tang WW-Y, Gao W, Ho W-K, Chan JY-W, Wei WI, Wong T-S. Curcumin inhibits tongue carcinoma cells migration and invasion through downregulation of matrix metallopeptidase 10. *Cancer Invest* 2012;30:503–12.

251. Koch U, Radtke F. Notch signaling in solid tumors. *Curr Top Dev Biol* 2010;92:411–55.

252. Vliet-Gregg P a, Hamilton JR, Katzenellenbogen R a. NFX1-123 and Human Papillomavirus 16E6 Increase Notch Expression in Keratinocytes. *J Virol* 2013;

253. Chen X, Zhang T, Shi J, Xu P, Gu Z, Sandham A, Yang L, Ye Q. Notch1 signaling regulates the proliferation and self-renewal of human dental follicle cells by modulating the G1/S phase transition and telomerase activity. *PLoS One* 2013;8:e69967.

254. Sparano A, Quesnelle KM, Kumar MS, Wang Y, Sylvester AJ, Feldman M, Sewell D a, Weinstein GS, Brose MS. Genome-wide profiling of oral squamous cell carcinoma by array-based comparative genomic hybridization. *Laryngoscope* 2006;116:735–41.

255. Zhang Y, Fan S, Meng Q, Ma Y, Katiyar P, Schlegel R, Rosen EM. BRCA1 interaction with human papillomavirus oncoproteins. *J Biol Chem* 2005;280:33165–77.

256. Dudás J, Fullár A, Bitsche M, Schartinger V, Kovalszky I, Sprinzl GM, Riechelmann H. Tumor-produced, active interleukin-1β regulates gene expression in carcinoma-associated fibroblasts. *Exp Cell Res* 2011;317:2222–9.

257. Kamatani T, Shiogama S, Yoshihama Y, Kondo S, Shirota T, Shintani S. Interleukin-1 beta in unstimulated whole saliva is a potential biomarker for oral squamous cell carcinoma. *Cytokine* 2013;

258. Cao W, Zhang Z-Y, Xu Q, Sun Q, Yan M, Zhang J, Zhang P, Han Z-G, Chen W-T. Epigenetic silencing of MAL, a putative tumor suppressor gene, can contribute to human epithelium cell carcinoma. *Mol Cancer* 2010;9:296.

259. Seiwert TY, Jagadeeswaran R, Faoro L, Janamanchi V, Nallasura V, El Dinali M, Yala S, Kanteti R, Cohen EEW, Lingen MW, Martin L, Krishnaswamy S, et al. The MET receptor tyrosine kinase is a potential novel therapeutic target for head and neck squamous cell carcinoma. *Cancer Res* 2009;69:3021–31.

260. Aebersold DM, Kollar a, Beer KT, Laissue J, Greiner RH, Djonov V. Involvement of the hepatocyte growth factor/scatter factor receptor c-met and of Bcl-xL in the resistance of oropharyngeal cancer to ionizing radiation. *Int J Cancer* 2001;96:41–54.

261. Chau NG, Perez-Ordonez B, Zhang K, Pham N-A, Ho J, Zhang T, Ludkovski O, Wang L, Chen EX, Tsao M-S, Kamel-Reid S, Siu LL. The association between EGFR variant III, HPV, p16, c-MET, EGFR gene copy number and response to EGFR inhibitors in patients with recurrent or metastatic squamous cell carcinoma of the head and neck. *Head Neck Oncol* 2011;3:11.

262. Park I-S, Chang X, Loyo M, Wu G, Chuang A, Kim MS, Chae YK, Lyford-Pike S, Westra WH, Saunders JR, Sidransky D, Pai SI. Characterization of the methylation patterns in human papillomavirus type 16 viral DNA in head and neck cancers. *Cancer Prev Res (Phila)* 2011;4:207–17.

263. Wilson G a, Lechner M, Köferle A, Caren H, Butcher LM, Feber A, Fenton T, Jay A, Boshoff C, Beck S. Integrated virus-host methylome analysis in head and neck squamous cell carcinoma. *Epigenetics* 2013;8:953–61.

APPENDIX A - DEG ALL TUMORS

Table A.1: HPV-active vs HPV-inactive vs HPV-negative, FC 2, p0.02

HPV-Active vs - Inactive		HPV-Active vs - Negative		HPV-Inactive vs - Negative		Gene	Genbank
FC (Abs)	Direction of change	FC (Abs)	Regulation	FC (Abs)	Direction of change	Symbol	Accession
4.90	up	10.37	up	2.11	up	AACSP1	NR_024035
2.09	up	1.65	up	1.26	down	AACSP1	NR_024035
1.52	down	2.06	down	1.36	down	AATK	NM_001080395
5.72	up	5.05	up	1.13	down	ABCA13	NM_152701
6.57	up	11.55	up	1.76	up	ABCA3	NM_001089
1.96	down	2.16	down	1.10	down	ABCC2	NM_000392
3.51	down	2.13	down	1.65	up	ABCC9	NM_005691
2.17	up	1.87	up	1.16	down	ABHD8	NM_024527
2.14	up	1.68	up	1.27	down	ABI2	NM_005759
2.14	down	1.81	down	1.19	up	ABL1	NM_007313
1.74	down	2.67	down	1.53	down	ABL2	NM_007314
1.27	up	2.22	up	1.75	up	ACACB	NM_001093
4.29	up	3.85	up	1.12	down	ACBD7	NM_001039844
1.98	down	2.71	down	1.37	down	ACOT8	
2.46	up	2.66	up	1.08	up	ACOXL	NM_001142807
2.42	up	2.69	up	1.11	up	ACPL2	NM_152282
2.74	up	3.37	up	1.23	up	ACSS1	NM_032501
2.46	down	3.55	down	1.44	down	ACTG2	NM_001615
1.47	down	2.56	down	1.74	down	ACTN1	NM_001102
1.60	down	2.62	down	1.64	down	ACTN3	NM_001104
2.25	up	2.08	up	1.08	down	ACTR3C	BX640643
2.64	up	2.46	up	1.07	down	ADAM1	NR_036636
2.61	up	4.05	up	1.55	up	ADAM22	NM_021721
1.91	up	3.07	up	1.61	up	ADAMTS17	NM_139057

2.06	down	2.74	down	1.33	down	ADAMTS L4	NM_019032
2.36	down	1.82	down	1.30	up	ADAMTS L4	NM_025008
10.50	up	10.76	up	1.02	up	ADARB2	NM_018702
4.22	up	4.60	up	1.09	up	ADARB2	NM_018702
3.26	up	3.35	up	1.03	up	ADARB2	NM_018702
2.57	up	3.42	up	1.33	up	ADCY5	NM_183357
2.19	up	2.54	up	1.16	up	ADCY6	NM_015270
1.63	down	2.02	down	1.24	down	AFAP1L1	NM_152406
2.19	up	1.44	up	1.52	down	AGAP1	NM_00103713 1
1.33	down	2.23	down	1.68	down	AGPAT4	NM_020133
1.43	down	2.35	down	1.64	down	AGPAT4	NM_020133
1.80	down	4.12	down	2.28	down	AGPAT4	NM_020133
1.73	down	2.23	down	1.29	down	AGPAT9	NM_032717
2.01	up	1.98	up	1.01	down	AHDC1	NM_00102988 2
1.58	down	3.12	down	1.98	down	AHNAK2	NM_138420
1.63	down	3.10	down	1.90	down	AHNAK2	NM_138420
2.47	down	2.85	down	1.15	down	AIG1	
2.04	up	1.70	up	1.20	down	AKAP1	NM_003488
6.20	down	6.49	down	1.05	down	AKR1C3	NM_003739
5.93	down	6.56	down	1.11	down	AKR1C4	NM_001818
1.78	up	2.79	up	1.57	up	AKR1E2	NM_00104017 7
6.79	up	8.64	up	1.27	up	ALDH1L 1	NM_012190
1.91	up	2.36	up	1.23	up	ALDH2	NM_000690
2.28	up	1.02	down	2.32	down	ALS2	NM_020919
2.37	down	1.82	down	1.30	up	AMFR	NM_001144
2.54	down	3.10	down	1.22	down	AMIGO2	NM_181847
2.60	up	4.83	up	1.86	up	AMOT	NM_133265
6.76	up	8.31	up	1.23	up	AMY1C	NM_00100821 9
6.40	up	6.87	up	1.07	up	AMY1C	NM_00100821 9
2.96	down	1.72	down	1.72	up	ANGPT4	NM_015985
3.09	up	2.84	up	1.09	down	ANKRD1 0-IT1	XR_109155
2.12	up	2.35	up	1.11	up	ANKRD2 0A2	NM_00101242 1

4.39	up	3.80	up	1.15	down	ANKRD20A5P	NR_040113
3.62	up	3.36	up	1.08	down	ANKRD20A5P	NR_040113
4.48	up	4.18	up	1.07	down	ANKRD20A9P	NR_027995
4.78	up	3.20	up	1.49	down	ANKRD33B	NM_001164440
2.32	up	2.75	up	1.18	up	ANKRD36	NM_001164315
2.07	up	2.29	up	1.10	up	ANKRD36	NM_001164315
1.31	up	2.12	up	1.62	up	ANKRD36	NM_001164315
1.89	up	2.02	up	1.07	up	ANKRD36B	NM_025190
1.87	up	2.14	up	1.14	up	ANKRD36B	NM_025190
1.92	up	3.28	up	1.71	up	ANKRD36BP2	BX648045
1.80	up	2.46	up	1.37	up	ANKRD36BP2	AK097649
1.55	up	2.29	up	1.48	up	ANKRD36BP2	NR_015424
1.46	up	2.03	up	1.39	up	ANKRD36BP2	NR_015424
4.64	up	9.58	up	2.06	up	ANKRD43	NM_175873
1.74	up	2.15	up	1.24	up	ANKRD6	NM_001242811
2.31	up	3.03	up	1.31	up	ANKRD65	NM_001145210
1.93	up	2.16	up	1.12	up	ANO9	NM_001012302
7.62	down	4.73	down	1.61	up	ANXA10	NM_007193
3.03	down	2.74	down	1.10	up	ANXA13	NM_001003954
2.28	up	1.77	down	4.03	down	ANXA3	NM_005139
3.65	up	5.68	up	1.56	up	AP3B2	NM_004644
1.64	down	2.37	down	1.44	down	AP4S1	NM_007077
1.72	down	2.57	down	1.49	down	AP4S1	NM_001128126

3.17	up	2.40	up	1.32	down	APOBEC 3B	NM_004900
2.68	up	2.34	up	1.14	down	APOBEC 3C	NM_014508
2.58	up	2.64	up	1.02	up	APOBEC 3F	NM_145298
3.26	up	2.31	up	1.41	down	APOBEC 3G	NM_021822
2.80	down	7.49	down	2.68	down	AREG	NM_001657
2.91	down	8.27	down	2.85	down	AREG	NM_001657
4.22	up	2.84	up	1.49	down	ARF3	
1.54	up	2.01	up	1.31	up	ARHGAP 24	AK130576
3.31	up	3.35	up	1.01	up	ARHGAP 26	NM_015071
2.57	up	2.46	up	1.04	down	ARHGAP 33	NM_052948
1.91	up	3.57	up	1.87	up	ARHGAP 4	NM_00116474 1
4.51	up	2.18	up	2.07	down	ARHGEF 16	NM_014448
3.51	up	2.09	up	1.68	down	ARHGEF 19	NM_153213
3.39	up	2.79	up	1.21	down	ARHGEF 19	NM_153213
3.00	up	3.94	up	1.31	up	ARHGEF 26	NM_015595
2.21	up	1.38	up	1.61	down	ARID1A	NM_006015
2.27	up	1.81	up	1.25	down	ARL3	NM_004311
3.67	down	4.09	down	1.12	down	ARL4D	NM_001661
2.56	up	1.12	up	2.28	down	ARL9	NM_206919
5.70	up	7.55	up	1.32	up	ARNT2	NM_014862
1.78	down	2.42	down	1.36	down	ARTN	NM_057090
5.50	up	6.59	up	1.20	up	ASCL4	NM_203436
2.42	up	1.96	up	1.23	down	ASF1B	NM_018154
1.58	down	2.17	up	3.43	up	ASPA	NM_000049
2.30	up	1.44	up	1.60	down	ASPM	NM_018136
2.15	up	1.54	up	1.39	down	ASPM	NM_018136
17.65	down	5.97	down	2.95	up	ASPRV1	NM_152792
1.93	up	2.21	up	1.15	up	ASRGL1	NM_00108392 6
2.47	up	1.81	up	1.36	down	ATAT1	NM_024909

3.43	up	2.92	up	1.18	down	ATF5	NM_012068
2.91	up	1.28	up	2.28	down	ATL2	NM_022374
2.02	up	1.36	up	1.49	down	ATL2	NM_022374
1.56	down	2.14	down	1.37	down	ATL3	NM_015459
2.37	up	1.21	up	1.95	down	ATP2B4	NM_001684
2.03	up	1.08	down	2.19	down	ATP2B4	NM_00100139 6
2.77	up	2.05	up	1.35	down	ATP2C1	NM_00119918 2
2.01	up	1.52	up	1.33	down	ATP5A1	NM_00100193 7
4.44	up	1.46	up	3.04	down	ATP5B	NM_001686
2.21	up	2.68	up	1.21	up	ATP6V0E 2	NM_145230
2.28	up	1.88	up	1.21	down	ATP7A	AB208828
13.79	down	4.60	down	3.00	up	ATP8B3	NM_138813
2.00	down	1.45	down	1.38	up	AVP	NM_000490
2.96	up	1.43	up	2.07	down	B3GALT L	NM_194318
4.20	down	4.17	down	1.01	up	B4GALN T1	NM_001478
2.13	down	1.69	down	1.26	up	BAALC	
1.56	down	2.36	down	1.52	down	BAG2	NM_004282
3.42	up	3.14	up	1.09	down	BAI2	NM_001703
1.74	up	2.27	up	1.31	up	BAI2	NM_001703
2.21	up	2.01	up	1.10	down	BARD1	NM_000465
1.54	down	2.24	down	1.46	down	BBS5	NM_152384
2.11	down	3.44	down	1.64	down	BCAT1	NM_005504
2.87	down	3.34	down	1.16	down	BCAT1	NM_005504
4.14	down	2.46	down	1.69	up	BCHE	NM_000055
4.30	up	2.92	up	1.47	down	BCL11A	NM_022893
2.71	up	3.62	up	1.33	up	BCL11A	NM_022893
2.52	up	2.80	up	1.11	up	BCL11A	NM_018014
2.21	up	2.59	up	1.17	up	BCL11A	NM_138559
3.22	up	3.79	up	1.18	up	BCL2	NM_000633
2.24	up	2.55	up	1.14	up	BCL2	NM_000657
2.82	down	1.35	down	2.10	up	BCO2	NM_031938
2.21	up	1.95	up	1.13	down	BCOR	BC128456
1.70	down	2.93	down	1.73	down	BDKRB1	NM_000710
1.62	up	2.36	up	1.46	up	BDNF-AS1	NR_002832
5.09	up	4.12	up	1.23	down	BIRC3	NM_001165

3.59	up	4.52	up	1.26	up	BK250D10.8	NR_024355
1.49	down	3.06	down	2.05	down	BNC1	NM_001717
2.44	up	2.05	up	1.19	down	BRCA2	NM_000059
1.96	down	2.84	down	1.45	down	BRI3	NM_001159491
2.21	down	3.26	down	1.47	down	BTBD11	NM_001018072
3.66	down	3.09	down	1.19	up	BTBD16	NM_144587
6.26	up	14.72	up	2.35	up	BTNL9	NM_152547
2.38	up	4.38	up	1.84	up	BZRAP1	NM_004758
1.55	down	2.32	down	1.49	down	BZW1	NM_001207068
2.44	down	2.17	down	1.13	up	C10orf114	NM_001010911
2.99	up	1.06	up	2.81	down	C10orf47	NM_153256
2.12	down	2.01	down	1.06	up	C10orf57	NM_025125
2.22	down	1.67	down	1.32	up	C11orf71	NM_019021
3.78	up	3.68	up	1.03	down	C11orf85	NM_001037225
29.00	up	42.97	up	1.48	up	C11orf92	NR_034154
5.03	up	8.93	up	1.78	up	C11orf93	NM_001136105
2.43	down	1.93	down	1.26	up	C11orf95	NM_001144936
2.31	up	2.57	up	1.12	up	C12orf34	NM_032829
1.57	down	3.41	down	2.17	down	C13orf16	NM_152324
1.68	down	2.19	down	1.30	down	C14orf109	NM_001098621
1.48	down	2.15	down	1.45	down	C14orf126	NM_080664
2.23	up	2.00	up	1.12	down	C14orf132	NR_023938
1.98	down	3.15	down	1.59	down	C14orf149	NM_144581
3.28	down	4.37	down	1.33	down	C14orf33	NR_027123
3.31	down	4.68	down	1.41	down	C14orf33	NR_027123
3.38	down	4.41	down	1.30	down	C14orf33	NR_027123
3.20	down	7.06	down	2.21	down	C14orf34	NR_026796
3.01	down	2.21	down	1.36	up	C14orf37	NM_001001872
2.51	up	2.03	up	1.24	down	C15orf2	NM_018958
1.65	up	2.03	up	1.23	up	C16orf5	NM_001199054
1.96	down	3.22	down	1.64	down	C16orf57	NM_00120491

							1
2.12	down	2.57	down	1.21	down	C16orf74	NM_206967
2.45	down	1.31	down	1.87	up	C17orf105	NM_00113648 3
1.04	up	2.04	up	1.96	up	C17orf108	NM_00107668 0
1.99	down	3.25	down	1.63	down	C17orf51	NM_00111343 4
2.00	down	1.98	down	1.01	up	C17orf51	NM_00111343 4
2.03	down	1.98	down	1.03	up	C17orf51	NM_00111343 4
2.07	down	1.91	down	1.09	up	C17orf51	NM_00111343 4
2.12	down	2.02	down	1.05	up	C17orf51	NM_00111343 4
2.36	up	1.60	up	1.48	down	C17orf53	NM_024032
3.28	up	2.90	up	1.13	down	C17orf88	NR_026770
2.07	up	2.17	up	1.05	up	C19orf25	NM_152482
1.03	down	2.73	down	2.65	down	C19orf33	NM_033520
2.94	up	3.47	up	1.18	up	C19orf46	NM_00103987 6
8.01	up	7.69	up	1.04	down	C19orf57	NM_024323
5.70	down	2.82	down	2.02	up	C19orf81	NM_00119507 6
2.27	down	2.09	down	1.09	up	C1D	NM_006333
2.02	up	1.56	up	1.30	down	C1orf112	NM_018186
3.68	up	2.49	up	1.48	down	C1orf213	NR_033690
2.26	up	1.26	up	1.79	down	C1orf213	NR_033691
2.08	down	1.53	down	1.36	up	C1orf229	NM_207401
3.13	up	4.15	up	1.33	up	C1orf51	NM_144697
1.97	up	2.08	up	1.05	up	C1orf63	NM_020317
1.71	up	2.02	up	1.18	up	C1orf93	NM_00119573 6
4.00	up	3.71	up	1.08	down	C21orf15	NR_026755
2.14	down	1.69	down	1.27	up	C21orf33	
1.75	up	2.07	up	1.18	up	C21orf63	NM_058187
1.73	up	2.11	up	1.22	up	C21orf63	NM_058187
1.62	up	2.13	up	1.32	up	C21orf63	NM_058187
3.23	up	3.22	up	1.00	down	C21orf71	NR_024092
2.18	up	3.85	up	1.76	up	C21orf81	NR_027270
5.25	up	5.23	up	1.00	down	C22orf45	NR_028484

1.94	up	2.19	up	1.13	up	C2CD2	NM_015500
2.61	up	2.30	up	1.14	down	C2CD4D	NM_001136003
4.53	up	2.78	up	1.63	down	C2orf15	NM_144706
8.47	up	4.51	up	1.88	down	C2orf54	NM_024861
6.71	up	5.09	up	1.32	down	C2orf55	NM_207362
2.93	up	3.11	up	1.06	up	C2orf65	NM_138804
2.21	up	1.86	up	1.19	down	C3orf14	NM_020685
2.22	up	1.91	up	1.16	down	C3orf17	NM_015412
2.72	down	2.17	down	1.26	up	C3orf33	NM_173657
6.64	down	7.58	down	1.14	down	C3orf67	NM_198463
2.10	up	1.76	up	1.19	down	C4orf21	AK002193
2.05	down	1.62	down	1.26	up	C4orf32	NM_152400
2.07	up	1.58	up	1.31	down	C4orf46	NM_001008393
57.41	up	131.36	up	2.29	up	C4orf7	NM_152997
3.55	up	4.49	up	1.27	up	C5	NM_001735
1.71	down	2.57	down	1.50	down	C5AR1	NM_001736
1.66	up	2.21	up	1.33	up	C5orf25	AK299336
2.29	down	1.33	down	1.72	up	C5orf27	NR_026936
2.33	up	1.93	up	1.21	down	C5orf30	NM_033211
2.88	up	2.80	up	1.03	down	C5orf34	NM_198566
2.00	up	2.05	up	1.02	up	C5orf54	NM_022090
3.84	up	4.02	up	1.05	up	C5orf56	AK096941
3.39	up	3.58	up	1.06	up	C5orf56	AK025221
2.63	up	2.68	up	1.02	up	C5orf56	NR_045116
1.39	down	2.02	down	1.45	down	C6orf170	NM_152730
8.62	up	4.18	up	2.06	down	C7orf13	NR_026865
2.95	up	2.47	up	1.19	down	C7orf13	NR_026865
2.35	up	2.77	up	1.18	up	C7orf46	NM_001127364
2.19	up	2.56	up	1.17	up	C7orf46	NM_199136
1.97	up	2.20	up	1.12	up	C7orf46	NM_199136
8.44	up	9.61	up	1.14	up	C8G	NM_000606
3.66	up	4.73	up	1.29	up	C8G	NM_000606
2.09	up	1.35	up	1.55	down	C8orf39	NR_027259
3.18	up	3.20	up	1.01	up	C8orf45	NM_173518
3.54	up	2.73	up	1.30	down	C8orf51	NR_026785
1.61	up	2.10	up	1.30	up	C8orf80	NM_001010906
2.08	up	2.68	up	1.29	up	C9orf174	NM_020893

2.16	up	1.89	up	1.14	down	C9orf3	NM_032823
1.65	up	2.02	up	1.23	up	C9orf91	NM_153045
2.29	down	4.83	down	2.10	down	CA12	NM_001218
1.54	down	2.19	down	1.42	down	CAB39	NM_00113084 9
2.05	down	1.76	down	1.17	up	CALCRL	NM_005795
1.38	down	2.05	down	1.49	down	CAP1	NM_006367
2.60	down	3.49	down	1.34	down	CAP2	NM_006366
5.42	up	7.24	up	1.34	up	CAPN14	NM_00114512 2
1.00	up	2.28	down	2.29	down	CAPSL	NM_144647
2.21	down	1.93	down	1.14	up	CARD6	NM_032587
2.97	down	2.62	down	1.13	up	CARD6	NM_032587
3.29	up	1.59	up	2.07	down	CASC2	NR_026939
1.97	up	2.08	up	1.06	up	CASP2	NM_032982
3.66	up	2.39	up	1.53	down	CATSPE R2	NM_172097
2.12	down	3.91	down	1.84	down	CAV1	NM_001753
2.17	down	3.65	down	1.68	down	CAV1	NM_001753
1.46	down	2.76	down	1.89	down	CAV2	NM_001233
2.63	down	4.34	down	1.65	down	CAV3	NM_001234
1.10	down	2.11	up	2.31	up	CBFA2T3	NM_005187
6.91	up	9.65	up	1.40	up	CBLN2	NM_182511
6.83	up	4.90	up	1.40	down	CBS	NM_000071
2.36	up	2.95	up	1.25	up	CBX5	NM_00112732 2
2.39	up	2.40	up	1.00	up	CBX6	NM_014292
2.30	up	3.30	up	1.43	up	CBX7	NM_175709
2.33	up	2.34	up	1.00	up	CCDC14	NM_022757
3.13	up	2.32	up	1.35	down	CCDC146	NM_020879
1.36	down	3.11	down	2.28	down	CCDC147	NM_00100872 3
2.36	up	1.74	up	1.36	down	CCDC150	NM_00108053 9
2.83	up	1.58	up	1.79	down	CCDC24	NM_152499
2.42	up	2.48	up	1.02	up	CCDC28 B	NM_024296
2.02	up	1.53	up	1.32	down	CCDC34	NM_030771
2.30	up	3.05	up	1.33	up	CCDC74 B	NM_207310
2.13	up	1.78	up	1.20	down	CCDC93	NM_019044
7.16	up	5.62	up	1.27	down	CCL20	NM_004591

2.78	down	3.31	down	1.19	down	CCL26	NM_006072
1.65	down	2.03	down	1.23	down	CCNC	NM_005190
2.36	up	1.65	up	1.43	down	CCNE2	NM_057749
2.71	up	2.39	up	1.13	down	CCNG2	NM_004354
6.26	up	7.95	up	1.27	up	CCNI2	NM_001039780
3.82	up	2.53	up	1.51	down	CCNJL	NM_024565
1.86	down	2.09	down	1.12	down	CCNK	NM_001099402
3.87	up	3.05	up	1.27	down	CCNO	NM_021147
1.21	down	2.00	down	1.65	down	CCNYL1	NM_152523
3.62	down	2.04	down	1.77	up	CCRL1	NM_178445
3.02	down	2.63	down	1.15	up	CD209	NM_021155
4.25	down	3.24	down	1.31	up	CD209	NM_001144897
12.26	down	1.93	down	6.36	up	CD36	NM_001001547
2.01	up	2.38	up	1.18	up	CD40	NM_001250
2.27	down	1.89	down	1.20	up	CD55	NM_000574
1.30	down	2.00	down	1.54	down	CD68	NM_001251
6.64	up	6.24	up	1.06	down	CD8B	NM_004931
6.47	up	5.65	up	1.15	down	CD8B	NM_004931
5.72	up	4.80	up	1.19	down	CD8B	NM_172102
2.61	down	3.74	down	1.43	down	CDA	NM_001785
2.02	up	1.44	up	1.40	down	CDC25A	NM_001789
2.05	up	1.69	up	1.21	down	CDC25C	NM_001790
3.73	up	2.94	up	1.27	down	CDC42EP4	NM_012121
2.25	up	2.18	up	1.03	down	CDC7	NM_003503
2.64	up	2.06	up	1.28	down	CDCA7	NM_031942
2.20	up	1.25	down	2.75	down	CDCP1	NM_178181
3.45	down	5.57	down	1.62	down	CDH15	NM_004933
2.84	down	1.96	down	1.45	up	CDHR1	NM_033100
4.11	up	2.17	up	1.90	down	CDK1	NM_001170406
3.66	up	2.12	up	1.73	down	CDK18	NM_212503
2.17	up	1.95	up	1.11	down	CDK20	NM_001039803
2.01	down	3.03	down	1.51	down	CDK6	NM_001259
31.15	up	24.37	up	1.28	down	CDKN2A	NM_000077
12.93	up	13.10	up	1.01	up	CDKN2A	NM_058197
5.12	up	4.27	up	1.20	down	CDKN2B-	NR_003529

						AS	
4.51	up	4.41	up	1.02	down	CDKN2B-AS	NR_003529
3.41	up	5.11	up	1.50	up	CDKN2C	NM_078626
2.91	up	4.19	up	1.44	up	CDON	NM_016952
15.88	down	25.99	down	1.64	down	CDSN	NM_001264
4.99	up	3.44	up	1.45	down	CEACAM1	NM_001712
1.57	down	2.19	down	1.39	down	CEBPE	NM_001805
5.19	up	5.12	up	1.01	down	CECR7	NR_015352
4.60	up	11.39	up	2.47	up	CELF4	NM_020180
2.65	up	3.52	up	1.33	up	CELF4	NM_020180
2.60	up	1.56	up	1.67	down	CELSR2	NM_001408
3.29	up	3.69	up	1.12	up	CELSR3	NM_001407
2.64	up	1.84	up	1.44	down	CENPF	NM_016343
2.20	up	1.41	up	1.56	down	CENPF	NM_016343
2.68	up	1.78	up	1.50	down	CENPH	NM_022909
2.52	up	2.36	up	1.07	down	CENPJ	NM_018451
2.97	up	2.32	up	1.28	down	CENPK	NM_022145
2.36	up	2.47	up	1.05	up	CENPM	NM_001002876
1.76	up	2.43	up	1.38	up	CENPM	NM_024053
2.21	up	1.71	up	1.29	down	CENPO	NM_001199803
2.15	down	2.13	down	1.01	up	CEP112	NM_145036
2.31	up	1.85	up	1.25	down	CEP152	NM_014985
1.82	up	2.18	up	1.19	up	CEP68	BX648774
2.37	up	3.98	up	1.68	up	CGNL1	NM_032866
1.98	up	3.41	up	1.73	up	CHADL	NM_138481
2.28	up	2.03	up	1.12	down	CHAF1A	NM_005483
2.11	up	2.26	up	1.07	up	CHAF1A	NM_005483
2.34	up	2.62	up	1.12	up	CHAF1B	NM_005441
8.45	up	9.20	up	1.09	up	CHDH	NM_018397
2.60	up	2.90	up	1.11	up	CHDH	NM_018397
2.06	down	1.97	down	1.05	up	CHPF	
3.14	up	3.50	up	1.11	up	CHPT1	NM_020244
3.07	up	2.68	up	1.15	down	CHRFAM7A	NM_139320
2.01	up	1.79	up	1.13	down	CHRNA6	NM_004198
1.33	down	2.08	down	1.56	down	CHRNB1	NM_000747
5.70	down	1.65	down	3.44	up	CIDEA	NM_001279
2.44	up	2.01	up	1.22	down	CIDEB	NM_014430

2.29	up	2.14	up	1.07	down	CIRBP	NR_023312
2.80	up	2.62	up	1.07	down	CIT	NM_007174
1.57	down	4.26	down	2.71	down	CLCA2	NM_006536
2.05	down	3.25	down	1.59	down	CLCF1	NM_013246
4.32	up	3.27	up	1.32	down	CLDN1	NM_021101
70.03	up	38.41	up	1.82	down	CLDN10	NM_182848
9.51	up	9.57	up	1.01	up	CLDN10	
1.36	up	1.68	down	2.28	down	CLDN12	NM_012129
12.76	up	30.52	up	2.39	up	CLDN3	NM_001306
5.58	up	2.64	up	2.11	down	CLDN7	NM_001307
2.37	up	2.04	up	1.16	down	CLDN7	NM_001307
2.65	down	1.68	up	4.46	up	CLEC3B	NM_003278
4.44	down	2.10	down	2.11	up	CLEC4G	NM_198492
11.46	up	8.77	up	1.31	down	CLGN	NM_004362
1.40	down	2.15	down	1.53	down	CLIC4	NM_013943
1.77	down	2.19	down	1.23	down	CLIP4	NM_024692
1.89	down	2.55	down	1.35	down	CLIP4	NM_024692
1.62	up	2.06	up	1.27	up	CLK4	NM_020666
2.29	up	2.51	up	1.09	up	CLMN	NM_024734
2.01	down	2.45	down	1.22	down	CLMP	NM_024769
2.35	up	1.94	up	1.22	down	CLTC-IT1	XM_003118745
1.97	down	2.15	down	1.10	down	CLTCL1	NM_007098
2.09	up	1.50	up	1.40	down	CNOT4	BC035590
1.86	down	2.07	down	1.12	down	CNST	NM_001139459
2.34	up	2.31	up	1.01	down	CNTLN	NM_017738
2.45	down	1.84	down	1.33	up	CNTNAP3B	NM_001201380
2.58	down	1.83	down	1.41	up	CNTNAP3B	AK054645
2.58	up	2.53	up	1.02	down	CNTRL	AK097636
22.02	up	4.91	up	4.48	down	COL22A1	
12.09	up	3.97	up	3.04	down	COL22A1	NM_152888
3.05	up	5.34	up	1.75	up	COL4A4	NM_000092
12.35	down	12.16	down	1.02	up	COL4A6	NM_033641
4.70	up	5.16	up	1.10	up	COL9A2	NM_001852
2.37	down	1.77	down	1.34	up	COPZ2	NM_016429
2.93	up	2.03	up	1.44	down	COQ4	AK301333
2.13	up	1.90	up	1.12	down	COX19	NM_001031617
2.49	down	1.98	down	1.26	up	COX7A1	NM_001864

1.90	up	3.92	up	2.07	up	CPEB1	NM_030594
3.05	up	11.32	up	3.72	up	CR2	NM_001006658
1.73	up	2.22	up	1.29	up	CREB3L4	NM_130898
1.73	down	2.76	down	1.60	down	CREB5	NM_182898
5.66	down	4.85	down	1.17	up	CREG2	NM_153836
1.73	up	2.72	up	1.57	up	CRIP3	NM_206922
2.34	up	2.23	up	1.05	down	CRIPAK	NM_175918
1.53	up	2.08	up	1.36	up	CRNDE	NR_034105
1.51	up	2.48	up	1.64	up	CRNDE	NR_034105
2.14	up	1.87	up	1.15	down	CRYGS	NM_017541
2.06	down	1.78	down	1.16	up	CSGALNACT1	NM_001130518
1.82	up	2.22	up	1.22	up	CTRC	NM_007272
1.25	down	2.08	down	1.67	down	CTSL1	NM_001912
1.34	down	2.25	down	1.68	down	CTSL1P8	NR_033405
1.61	down	2.71	down	1.69	down	CTTN	NM_001184740
1.82	up	2.40	up	1.32	up	CUL3	NM_003590
2.37	up	2.60	up	1.10	up	CUL9	NM_015089
2.70	up	3.04	up	1.13	up	CX3CL1	NM_002996
1.22	up	2.46	up	2.02	up	CX3CR1	NM_001337
3.17	up	2.59	up	1.22	down	CXADR	NM_001338
6.05	up	4.05	up	1.49	down	CXCL10	NM_001565
5.04	up	3.67	up	1.37	down	CXCL10	NM_001565
4.45	down	1.75	down	2.54	up	CXCL12	NM_001033886
6.05	down	5.02	down	1.20	up	CXCL14	NM_004887
2.74	down	2.32	down	1.18	up	CXorf48	NM_001031705
4.09	up	4.00	up	1.02	down	CXXC4	NM_025212
3.03	up	2.35	up	1.29	down	CYB5R2	NM_016229
2.40	down	1.22	down	1.97	up	CYBRD1	NM_024843
10.95	up	3.10	up	3.54	down	CYP24A1	NM_000782
7.59	up	2.48	up	3.07	down	CYP24A1	NM_000782
3.34	up	4.81	up	1.44	up	CYP27A1	NM_000784
2.36	up	1.95	up	1.21	down	CYP2D6	NM_000106
4.51	up	5.16	up	1.15	up	CYP2E1	NM_000773
4.96	up	3.00	up	1.65	down	CYP2J2	NM_000775
12.13	up	11.76	up	1.03	down	CYP4X1	NM_178033
9.19	up	6.60	up	1.39	down	CYP4Z1	NM_178134
7.53	up	6.17	up	1.22	down	CYP4Z1	NM_178134

5.81	up	5.34	up	1.09	down	CYP4Z1	NM_178134
1.63	up	2.06	up	1.26	up	D2HGDH	NM_152783
1.99	down	3.30	down	1.66	down	DAAM1	NM_014992
1.87	down	2.20	down	1.18	down	DAAM2	BC078153
3.42	up	1.98	up	1.73	down	DAGLA	NM_006133
1.88	up	2.19	up	1.17	up	DBP	NM_001352
1.58	down	2.07	down	1.31	down	DCBLD1	NM_173674
1.84	down	2.03	down	1.10	down	DCUN1D3	NM_173475
1.97	down	2.77	down	1.41	down	DCUN1D5	NM_032299
1.69	up	2.17	up	1.28	up	DDB2	NM_000107
3.19	up	2.01	up	1.59	down	DDX11	NM_152438
2.69	up	2.20	up	1.22	down	DDX11	NM_030653
2.55	up	2.18	up	1.17	down	DDX11	NM_030653
1.68	up	2.18	up	1.30	up	DDX17	NM_006386
2.48	up	2.56	up	1.03	up	DDX26B	NM_182540
2.15	up	2.39	up	1.11	up	DDX26B	NM_182540
113.30	up	8.01	up	14.15	down	DDX3Y	NM_001122665
3.74	up	1.66	up	2.25	down	DDX3Y	NM_004660
2.02	up	1.41	up	1.43	down	DEM1	NM_022774
1.44	up	2.18	up	1.51	up	DENND2D	NM_024901
2.12	up	1.55	up	1.37	down	DENR	NM_003677
3.40	up	4.62	up	1.36	up	DERL3	NM_198440
1.71	down	2.72	down	1.59	down	DFNA5	NM_004403
2.70	up	2.78	up	1.03	up	DHFR	NM_000791
1.72	up	2.49	up	1.44	up	DHRS3	NM_004753
2.14	up	1.10	up	1.94	down	DHX34	NM_014681
2.03	up	2.13	up	1.05	up	DIDO1	NM_080797
5.70	down	2.47	down	2.31	up	DIRAS1	NM_145173
2.03	up	2.01	up	1.01	down	DKFZp547G183	AL359570
4.17	down	2.98	down	1.40	up	DKFZP586K1520	AL050153
2.76	down	2.63	down	1.05	up	DKFZp779M0652	NR_027134
2.08	up	1.87	up	1.11	down	DLG3	NM_021120
2.18	down	4.17	down	1.91	down	DLX1	NM_178120
2.10	down	5.02	down	2.39	down	DLX2	NM_004405
3.74	up	3.02	up	1.24	down	DMD	NM_004010

2.91	up	1.97	up	1.47	down	DMD	NM_004021
3.65	down	4.10	down	1.12	down	DMKN	NM_033317
3.89	down	4.05	down	1.04	down	DMKN	NM_001035516
21.02	up	23.04	up	1.10	up	DMRTA2	NM_032110
1.45	up	2.04	up	1.41	up	DNHD1	NM_144666
1.22	up	3.48	up	2.85	up	DNM1P46	NR_003260
1.17	up	3.77	up	3.22	up	DNM1P46	NR_003260
1.14	up	2.46	up	2.16	up	DNM1P46	NR_003260
2.08	up	1.77	up	1.18	down	DNMT1	NM_001130823
3.64	up	4.17	up	1.15	up	DOC2B	NM_003585
2.34	up	2.78	up	1.19	up	DOC2B	NM_003585
1.31	down	2.29	down	1.74	down	DOCK5	NM_024940
2.24	up	1.77	up	1.26	down	DOT1L	NM_032482
1.06	down	2.53	up	2.68	up	DPT	NM_001937
18.78	down	9.20	down	2.04	up	DSC1	NM_004948
5.11	up	6.64	up	1.30	up	DSCR6	NM_018962
3.47	down	10.15	down	2.93	down	DSG1	NM_001942
2.32	up	2.19	up	1.06	down	DTL	NM_016448
2.72	up	2.06	up	1.32	down	DTX2	NM_001102594
2.69	up	1.97	up	1.36	down	DTX2	NM_020892
2.62	up	1.89	up	1.38	down	DTX2	NM_020892
2.30	up	1.79	up	1.28	down	DTX2	NM_020892
4.66	up	4.03	up	1.16	down	DYDC2	NM_032372
1.38	down	2.18	down	1.57	down	DYNLT3	NM_006520
2.16	down	1.94	down	1.11	up	DYRK4	NM_003845
3.64	up	2.46	up	1.48	down	DZANK1	NM_001099407
2.13	up	2.35	up	1.11	up	E2F2	NM_004091
3.40	up	2.29	up	1.49	down	E2F7	NM_203394
2.66	up	2.05	up	1.29	down	E2F7	NM_203394
2.46	up	2.19	up	1.13	down	E2F8	NM_024680
2.54	up	2.30	up	1.10	down	EBF4	NM_001110514
2.90	up	2.71	up	1.07	down	ECE1	NM_001113347
1.51	down	2.07	down	1.38	down	ECHDC1	NM_018479

1.75	up	2.56	up	1.46	up	ECHDC2	NM_018281
2.14	down	1.30	down	1.65	up	EDA	NM_001005610
2.10	up	1.36	up	1.54	down	EDARADD	NM_080738
1.59	down	2.80	down	1.76	down	EFNB3	NM_001406
2.07	down	1.40	down	1.47	up	EGFL7	NM_201446
4.35	up	4.22	up	1.03	down	EGOT	NR_004428
20.29	up	4.95	up	4.10	down	EIF1AY	NM_004681
2.46	up	1.93	up	1.28	down	EIF3D	
4.95	down	1.20	down	4.12	up	EIF4G3	
2.01	down	2.63	down	1.31	down	EML1	NM_001008707
2.05	up	1.98	up	1.04	down	EMP2	NM_001424
2.14	up	1.32	up	1.62	down	ENO1	NM_001428
4.20	up	4.97	up	1.18	up	ENPP5	NM_021572
1.53	up	2.02	up	1.32	up	EPB41L4A	NM_022140
2.49	up	1.98	up	1.26	down	EPB41L5	NM_020909
4.34	up	6.20	up	1.43	up	EPHA10	NM_001099439
2.62	up	4.39	up	1.68	up	EPHX2	NM_001979
3.11	up	2.41	up	1.29	down	EPHX3	NM_024794
2.73	up	2.34	up	1.16	down	EPM2AIP1	NM_014805
1.61	down	2.00	down	1.25	down	EPT1	NM_033505
1.65	down	2.11	down	1.28	down	ERBB2	AB025286
2.92	up	3.14	up	1.08	up	ERO1LB	NM_019891
2.15	up	2.70	up	1.26	up	ERVK13-1	NR_040023
2.30	up	1.76	up	1.31	down	ESPL1	NM_012291
2.95	up	2.82	up	1.05	down	ESPN	NM_031475
3.04	up	3.84	up	1.26	up	ESR1	NM_000125
1.60	down	2.52	down	1.58	down	ETNK1	NM_001039481
3.61	up	1.36	down	4.89	down	ETV4	NM_001079675
2.23	up	2.29	up	1.03	up	ETV6	NM_001987
4.52	up	9.08	up	2.01	up	EXOC3L4	NM_001077594
1.39	down	2.92	down	2.09	down	EXOC6B	NM_015189
2.29	up	2.04	up	1.12	down	EXOC7	AK022397

2.39	up	4.60	up	1.92	up	EYA2	NM_005244
1.75	up	3.09	up	1.77	up	EZH1	NM_001991
2.03	up	2.27	up	1.11	up	EZH2	NM_004456
7.38	down	10.67	down	1.45	down	F2RL1	NM_005242
1.01	down	3.02	down	3.00	down	F3	NM_001993
2.95	up	3.69	up	1.25	up	FAAH2	NM_174912
46.59	down	3.98	down	11.70	up	FABP4	NM_001442
2.88	up	3.73	up	1.29	up	FADS2	NM_004265
2.48	up	2.55	up	1.03	up	FAM106CP	NR_026810
2.15	up	1.57	up	1.37	down	FAM108A1	AK090438
1.96	down	2.67	down	1.36	down	FAM110C	NM_001077710
2.02	down	2.54	down	1.26	down	FAM110C	NM_001077710
2.42	up	2.81	up	1.16	up	FAM111B	NM_198947
1.70	up	2.48	up	1.46	up	FAM117A	NM_030802
2.05	down	2.49	down	1.21	down	FAM126A	NM_032581
2.22	down	2.53	down	1.14	down	FAM126A	NM_032581
3.04	down	3.53	down	1.16	down	FAM126A	
1.76	up	2.56	up	1.45	up	FAM149A	NM_015398
6.16	up	6.15	up	1.00	down	FAM150B	NM_001002919
5.89	up	6.16	up	1.05	up	FAM150B	NM_001002919
2.86	up	1.72	up	1.66	down	FAM161A	NM_032180
2.59	up	1.58	up	1.64	down	FAM161A	NM_032180
2.10	up	2.67	up	1.27	up	FAM164A	NM_016010
1.72	up	3.23	up	1.87	up	FAM164A	NM_016010
2.05	up	2.76	up	1.35	up	FAM171A1	NM_001010924
1.03	down	3.31	down	3.21	down	FAM176	NM_00113503

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3.43	up	4.26	up	1.24	up	FAM189A2	NM_004816
3.04	up	7.51	up	2.47	up	FAM189A2	NM_004816
2.96	up	1.56	up	1.89	down	FAM24B	NM_152644
3.19	up	2.54	up	1.26	down	FAM27E3	XM_001720463
18.03	up	17.87	up	1.01	down	FAM3B	NM_058186
2.72	up	2.18	up	1.24	down	FAM65C	NM_080829
4.65	up	3.75	up	1.24	down	FAM81A	NM_152450
1.44	down	5.15	down	3.57	down	FAM83A	NM_207006
1.47	down	4.38	down	2.97	down	FAM83A	NM_032899
1.07	up	2.10	down	2.23	down	FAM83B	NM_001010872
3.27	down	3.27	down	1.00	down	FAM89A	NM_198552
1.43	down	2.48	down	1.73	down	FAM91A1	NM_144963
2.35	up	1.93	up	1.22	down	FANCA	NM_001018112
2.09	up	1.64	up	1.28	down	FANCB	NM_001018113
2.43	up	2.79	up	1.15	up	FANCC	NM_000136
2.32	up	1.71	up	1.36	down	FANCD2	NM_001018115
2.18	up	1.73	up	1.26	down	FANCG	NM_004629
2.45	up	2.36	up	1.04	down	FANCL	NM_018062
2.41	up	2.19	up	1.10	down	FANCL	NM_001114636
2.28	up	1.65	up	1.38	down	FAR1	NM_032228
2.11	up	2.04	up	1.03	down	FAT2	NM_001447
1.65	up	2.10	up	1.27	up	FAT3	NM_001008781
2.09	up	2.21	up	1.05	up	FBF1	NM_001080542
1.73	down	2.54	down	1.47	down	FBLIM1	NM_017556
1.87	down	2.88	down	1.54	down	FBLIM1	NM_001024215
1.35	down	2.00	down	1.48	down	FBXO3	NM_033406
3.57	up	3.91	up	1.10	up	FBXO43	NM_001029860
2.67	up	3.83	up	1.44	up	FCGBP	NM_003890

2.24	down	3.38	down	1.51	down	FERMT2	NM_001135000
2.53	down	2.39	down	1.06	up	FERMT2	NM_001134999
1.83	down	2.29	down	1.25	down	FEZ1	NM_005103
3.38	down	3.08	down	1.10	up	FFAR3	NM_005304
4.47	up	3.95	up	1.13	down	FHAD1	NM_052929
1.73	up	2.38	up	1.38	up	FICD	NM_007076
2.39	up	1.91	up	1.25	down	FIGNL1	NM_001042762
2.77	up	2.96	up	1.07	up	FLJ11710	AK021772
6.62	down	13.13	down	1.98	down	FLJ13744	AK023806
2.17	up	1.81	up	1.20	down	FLJ14186	NR_037596
2.03	up	2.07	up	1.02	up	FLJ14186	NR_037596
2.33	down	2.21	down	1.05	up	FLJ16779	NR_024389
4.04	down	6.01	down	1.49	down	FLJ22447	NR_039985
2.20	up	2.07	up	1.06	down	FLJ25694	AK127969
1.75	down	2.45	down	1.40	down	FLJ30838	NR_033873
2.73	down	2.21	down	1.24	up	FLJ31713	AK056275
5.02	up	1.72	up	2.91	down	FLJ35024	NR_015375
4.49	up	1.83	up	2.45	down	FLJ35024	NR_015375
4.15	up	3.75	up	1.11	down	FLJ35024	BC090887
2.62	up	1.44	up	1.82	down	FLJ35024	NR_015375
5.96	up	4.30	up	1.39	down	FLJ37638	AK127565
5.32	up	3.20	up	1.66	down	FLJ37638	AK094957
4.98	up	4.42	up	1.13	down	FLJ37638	AK127565
2.50	down	3.95	down	1.58	down	FLJ37786	XR_108343
2.14	up	3.13	up	1.47	up	FLJ38109	AK095428
2.63	up	3.40	up	1.29	up	FLJ38717	XR_108650
1.98	up	2.40	up	1.21	up	FLJ39653	BC132927
4.21	up	3.69	up	1.14	down	FLJ40852	NR_015392
4.98	down	4.24	down	1.17	up	FLJ41200	NR_033863
2.00	up	2.03	up	1.02	up	FLJ42289	NR_028139
2.83	down	2.69	down	1.05	up	FLJ45248	AK127183
3.03	down	2.71	down	1.12	up	FLJ45248	AK127183
2.37	up	2.06	up	1.15	down	FLJ45340	NR_024368
10.67	up	5.96	up	1.79	down	FLJ45482	AK127393
7.01	up	4.98	up	1.41	down	FLJ45482	AK127393
1.51	down	2.12	down	1.41	down	FLJ46906	NR_033896
2.03	up	1.82	up	1.12	down	FLNA	AK125630
1.64	down	3.03	down	1.85	down	FLRT2	NM_013231
1.93	down	5.93	down	3.07	down	FLRT3	NM_198391

2.23	up	2.26	up	1.02	up	FMNL3	NM_175736
5.65	down	2.84	down	1.99	up	FNDC1	NM_032532
5.27	down	3.43	down	1.54	up	FONG	NR_034096
1.18	down	3.21	down	2.72	down	FOSL1	NM_005438
7.80	up	5.61	up	1.39	down	FOXA1	NM_004496
6.68	up	7.62	up	1.14	up	FOXD3	NM_012183
3.17	up	2.54	up	1.25	down	FOXD4	NM_207305
1.60	down	2.22	down	1.39	down	FOXF2	NM_001452
1.65	down	2.31	down	1.40	down	FOXP1	NM_00124480 8
2.17	up	1.64	up	1.32	down	FOXP4	NM_00101242 6
4.27	up	3.60	up	1.19	down	FOXRED 2	NM_024955
2.57	up	2.40	up	1.07	down	FOXRED 2	NM_024955
2.14	up	1.75	up	1.22	down	FRA10AC 1	NM_145246
2.85	up	3.14	up	1.10	up	FRMD4A	AK001072
2.44	up	1.99	up	1.23	down	FRMD4A	NM_018027
1.22	down	2.23	down	1.83	down	FSD1L	NM_031919
1.89	up	1.95	down	3.68	down	FST	NM_013409
2.28	down	2.85	down	1.25	down	FSTL3	NM_005860
3.35	up	2.83	up	1.18	down	FXYD3	NM_00113600 8
2.19	up	2.63	up	1.20	up	FXYD6	NM_022003
1.46	up	2.38	up	1.63	up	FZD8	NM_031866
43.03	up	22.78	up	1.89	down	GABRP	NM_014211
10.88	up	8.27	up	1.32	down	GAD1	NM_000817
4.35	down	6.06	down	1.39	down	GAL	NM_015973
2.04	down	1.69	down	1.21	up	GALNT1	NM_020474
2.45	down	2.89	down	1.18	down	GALNT6	NM_007210
5.21	down	3.94	down	1.32	up	GALNTL 2	NM_054110
3.82	down	4.09	down	1.07	down	GAST	NM_000805
2.36	up	3.49	up	1.48	up	GATM	NM_001482
2.42	up	2.72	up	1.13	up	GBP4	NM_052941
3.98	up	4.76	up	1.20	up	GCET2	NM_00119025 9
2.40	up	2.72	up	1.13	up	GCET2	NM_00119025 9
2.10	up	2.49	up	1.18	up	GCHFR	NM_005258

2.01	up	2.17	up	1.08	up	GGA2	NM_015044
2.06	up	1.63	up	1.27	down	GGT7	NM_178026
2.32	up	2.24	up	1.04	down	GHRLOS	NR_004431
2.22	up	1.72	up	1.29	down	GINS1	NM_021067
2.60	up	2.29	up	1.14	down	GINS4	NM_032336
2.26	down	2.74	down	1.21	down	GJA1	NM_000165
1.59	down	1.32	up	2.11	up	GJA4	NM_002060
1.91	down	4.10	down	2.14	down	GJB2	NM_004004
5.67	up	1.75	up	3.24	down	GJB4	NM_153212
7.49	down	13.62	down	1.82	down	GJB6	NM_006783
1.73	up	2.20	up	1.28	up	GKAP1	NM_025211
3.39	up	3.77	up	1.11	up	GLB1L2	NM_138342
10.43	up	10.96	up	1.05	up	GLS2	NM_013267
2.14	down	1.56	down	1.37	up	GNG11	NM_004126
3.48	down	4.59	down	1.32	down	GNGT1	NM_021955
2.04	up	1.83	up	1.11	down	GNRH1	NM_000825
1.94	up	2.40	up	1.24	up	GOLGA2P5	NR_024261
2.41	down	1.38	down	1.74	up	GOLGA6L7P	XR_110303
5.41	down	10.62	down	1.96	down	GOLGA7B	NM_001010917
2.17	up	2.13	up	1.02	down	GOLGA8A	NR_027409
6.39	up	6.93	up	1.08	up	GOLT1A	NM_198447
3.05	up	2.85	up	1.07	down	GPC2	NM_152742
1.30	down	2.10	down	1.61	down	GPM6B	NM_001001996
2.98	up	2.17	up	1.38	down	GPR126	NM_020455
2.11	up	1.52	up	1.39	down	GPR137	NM_020155
2.80	up	2.76	up	1.01	down	GPR137C	NM_001099652
8.92	down	4.51	down	1.98	up	GPR158	NM_020752
2.84	up	4.70	up	1.66	up	GPR64	NM_001079858
2.45	up	5.38	up	2.20	up	GPT	NM_005309
1.65	down	2.49	down	1.51	down	GPX8	NM_001008397
2.02	up	2.09	up	1.03	up	GRAMD4	NM_015124
7.88	up	13.33	up	1.69	up	GRIN2C	NM_000835
1.97	up	2.24	up	1.14	up	GRIN2C	NM_000835
1.34	down	2.40	down	1.78	down	GRIN3B	NM_138690

3.18	up	1.39	up	2.29	down	GRM8	NM_000845
2.08	down	5.36	down	2.58	down	GSDMC	NM_031415
2.15	down	1.65	down	1.30	up	GUCY2GP	NR_028134
2.26	up	2.35	up	1.04	up	GUSBP1	NR_027028
2.03	up	2.14	up	1.06	up	GUSBP1	NR_027028
1.92	up	2.03	up	1.06	up	GUSBP11	NR_024448
3.73	up	2.66	up	1.40	down	GUSBP3	AK124130
2.48	down	1.80	down	1.38	up	H2AFJ	NM_177925
2.17	up	1.63	up	1.33	down	H2AFV	NM_138635
2.00	up	2.13	up	1.07	up	H6PD	NM_004285
1.54	up	2.87	up	1.86	up	HAAO	NM_012205
3.12	up	2.19	up	1.42	down	HAUS3	NM_024511
2.39	up	2.39	up	1.00	down	HAUS5	NM_015302
2.37	up	1.31	up	1.81	down	HCFC1	NM_005334
1.24	down	2.04	down	1.65	down	HCG18	NR_024052
2.45	up	1.70	up	1.44	down	HCG27	NR_026791
2.95	up	2.29	up	1.29	down	HCN3	NM_020897
2.06	up	1.50	up	1.37	down	HDAC10	NM_032019
1.49	down	2.00	down	1.35	down	HEATR5A	BC062720
2.00	down	2.31	down	1.15	down	HEATR7A	NM_001099280
2.08	up	1.96	up	1.06	down	HELLS	NM_018063
1.89	up	2.05	up	1.08	up	HELLS	NM_018063
1.78	up	2.06	up	1.16	up	HENMT1	NM_144584
2.54	up	2.62	up	1.03	up	HESX1	NM_003865
1.88	down	2.34	down	1.25	down	HIF1A	NM_181054
1.95	down	2.17	down	1.11	down	HIF1A	NM_181054
2.89	down	2.19	down	1.32	up	HIST2H2AA4	NM_001040874
2.06	up	1.72	up	1.20	down	HIVEP1	NM_002114
3.74	up	2.55	up	1.47	down	HIVEP3	NM_024503
2.71	up	1.85	up	1.46	down	HIVEP3	NR_038260
5.81	up	9.96	up	1.71	up	HLF	NM_002126
2.23	up	2.39	up	1.07	up	HLTF	NM_003071
1.37	down	4.13	down	3.01	down	HMGA2	NM_003484
1.96	up	2.11	up	1.08	up	HMGB2	NM_002129
2.10	up	2.51	up	1.19	up	HMGN5	NM_030763
1.91	down	2.48	down	1.30	down	HMOX1	NM_002133
3.11	up	2.94	up	1.06	down	HMP19	AK098398
4.11	up	5.71	up	1.39	up	HMSD	NM_00112336

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1.55	up	2.04	up	1.32	up	HNRNPU -AS1	NR_026778
3.15	down	3.66	down	1.16	down	HOMER2	NM_199330
1.25	down	2.06	down	1.65	down	HOMER3	NM_00114572 2
1.29	down	2.16	down	1.68	down	HOMER3	NM_004838
1.33	down	2.46	down	1.84	down	HOMER3	NM_00114572 4
2.43	up	1.61	up	1.51	down	HOOK2	NM_013312
1.39	up	2.31	up	1.66	up	HOXA6	NM_024014
1.32	down	5.67	up	7.46	up	HOXA7	NM_006896
23.59	up	49.45	up	2.10	up	HOXB13	NM_006361
2.30	down	1.67	down	1.38	up	HOXB2	NM_002145
4.24	down	4.94	down	1.17	down	HOXC13	NM_017410
3.14	up	4.62	up	1.47	up	HOXC6	NM_153693
3.03	down	2.07	down	1.46	up	HOXD8	NM_019558
1.66	up	2.06	up	1.25	up	HP1BP3	NM_016287
2.41	up	2.81	up	1.17	up	HPCA	NM_002143
1.37	down	2.08	down	1.51	down	HPSE	NM_006665
1.30	down	3.20	down	2.45	down	HS1BP3	BC038847
2.99	up	1.99	up	1.51	down	HS3ST1	NM_005114
6.83	up	15.30	up	2.24	up	HS3ST4	NM_006040
2.75	up	2.26	up	1.21	down	HSD17B7	AK022929
2.90	down	3.91	down	1.35	down	HSPA12A	NM_025015
18.11	down	11.25	down	1.61	up	HSPB3	NM_006308
2.77	up	1.64	up	1.69	down	HSPG2	NM_005529
2.88	down	2.99	down	1.04	down	HTR7	NM_019859
2.12	down	2.00	down	1.06	up	HTR7P1	NR_002774
1.80	up	2.02	up	1.12	up	HVCN1	NM_00104010 7
1.62	up	2.10	up	1.29	up	HVCN1	NM_00104010 7
1.76	up	2.70	up	1.53	up	ICA1	NM_004968
1.65	up	2.51	up	1.53	up	ICA1	NM_004968
4.09	up	4.04	up	1.01	down	ICAM4	NM_022377
3.21	up	3.10	up	1.04	down	ICOSLG	
1.80	up	2.04	up	1.13	up	IFT122	NM_018262
2.24	down	3.86	down	1.72	down	IGF2BP2	NM_006548
4.43	down	7.80	down	1.76	down	IGF2BP2	NM_006548
3.43	down	3.64	down	1.06	down	IGFBP6	NM_002178
1.96	up	2.06	up	1.05	up	IGFBPL1	NM_00100756

							3
6.39	down	8.70	down	1.36	down	IGFL2	NM_00100291 5
2.13	up	1.91	up	1.11	down	IGLL1	NM_020070
3.26	up	2.87	up	1.13	down	IGSF9	NM_020789
2.54	up	2.10	up	1.21	down	IKBKE	NM_014002
3.56	up	2.81	up	1.27	down	IKZF3	NM_012481
1.40	up	3.79	down	5.33	down	IL11	NM_000641
1.77	up	2.25	up	1.27	up	IL11RA	NM_147162
9.01	up	8.70	up	1.04	down	IL17RB	NM_018725
2.08	up	2.53	down	5.25	down	IL1A	NM_000575
1.69	down	2.48	down	1.47	down	IL1RAP	NM_134470
1.57	down	5.16	down	3.29	down	IL20	NM_018724
3.82	up	3.44	up	1.11	down	IL23A	NM_016584
1.31	down	8.06	down	6.17	down	IL24	NM_00118515 6
3.33	up	3.30	up	1.01	down	IL27RA	NM_004843
3.67	up	2.34	up	1.57	down	IL2RG	NM_000206
2.02	up	2.34	up	1.16	up	IL2RG	NM_000206
1.54	up	2.18	up	1.41	up	IL34	NM_152456
2.56	up	2.60	up	1.01	up	IL4I1	NM_172374
2.01	up	2.13	up	1.06	up	ILDR1	NM_175924
2.70	down	3.59	down	1.33	down	INHBB	NM_002193
3.04	up	3.50	up	1.15	up	INPP1	NM_002194
2.34	up	2.13	up	1.10	down	INPP5F	NM_014937
1.86	up	2.11	up	1.13	up	INPP5J	NM_00100283 7
2.94	up	1.25	up	2.34	down	INTS4	NM_033547
1.43	up	1.47	down	2.10	down	INTS6	NM_012141
2.42	down	3.88	down	1.60	down	IRS1	NM_005544
2.65	down	3.71	down	1.40	down	IRS1	NM_005544
1.94	up	2.12	up	1.10	up	IRX3	NM_024336
5.95	up	5.20	up	1.14	down	IRX6	NM_024335
11.21	up	9.93	up	1.13	down	ISL1	NM_002202
2.88	up	2.75	up	1.05	down	ISYNA1	NM_016368
2.72	up	2.93	up	1.08	up	ISYNA1	NM_016368
1.29	down	2.03	down	1.58	down	ITGA5	NM_002205
1.16	down	2.42	down	2.10	down	ITGA6	NM_000210
1.19	down	2.65	down	2.22	down	ITGA6	NM_000210
2.25	down	1.71	down	1.32	up	ITGAD	NM_005353
1.36	down	2.03	down	1.49	down	JKAMP	NM_016475
1.80	down	2.68	down	1.49	down	JPH2	NM_020433

5.13	up	4.82	up	1.06	down	KATNAL 2	NM_031303
4.01	up	4.06	up	1.01	up	KATNAL 2	NM_031303
10.81	up	11.15	up	1.03	up	KCNA2	NM_00120426 9
2.63	down	1.83	down	1.44	up	KCNA6	NM_002235
10.06	up	13.08	up	1.30	up	KCNB2	NM_004770
1.11	down	2.09	down	1.88	down	KCNE1L	NM_012282
3.44	down	2.61	down	1.32	up	KCNE4	NM_080671
2.94	up	1.92	up	1.54	down	KCNIP4	NM_00103500 3
2.91	up	2.06	up	1.42	down	KCNJ14	NM_170720
1.62	down	2.46	down	1.52	down	KCNJ15	NM_170736
2.28	down	1.57	down	1.45	up	KCNJ8	NM_004982
1.13	down	2.17	up	2.45	up	KCNK17	NM_031460
2.31	down	1.33	down	1.74	up	KCNQ4	NM_004700
97.87	up	63.01	up	1.55	down	KCNS1	NM_002251
2.40	up	1.69	up	1.41	down	KDM4C	NM_00114669 4
11.79	up	4.36	up	2.70	down	KDM5D	NM_004653
9.73	up	13.35	up	1.37	up	KEL	NM_000420
2.23	down	1.36	down	1.64	up	KGFLP1	NR_003674
2.49	up	2.83	up	1.14	up	KHK	NM_000221
2.24	up	4.62	up	2.06	up	KIAA012 5	NR_026800
2.72	up	1.53	up	1.78	down	KIAA031 9L	AB058740
3.28	up	2.47	up	1.33	down	KIAA036 8	NM_00108039 8
2.38	up	2.34	up	1.02	down	KIAA048 5	AB007954
2.58	up	2.12	up	1.22	down	KIAA114 7	NM_00108039 2
2.14	up	2.11	up	1.02	down	KIAA114 7	NM_00108039 2
2.12	up	2.11	up	1.00	down	KIAA132 8	NM_020776
1.91	up	2.32	up	1.22	up	KIAA140 7	NM_020817
2.78	up	1.55	up	1.80	down	KIAA152 2	NM_020888

1.79	up	2.35	up	1.31	up	KIAA1683	NM_025249
3.18	up	6.04	up	1.90	up	KIAA2022	NM_001008537
1.18	down	2.11	down	1.78	down	KIF13A	NM_022113
2.41	up	1.70	up	1.42	down	KIF15	NM_020242
2.32	up	1.57	up	1.47	down	KIF20A	NM_005733
3.00	up	2.21	up	1.36	down	KIF24	NM_194313
10.15	up	14.69	up	1.45	up	KIF25	NM_030615
2.13	up	1.34	up	1.58	down	KIF2C	NM_006845
1.75	down	2.28	down	1.30	down	KIRREL	NM_018240
2.12	down	2.24	down	1.06	down	KIRREL	AK090554
2.14	up	2.39	up	1.12	up	KITLG	NM_000899
1.43	down	3.02	down	2.11	down	KLC3	NM_177417
1.76	down	2.34	down	1.33	down	KLF7	NM_003709
3.62	up	3.46	up	1.05	down	KLHDC7B	NM_138433
2.77	up	2.26	up	1.23	down	KLHL23	NM_144711
10.91	up	9.55	up	1.14	down	KLHL35	NM_001039548
2.94	down	5.16	down	1.76	down	KLK10	NM_002776
3.03	down	6.78	down	2.24	down	KLK8	NM_144505
5.67	down	5.84	down	1.03	down	KLK9	NM_012315
2.92	up	2.62	up	1.11	down	KNTC1	NM_014708
2.32	down	4.51	down	1.94	down	KPNA7	NM_001145715
2.76	down	4.47	down	1.62	down	KPNA7	NM_001145715
3.30	up	3.00	up	1.10	down	KREMEN1	NM_001039570
8.30	up	4.83	up	1.72	down	KREMEN2	NM_172229
15.86	up	10.00	up	1.59	down	KRT13	NM_002274
1.22	up	3.41	down	4.16	down	KRT14	NM_000526
7.60	up	4.45	up	1.71	down	KRT15	NM_002275
1.11	up	3.36	down	3.73	down	KRT17	NM_000422
137.25	up	43.31	up	3.17	down	KRT19	NM_002276
84.61	up	33.18	up	2.55	down	KRT19P2	NR_036685
1.66	down	4.34	down	2.61	down	KRT42P	NR_033415
7.39	down	4.59	down	1.61	up	KRT42P	NR_033415
2.25	up	1.96	up	1.15	down	KRT86	NM_002284

12.66	down	16.24	down	1.28	down	KRTDAP	NM_207392
3.75	up	4.22	up	1.13	up	L3MBTL 1	NM_032107
3.05	up	2.47	up	1.24	down	L3MBTL 1	NM_032107
2.47	up	2.96	up	1.20	up	L3MBTL 1	XR_109604
2.44	up	2.86	up	1.17	up	L3MBTL 1	XR_109604
4.21	up	4.62	up	1.10	up	L3MBTL 4	NM_173464
3.91	up	3.94	up	1.01	up	L3MBTL 4	NM_173464
2.00	down	2.03	down	1.01	down	LAMA4	NM_00110520 6
2.24	down	1.66	down	1.35	up	LAMA4	NM_00110520 9
2.56	up	1.88	down	4.83	down	LAMC2	NM_018891
1.88	down	2.74	down	1.46	down	LANCL3	NM_198511
7.41	down	4.91	down	1.51	up	LCE2A	NM_178428
5.64	down	7.09	down	1.26	down	LCE3C	NM_178434
2.44	up	1.69	up	1.45	down	LCORL	NM_153686
2.35	down	1.61	down	1.46	up	LDB3	NM_00117161 0
6.04	up	3.26	up	1.85	down	LDHC	NM_002301
3.33	up	2.75	up	1.21	down	LEAP2	NM_052971
2.13	down	2.16	down	1.01	down	LEPROT	NM_00119868 3
2.03	down	2.59	down	1.27	down	LETM2	NM_144652
1.49	down	1.55	up	2.31	up	LGALS4	NM_006149
2.39	up	1.89	up	1.27	down	LGALS9	NM_009587
2.26	up	2.14	up	1.05	down	LGALS9 C	NM_00104007 8
3.10	up	3.00	up	1.04	down	LHFPL1	NM_178175
3.48	down	8.44	down	2.43	down	LHX1	NM_005568
10.91	up	6.94	up	1.57	down	LHX2	NM_004789
3.37	up	3.35	up	1.01	down	LIFR	NM_002310
2.70	up	2.56	up	1.05	down	LIG1	NM_000234
2.96	down	2.89	down	1.02	up	LIMS3-LOC4408 95	NR_027145
2.23	up	2.87	up	1.28	up	LINC0002	NR_024358

						8	
1.55	down	2.04	down	1.32	down	LINC00152	NR_024204
3.37	up	2.80	up	1.20	down	LINC00173	NR_027346
2.89	up	2.73	up	1.06	down	LINC00173	NR_027345
7.40	up	2.88	up	2.57	down	LINC00230A	NR_002161
2.06	up	2.59	up	1.26	up	LINC00240	NR_026775
2.38	up	1.89	up	1.26	down	LINC00263	NR_026762
3.42	up	2.57	up	1.33	down	LINC00319	NR_026960
2.00	up	1.49	up	1.34	down	LINC00472	NR_026807
2.17	down	1.51	down	1.44	up	LINC00487	NR_038369
9.68	up	5.26	up	1.84	down	LINGO2	NM_152570
3.08	down	1.88	down	1.64	up	LIPC	NM_000236
1.35	up	3.11	up	2.30	up	LIPE	NM_005357
4.98	up	3.48	up	1.43	down	LMO4	NM_006769
4.93	up	3.37	up	1.46	down	LMO4	NM_006769
2.47	down	2.18	down	1.13	up	LMOD1	NM_012134
2.42	down	2.14	down	1.13	up	LOC100127891	XR_108812
4.06	up	4.23	up	1.04	up	LOC100127909	XR_111781
2.19	up	2.89	up	1.32	up	LOC100128191	NR_027157
4.28	up	5.24	up	1.22	up	LOC100128252	NR_036522
3.06	up	4.07	up	1.33	up	LOC100128252	NR_036522
2.06	up	1.68	up	1.22	down	LOC100128361	NR_036505
2.20	up	2.29	up	1.04	up	LOC100128402	AK124574
2.00	down	1.35	down	1.49	up	LOC100128869	XM_001719518
1.73	down	2.83	down	1.64	down	LOC1001	NR_036480

						28881	
3.79	up	4.00	up	1.06	up	LOC1001 29148	NR_033999
1.66	up	2.11	up	1.27	up	LOC1001 29196	NR_034182
2.77	up	1.88	up	1.48	down	LOC1001 29216	NM_00124285 3
2.79	up	2.15	up	1.30	down	LOC1001 29387	NR_024490
2.56	up	2.95	up	1.15	up	LOC1001 29534	NR_024489
2.11	down	4.21	down	2.00	down	LOC1001 29781	XR_109259
2.78	down	4.19	down	1.51	down	LOC1001 29781	XR_109258
2.04	up	1.98	up	1.03	down	LOC1001 29917	NR_036511
2.94	up	2.75	up	1.07	down	LOC1001 30093	NR_024485
2.00	up	1.65	up	1.21	down	LOC1001 30463	AK124300
2.27	up	2.53	up	1.11	up	LOC1001 30930	AK126579
2.35	down	3.67	down	1.57	down	LOC1001 30938	XR_110148
2.60	down	4.66	down	1.80	down	LOC1001 30938	XR_110148
3.02	down	4.11	down	1.36	down	LOC1001 30938	XR_110148
2.09	up	3.20	up	1.53	up	LOC1001 31096	NR_040071
1.99	down	2.09	down	1.05	down	LOC1001 31242	AK124483
1.97	up	2.99	up	1.52	up	LOC1001 31355	AK124217
1.84	up	2.62	up	1.42	up	LOC1001 31564	NR_034089
1.84	up	2.60	up	1.42	up	LOC1001 31564	NR_034089
5.16	up	5.47	up	1.06	up	LOC1001 31654	AK124891
3.14	up	2.33	up	1.35	down	LOC1001	AK126439

						31929	
3.43	up	2.99	up	1.15	down	LOC100132111	NR_024237
2.40	up	1.96	up	1.22	down	LOC100132167	BC006438
2.19	up	2.24	up	1.02	up	LOC100132247	NM_001135865
2.21	up	1.82	up	1.22	down	LOC100132287	NR_028322
2.22	up	2.38	up	1.07	up	LOC100132352	AK023536
2.17	up	2.01	up	1.08	down	LOC100132832	NR_028058
2.03	up	1.79	up	1.13	down	LOC100132832	NR_028058
2.15	up	2.08	up	1.03	down	LOC100133050	NR_027503
2.68	up	2.41	up	1.11	down	LOC100133315	NR_029192
2.10	up	1.68	up	1.25	down	LOC100133331	NR_028327
2.44	up	2.23	up	1.10	down	LOC100144603	BQ706985
2.56	up	2.86	up	1.12	up	LOC100170939	NR_024054
2.20	up	3.48	up	1.58	up	LOC100233156	AK126241
3.65	up	2.17	up	1.68	down	LOC100272216	NR_027439
2.60	up	3.28	up	1.26	up	LOC100287188	XM_003119104
1.65	down	2.57	down	1.56	down	LOC100287314	NR_040245
2.28	up	2.07	up	1.10	down	LOC100288637	NR_038253
2.12	down	1.87	down	1.13	up	LOC100288911	NR_037631
2.28	down	1.96	down	1.17	up	LOC100288911	NR_037631
1.80	up	2.19	up	1.22	up	LOC100289097	XM_002343891
2.36	up	2.51	up	1.06	up	LOC1002	NR_036530

						89230	
1.55	up	2.34	up	1.50	up	LOC100499466	NR_027418
2.23	up	2.41	up	1.08	up	LOC100505483	NR_038926
2.31	up	1.76	up	1.32	down	LOC100505648	AK125393
2.11	up	1.86	up	1.14	down	LOC100505666	NR_040772
2.42	down	3.06	down	1.27	down	LOC100505668	XR_112556
2.11	down	1.54	down	1.37	up	LOC100505679	NM_001243531
2.20	down	2.34	down	1.06	down	LOC100505687	NR_038301
1.39	up	2.61	up	1.88	up	LOC100505719	XR_110561
2.65	down	2.72	down	1.03	down	LOC100505729	XR_108524
1.41	up	3.27	up	2.32	up	LOC100505799	XR_111953
7.46	up	2.55	up	2.93	down	LOC100505882	XR_110336
1.68	up	2.06	up	1.23	up	LOC100505960	XR_108741
2.81	down	1.18	down	2.39	up	LOC100505976	XR_110096
6.13	up	3.89	up	1.58	down	LOC100506003	XR_109785
2.89	up	3.34	up	1.16	up	LOC100506123	NR_040097
2.66	up	3.45	up	1.30	up	LOC100506123	NR_040097
1.65	down	2.09	down	1.27	down	LOC100506136	NR_038948
3.17	up	2.07	up	1.54	down	LOC100506255	XM_003403636
2.72	up	2.28	up	1.19	down	LOC100506262	XR_109925
3.47	up	1.93	up	1.80	down	LOC100506314	NR_038920
2.19	down	1.71	down	1.29	up	LOC1005	XR_112081

						06327	
15.22	up	2.12	up	7.19	down	LOC1005 06328	AK055877
7.42	up	1.61	up	4.62	down	LOC1005 06328	AK055877
5.82	up	1.45	up	4.03	down	LOC1005 06328	AK055877
2.05	up	2.15	up	1.05	up	LOC1005 06342	XR_108862
2.44	up	2.31	up	1.05	down	LOC1005 06379	XR_108672
2.39	up	2.16	up	1.11	down	LOC1005 06472	NR_040535
3.54	up	2.65	up	1.33	down	LOC1005 06503	XR_109701
3.98	up	4.02	up	1.01	up	LOC1005 06538	XR_108868
2.97	up	3.39	up	1.14	up	LOC1005 06553	XR_109636
3.75	up	2.57	up	1.46	down	LOC1005 06660	NR_038927
1.95	down	2.20	down	1.13	down	LOC1005 06714	NR_038956
2.81	down	4.61	down	1.64	down	LOC1005 06718	XR_110230
13.48	down	3.80	down	3.55	up	LOC1005 06783	NR_038435
2.17	up	2.35	up	1.08	up	LOC1005 06821	XR_109474
1.97	down	2.62	down	1.33	down	LOC1005 06860	XR_108813
2.34	down	2.26	down	1.03	up	LOC1005 06870	XR_110520
3.94	down	9.82	down	2.49	down	LOC1005 06895	NR_038276
2.05	up	2.36	up	1.15	up	LOC1005 06930	AK090827
2.00	up	1.88	up	1.07	down	LOC1005 06930	AK090827
2.83	up	2.29	up	1.23	down	LOC1005 06934	XR_109940
2.80	up	2.65	up	1.06	down	LOC1005	XR_113296

						06992	
8.94	up	4.94	up	1.81	down	LOC100506994	NR_038281
4.05	down	2.19	down	1.85	up	LOC100506995	XR_108482
2.27	up	2.45	up	1.08	up	LOC100507018	XR_108884
2.81	up	2.96	up	1.05	up	LOC100507053	NR_037884
3.67	up	3.32	up	1.11	down	LOC100507094	XR_109558
3.07	down	10.03	down	3.27	down	LOC100507127	NR_038291
2.75	up	1.98	up	1.39	down	LOC100507128	XR_109038
2.05	up	1.96	up	1.05	down	LOC100507149	XR_132713
2.38	up	2.31	up	1.03	down	LOC100507153	XR_110384
2.48	up	3.38	up	1.36	up	LOC100507161	XM_003118878
1.97	up	2.47	up	1.25	up	LOC100507266	NR_037888
2.12	up	1.72	up	1.24	down	LOC100507312	XR_113288
3.92	up	3.78	up	1.04	down	LOC100507404	XR_133567
3.10	down	6.08	down	1.96	down	LOC100507420	XR_110876
7.95	up	9.39	up	1.18	up	LOC100507421	NM_001195278
3.35	down	3.64	down	1.09	down	LOC100507429	XR_110179
3.48	down	3.51	down	1.01	down	LOC100507429	XR_110179
2.04	up	2.33	up	1.14	up	LOC100507501	NR_039999
3.12	down	1.91	down	1.64	up	LOC100507554	XR_108428
3.31	up	3.16	up	1.05	down	LOC100507580	XR_109752
1.80	down	2.35	down	1.31	down	LOC1005	XR_110188

						07624	
2.29	up	2.31	up	1.01	up	LOC1005 07663	XR_132568
2.71	up	1.57	up	1.72	down	LOC1005 07760	XR_113110
1.71	down	2.01	down	1.18	down	LOC1005 08950	XR_112293
2.07	up	2.55	up	1.23	up	LOC1005 08995	XR_111214
4.25	up	3.40	up	1.25	down	LOC1005 09075	XR_111772
3.32	up	4.10	up	1.24	up	LOC1005 09075	XR_111771
40.65	up	8.91	up	4.56	down	LOC1005 09121	XM_00312033 4
2.48	up	2.66	up	1.07	up	LOC1005 09263	XM_00340344 3
2.31	up	2.33	up	1.01	up	LOC1005 27964	NR_037642
3.15	up	2.04	up	1.54	down	LOC1006 16668	NR_038258
2.22	up	2.69	up	1.21	up	LOC1006 52912	XR_132665
2.49	up	3.55	up	1.42	up	LOC1006 52917	XR_132741
3.32	down	1.86	down	1.79	up	LOC1006 52963	XM_00340347 2
3.52	up	2.33	up	1.51	down	LOC1006 53030	XR_132913
1.32	up	2.17	up	1.65	up	LOC1006 53193	XM_00340383 3
1.60	up	2.08	up	1.29	up	LOC1006 53329	XR_133136
1.73	down	2.07	down	1.20	down	LOC1006 53338	XR_133053
2.64	up	2.74	up	1.04	up	LOC1151 10	NR_026927
1.90	up	2.35	up	1.23	up	LOC1151 10	NR_026927
1.59	up	2.10	up	1.32	up	LOC1432 86	AL049428
2.47	down	4.87	down	1.97	down	LOC1497	NR_034147

						73	
3.53	down	4.89	down	1.38	down	LOC149773	NR_034147
1.69	up	2.53	up	1.50	up	LOC151657	AK091114
2.62	up	1.67	up	1.57	down	LOC157860	AK025743
1.89	up	2.39	up	1.26	up	LOC202025	AL713660
2.21	up	1.86	up	1.19	down	LOC202181	NR_026921
3.23	up	3.75	up	1.16	up	LOC219731	NR_038222
2.92	down	1.53	down	1.91	up	LOC254057	AK024653
8.03	up	11.72	up	1.46	up	LOC254559	NR_015411
5.39	up	8.50	up	1.58	up	LOC254559	NR_015411
5.08	up	9.66	up	1.90	up	LOC255167	NR_024424
2.20	down	1.58	down	1.39	up	LOC255177	BC031230
2.47	up	1.02	up	2.42	down	LOC257396	BC041894
7.90	up	10.04	up	1.27	up	LOC283174	NR_024344
7.83	up	8.83	up	1.13	up	LOC283174	NR_024344
7.15	up	7.91	up	1.11	up	LOC283174	NR_024344
3.58	up	3.70	up	1.03	up	LOC283174	NR_024344
2.26	down	1.62	down	1.40	up	LOC283352	AK097496
3.96	down	5.19	down	1.31	down	LOC283404	NR_027358
13.82	up	37.54	up	2.72	up	LOC283485	AK093862
2.10	up	3.08	up	1.47	up	LOC283713	AK094982
2.25	up	1.40	up	1.60	down	LOC2840	NR_024349

						23	
6.20	up	6.14	up	1.01	down	LOC284630	AK096384
2.93	up	3.45	up	1.17	up	LOC284837	NR_026961
1.93	up	2.04	up	1.05	up	LOC284837	NR_026961
1.81	up	2.90	up	1.60	up	LOC284837	NR_026961
66.28	up	83.68	up	1.26	up	LOC285084	NR_038897
33.88	up	48.47	up	1.43	up	LOC285084	NR_038897
1.87	up	2.47	up	1.32	up	LOC285540	NR_037934
2.21	down	1.90	down	1.16	up	LOC285847	NR_027117
2.06	up	2.75	up	1.33	up	LOC286161	AK091672
1.14	up	2.01	up	1.77	up	LOC286367	NR_024011
1.77	up	2.20	up	1.24	up	LOC338799	NR_002809
3.76	up	4.09	up	1.09	up	LOC338817	NR_033890
4.69	down	4.47	down	1.05	up	LOC339240	NR_001443
6.40	down	4.24	down	1.51	up	LOC339240	NR_001443
2.38	down	2.20	down	1.08	up	LOC339807	NR_034023
1.66	up	2.82	up	1.71	up	LOC349196	NR_027000
17.66	up	18.94	up	1.07	up	LOC375196	NR_028386
3.58	down	2.89	down	1.24	up	LOC375295	NR_040001
4.02	down	3.36	down	1.20	up	LOC375295	NR_040001
4.55	down	3.50	down	1.30	up	LOC375295	NR_040001
1.72	down	3.80	down	2.21	down	LOC3887	XR_109642

						80	
2.71	up	2.09	up	1.30	down	LOC389602	XR_108709
1.88	up	2.21	up	1.18	up	LOC389641	NR_033928
5.38	up	2.84	up	1.89	down	LOC389831	NM_001242480
4.75	up	3.04	up	1.56	down	LOC389831	AK123495
4.68	up	3.18	up	1.47	down	LOC389831	NM_001242480
2.36	up	3.29	up	1.40	up	LOC389834	NR_027420
2.16	up	3.41	up	1.58	up	LOC389834	NR_027420
2.11	up	4.56	up	2.16	up	LOC389834	NR_027420
1.69	up	2.35	up	1.39	up	LOC389834	NR_027420
2.31	up	1.77	up	1.31	down	LOC399900	XR_111182
1.79	up	2.31	up	1.29	up	LOC401068	XR_110024
4.81	up	5.45	up	1.13	up	LOC401109	NR_034088
2.43	up	2.71	up	1.12	up	LOC401109	NR_034088
2.71	up	5.74	up	2.12	up	LOC401431	NR_027040
3.56	up	4.86	up	1.36	up	LOC401561	AY129027
2.92	down	1.64	down	1.78	up	LOC439990	NR_038464
4.16	up	3.95	up	1.05	down	LOC440792	AB051440
2.86	up	3.61	up	1.26	up	LOC441268	AK125166
1.41	up	2.90	up	2.06	up	LOC497257	BC030211
1.53	down	2.02	down	1.32	down	LOC541471	NR_024373
14.82	up	10.38	up	1.43	down	LOC5414	NR_003602

						73	
2.27	up	2.23	up	1.02	down	LOC553103	NR_037898
6.21	up	7.36	up	1.19	up	LOC642366	XR_108597
2.09	up	2.25	up	1.08	up	LOC644339	XR_132877
2.09	up	2.20	up	1.05	up	LOC644656	NR_036539
2.20	down	2.12	down	1.04	up	LOC645722	XR_132630
1.11	down	2.53	down	2.27	down	LOC646329	NR_034120
3.09	up	2.32	up	1.33	down	LOC646719	XR_112726
2.45	up	3.01	up	1.23	up	LOC646778	XR_132648
4.25	up	2.82	up	1.51	down	LOC647946	NR_024391
4.14	up	2.90	up	1.43	down	LOC647946	BC035184
2.02	down	1.54	down	1.31	up	LOC649294	AK091259
2.87	up	1.50	up	1.91	down	LOC653160	NR_037869
2.03	down	1.16	down	1.76	up	LOC653720	XM_002344825
2.57	up	3.02	up	1.18	up	LOC728061	AK025151
2.76	up	2.48	up	1.11	down	LOC728147	AK096262
2.12	down	1.63	down	1.30	up	LOC728190	NR_024397
3.04	up	4.56	up	1.50	up	LOC728537	NR_038386
1.96	up	3.45	up	1.76	up	LOC728537	NR_038386
4.95	up	5.33	up	1.08	up	LOC728715	XM_003119524
3.04	down	1.53	down	1.99	up	LOC729178	NR_034115
2.44	up	2.45	up	1.01	up	LOC7293	AK055581

						24	
3.41	up	2.17	up	1.57	down	LOC729558	AK096995
2.59	up	3.46	up	1.34	up	LOC729732	XR_132886
2.32	down	1.61	down	1.44	up	LOC729887	BC052334
3.32	up	7.06	up	2.13	up	LOC84856	NR_026827
3.15	up	6.06	up	1.92	up	LOC84856	NR_026827
2.20	up	1.88	up	1.17	down	LOC90784	NR_026984
4.70	down	2.44	down	1.93	up	LPL	NM_000237
1.34	down	2.06	down	1.54	down	LPPR4	NM_014839
1.64	down	2.29	down	1.39	down	LRP11	NM_032832
2.40	up	2.08	up	1.15	down	LRPAP1	NM_002337
2.20	up	1.18	up	1.86	down	LRRC42	
3.20	up	3.85	up	1.20	up	LRRC56	NM_198075
2.13	up	1.93	up	1.10	down	LRRC61	NM_001142928
2.62	down	2.63	down	1.01	down	LRRC69	NM_001129890
2.99	down	2.71	down	1.10	up	LRRC69	NM_001129890
2.11	up	1.87	up	1.13	down	LRRC8B	NM_015350
6.09	up	4.01	up	1.52	down	LRRIQ1	NM_001079910
5.31	up	3.96	up	1.34	down	LRRN1	NM_020873
2.11	up	1.35	up	1.56	down	LSM14B	NM_144703
21.08	up	27.98	up	1.33	up	LTF	NM_002343
2.54	up	2.19	up	1.16	down	LTN1	BC031633
5.12	up	3.84	up	1.33	down	LY75	NM_002349
2.16	up	1.96	up	1.10	down	MACROD2	BC035876
3.59	down	2.79	down	1.29	up	MAGEA6	NM_175868
2.39	up	1.84	up	1.30	down	MAGI3	NM_152900
3.69	up	1.79	up	2.06	down	MAK	NM_005906
13.22	up	8.79	up	1.50	down	MAL	NM_002371
3.30	up	2.88	up	1.14	down	MAMDC4	NM_206920
2.00	down	2.13	down	1.06	down	MAP1LC	NM_022818

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1.65	down	2.11	down	1.28	down	MAP2K4	NM_003010
2.88	up	2.53	up	1.14	down	MAP3K13	NM_004721
2.64	up	3.19	up	1.21	up	MAP3K14	NM_003954
2.57	up	2.36	up	1.09	down	MAP3K6	NM_004672
1.88	down	2.43	down	1.30	down	MAP7	NM_003980
10.68	up	12.22	up	1.14	up	MAP7D2	NM_152780
2.24	up	2.42	up	1.08	up	MAP7D2	NM_152780
1.72	down	2.19	down	1.27	down	MAP7D3	NM_024597
2.62	up	4.73	up	1.80	up	MAPK4	NM_002747
2.02	up	1.50	up	1.35	down	MAPK8	AB074280
2.58	up	1.41	up	1.84	down	MARVELD2	NM_001038603
2.45	up	1.68	up	1.46	down	MARVELD2	AK055094
2.23	up	1.89	up	1.18	down	MAST4	NM_001164664
2.49	up	4.55	up	1.82	up	MAT1A	NM_000429
3.35	up	3.44	up	1.03	up	MCF2L	NM_024979
2.41	up	3.09	up	1.28	up	MCF2L	NM_024979
4.55	up	6.49	up	1.43	up	MCF2L-AS1	NR_034002
1.53	down	2.11	down	1.38	down	MCFD2	NM_139279
2.26	up	1.59	up	1.42	down	MCM10	NM_182751
3.45	up	3.38	up	1.02	down	MCM2	NM_004526
2.19	up	2.04	up	1.07	down	MCM3	NM_002388
2.01	up	1.50	up	1.34	down	MCM4	NM_005914
2.17	up	2.40	up	1.11	up	MCM5	NM_006739
2.20	up	2.57	up	1.16	up	MCM5	NM_006739
2.17	up	1.93	up	1.13	down	MCM7	NM_182776
2.59	up	2.60	up	1.00	up	MCM8	NM_182802
1.62	down	2.55	down	1.58	down	MDFI	NM_005586
1.96	up	2.89	up	1.48	up	MDK	NM_001012334
2.38	up	2.48	up	1.04	up	MDM1	NM_017440
2.42	up	2.69	up	1.11	up	MDM2	NM_002392
2.12	up	1.79	up	1.18	down	MDM2	NM_002392
2.78	down	3.44	down	1.24	down	ME1	NM_002395
2.54	up	3.64	up	1.43	up	MECOM	NM_005241
2.08	up	3.05	up	1.47	up	MECOM	NM_00116400

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6.59	up	7.12	up	1.08	up	MEI1	NM_152513
2.51	up	2.75	up	1.10	up	MEIS1	NM_002398
1.87	up	2.88	up	1.54	up	MESP1	NM_018670
1.83	down	1.65	up	3.02	up	METTL7A	NM_014033
2.52	up	1.69	up	1.49	down	MFI2	NM_005929
2.09	up	2.52	up	1.21	up	MFI2-AS1	NR_038285
1.31	down	2.61	down	1.99	down	MFSD2A	NM_001136493
4.37	up	4.39	up	1.00	up	MFSD4	NM_181644
8.28	up	11.71	up	1.41	up	MGAT3	NM_002409
2.07	up	1.50	up	1.38	down	MIB1	NM_020774
2.81	up	2.92	up	1.04	up	MICALL2	NM_182924
2.00	up	2.05	up	1.02	up	MID1	NM_001193278
1.91	down	2.07	down	1.08	down	MIR143HG	NR_027180
4.46	up	3.33	up	1.34	down	MIR600HG	NR_026677
2.21	up	2.17	up	1.02	down	MIRLET7BHG	NR_027033
2.33	up	1.62	up	1.44	down	MKI67	NM_002417
2.62	up	2.36	up	1.11	down	MLF1IP	NM_024629
1.69	up	2.01	up	1.19	up	MLLT6	NM_005937
1.61	up	2.24	up	1.39	up	MLPH	NM_024101
2.15	up	2.84	up	1.32	up	MMAA	NM_172250
2.23	down	1.66	down	1.34	up	MME	NM_007289
3.71	down	3.52	down	1.05	up	MME	NM_007289
1.66	down	2.89	down	1.74	down	MMRN2	XR_111094
1.72	up	1.75	down	3.01	down	MNAT1	NM_002431
3.85	up	2.27	up	1.69	down	MNS1	NM_018365
3.54	down	2.96	down	1.20	up	MORN4	BC022054
1.30	up	2.46	up	1.89	up	MOSC2	NM_017898
1.63	down	2.35	down	1.44	down	MOSPD1	NM_019556
2.55	up	4.00	up	1.57	up	MOXD1	NM_015529
1.53	down	2.43	down	1.58	down	MPDU1	AK027742
7.22	up	4.16	up	1.73	down	MPP2	NM_005374
4.04	up	2.24	up	1.80	down	MPP2	NM_005374
1.44	down	2.55	down	1.77	down	MPP6	NM_016447
4.09	down	5.64	down	1.38	down	MPPED1	NM_00104437

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1.69	down	2.23	down	1.32	down	MPZL3	NM_198275
2.03	down	1.68	down	1.21	up	MRGPRG	NM_001164377
2.06	up	1.75	up	1.17	down	MSH2	NM_000251
2.04	up	2.11	up	1.03	up	MST1	NM_020998
1.70	up	2.17	up	1.28	up	MST1	NM_020998
2.74	down	2.87	down	1.05	down	MST1	BC044862
4.60	up	2.67	up	1.72	down	MST1R	NM_002447
4.70	down	4.36	down	1.08	up	MSX2P1	NR_002307
2.02	down	2.17	down	1.07	down	MT1E	NM_175617
1.48	up	2.74	up	1.85	up	MTERFD2	NR_028049
1.55	down	2.06	down	1.33	down	MTHFD1L	NM_015440
1.97	down	2.28	down	1.15	down	MTHFD1L	NM_015440
1.26	down	2.35	down	1.86	down	MTSS1	NM_014751
2.14	up	1.70	up	1.26	down	MTX3	NM_001010891
22.78	up	9.42	up	2.42	down	MUC21	NM_001010909
2.34	down	2.79	down	1.19	down	MUSK	NM_005592
3.07	up	3.09	up	1.01	up	MXD3	NM_001142935
1.48	down	2.07	down	1.40	down	MXRA7	NM_001008529
5.04	up	5.36	up	1.06	up	MYB	NM_005375
5.55	up	4.86	up	1.14	down	MYCN	NM_005378
2.27	up	1.98	up	1.14	down	MYEOV	NM_138768
2.11	up	2.81	up	1.33	up	MYO15B	AK074680
1.41	down	2.17	down	1.54	down	MYO1B	NM_012223
10.70	up	9.94	up	1.08	down	MYO3A	NM_017433
7.21	up	8.41	up	1.17	up	MYO3A	BC036079
2.77	down	2.90	down	1.05	down	MYO5A	NM_000259
3.19	up	1.77	up	1.80	down	MYO5B	NM_001080467
1.70	up	2.99	up	1.76	up	MYO5C	NM_018728
1.89	up	2.17	up	1.15	up	MZT2A	BC017694
5.91	down	3.01	down	1.96	up	NAP1L2	NM_021963
2.82	up	1.95	up	1.45	down	NASP	NM_002482
1.86	down	2.28	down	1.22	down	NAV1	NM_020443

1.85	down	4.30	down	2.33	down	NAV3	NM_014903
2.66	down	2.05	down	1.30	up	NAV3	NM_014903
2.02	up	1.79	up	1.13	down	NBPF15	BX538005
1.51	up	2.08	up	1.38	up	NCK2	NM_001004722
29.20	up	9.13	up	3.20	down	NCRNA00185	NR_001544
2.00	up	1.37	up	1.46	down	NDC80	NM_006101
1.52	down	2.17	down	1.43	down	NDEL1	NM_030808
2.61	down	2.26	down	1.15	up	NDST2	BC018681
6.97	down	4.51	down	1.54	up	NEB	NM_004543
3.08	up	2.73	up	1.13	down	NEDD1	NM_152905
3.97	up	3.14	up	1.26	down	NEDD4L	NM_001144967
3.39	up	3.14	up	1.08	down	NEDD4L	NM_015277
2.07	up	2.65	up	1.28	up	NEURL	NM_004210
2.91	up	2.54	up	1.14	down	NEURL1B	NM_001142651
13.00	up	6.64	up	1.96	down	NEURL3	NR_026875
3.25	down	3.10	down	1.05	up	NEXN	NM_144573
2.57	down	2.22	down	1.16	up	NFASC	NM_001005388
3.75	up	3.75	up	1.00	down	NFE2L3	NM_004289
2.93	up	2.54	up	1.15	down	NFIB	NM_005596
2.28	up	1.93	up	1.18	down	NFKB2	NM_001077493
2.32	up	1.93	up	1.20	down	NFKBID	NM_139239
1.50	up	3.56	down	5.32	down	NGEF	NM_019850
6.71	up	2.85	up	2.36	down	NGFR	NM_002507
3.00	up	2.86	up	1.05	down	NINJ1	NM_004148
2.42	up	2.44	up	1.01	up	NINL	NM_025176
1.84	up	2.46	up	1.34	up	NINL	NM_025176
1.23	down	2.59	down	2.11	down	NIPAL1	NM_207330
2.87	down	3.32	down	1.16	down	NIPAL4	NM_001172292
1.90	down	2.19	down	1.16	down	NME4	NM_005009
3.77	up	2.80	up	1.35	down	NMU	NM_006681
3.82	down	2.69	down	1.42	up	NNMT	NM_006169
3.41	up	8.91	up	2.61	up	NOS2	NM_000625
4.38	up	3.21	up	1.37	down	NOTCH1	NM_017617
1.04	up	3.02	up	2.91	up	NOVA1	NM_002515
3.26	up	3.92	up	1.20	up	NPB	NM_148896

4.17	up	5.08	up	1.22	up	NPPC	NM_024409
9.39	down	1.94	down	4.85	up	NPTX1	NM_002522
3.30	down	4.56	down	1.38	down	NQO1	NM_000903
3.96	up	6.73	up	1.70	up	NR3C2	NM_000901
1.16	down	3.38	down	2.91	down	NRG1	AF176921
1.33	down	4.11	down	3.10	down	NRG1	NM_004495
1.54	down	5.49	down	3.57	down	NRG1	NM_004495
2.78	up	3.76	up	1.35	up	NRG2	NM_013982
2.01	down	1.85	down	1.08	up	NRP1	NM_00102462 9
3.96	up	2.59	up	1.53	down	NSUN7	NM_024677
2.75	up	1.47	up	1.87	down	NT5DC3	NM_00103170 1
2.32	down	4.09	down	1.76	down	NT5E	NM_002526
3.03	down	4.38	down	1.45	down	NT5E	NM_002526
2.18	up	2.49	up	1.14	up	NT5M	NM_020201
3.46	up	4.07	up	1.18	up	NUP210	NM_024923
2.02	up	1.72	up	1.18	down	NUP62	NM_153719
1.92	up	2.29	up	1.19	up	NUP62CL	NM_017681
2.00	up	1.94	up	1.03	down	NUSAP1	NM_016359
2.06	down	1.35	down	1.52	up	NXF5	NM_032946
2.22	up	2.42	up	1.09	up	NYNRIN	NM_025081
5.55	up	8.46	up	1.52	up	OCA2	NM_000275
5.16	up	9.89	up	1.92	up	ODAM	NM_017855
1.41	up	2.01	up	1.43	up	OGT	NM_181672
4.91	up	7.39	up	1.51	up	OLFM1	NM_014279
3.95	up	5.14	up	1.30	up	OLFM1	NM_006334
2.12	up	2.26	up	1.07	up	ONECUT 2	NM_004852
2.18	down	1.46	down	1.49	up	OR10G8	NM_00100446 4
2.04	down	1.28	down	1.59	up	OR1K1	NM_080859
2.14	up	2.09	up	1.02	down	OR7G1	NM_00100519 2
2.26	up	1.56	up	1.45	down	ORC1	NM_004153
9.16	up	3.06	up	2.99	down	OSTalpha	NM_152672
2.86	up	3.47	up	1.21	up	OXER1	NM_148962
3.88	down	12.92	down	3.33	down	P01115	
2.53	up	1.97	up	1.28	down	P39188	
1.44	down	2.82	down	1.96	down	P39194	
2.16	up	2.52	up	1.17	up	P39195	
2.33	up	2.13	up	1.09	down	PABPC1L	NM_00112475

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2.54	up	2.72	up	1.07	up	PABPC4L	NM_001114734
2.89	up	1.57	up	1.84	down	PACRGL	NM_145048
2.26	up	1.76	up	1.29	down	PAFAH1B3	NM_002573
1.84	up	2.91	up	1.58	up	PAPLN	NM_173462
1.96	down	2.75	down	1.40	down	PAPPA	NM_002581
1.91	down	3.65	down	1.91	down	PAQR5	NM_001104554
2.41	up	2.09	up	1.16	down	PARD6A	NM_016948
2.82	up	2.17	up	1.30	down	PARD6B	NM_032521
5.07	up	6.36	up	1.25	up	PARM1	NM_015393
1.40	up	2.70	up	1.93	up	PASK	NM_015148
69.13	up	39.48	up	1.75	down	PAX1	NM_006192
4.02	up	8.41	up	2.09	up	PAX6	NM_000280
5.57	up	3.19	up	1.75	down	PAX9	NM_006194
2.02	up	2.34	up	1.16	up	PBX1	NM_002585
2.00	up	3.40	up	1.70	up	PBX1	NM_002585
3.90	up	3.15	up	1.24	down	PBX4	NM_025245
1.85	down	2.21	down	1.19	down	PCDH18	NM_019035
2.53	down	2.43	down	1.04	up	PCDHB2	NM_018936
2.61	down	2.05	down	1.28	up	PCDHGB4	NM_032098
3.75	up	2.89	up	1.30	down	PCLO	NM_014510
2.50	up	2.16	up	1.16	down	PCNA	NM_002592
2.33	up	2.13	up	1.09	down	PCNA	NM_002592
2.28	up	2.14	up	1.06	down	PCNA	NM_002592
1.51	up	2.00	up	1.33	up	PCNA-AS1	NR_028370
1.80	up	3.86	up	2.14	up	PCOLCE2	NM_013363
2.30	up	2.84	up	1.24	up	PCP2	NM_174895
4.53	down	5.99	down	1.32	down	PCSK1	NM_000439
3.25	down	2.70	down	1.20	up	PCSK5	NM_006200
3.66	down	2.37	down	1.55	up	PCSK5	NM_006200
2.33	down	1.22	down	1.91	up	PDE1A	NM_001003683
2.63	down	1.80	down	1.46	up	PDE2A	NM_002599
2.06	up	2.00	up	1.03	down	PDE4DIP	AK024906
1.58	up	2.20	up	1.40	up	PDE4DIP	
2.50	up	2.13	up	1.17	down	PDE6B	NM_000283
3.00	down	1.47	down	2.04	up	PDE7B	NM_018945

2.91	up	3.07	up	1.05	up	PDXK	NM_003681
6.24	down	1.51	down	4.13	up	PEG3	NM_006210
5.18	up	2.87	up	1.80	down	PER3	NM_016831
4.79	up	2.68	up	1.79	down	PER3	NM_016831
2.03	up	1.87	up	1.09	down	PFN1P2	NR_003242
1.48	down	2.09	down	1.41	down	PGM3	NM_001199919
1.62	down	2.03	down	1.25	down	PGM3	NM_015599
2.14	up	2.31	up	1.08	up	PGPEP1	NM_017712
2.04	up	1.54	up	1.32	down	PHACTR4	BC068508
1.91	down	2.95	down	1.54	down	PHEX	NM_000444
1.85	up	2.01	up	1.09	up	PHF17	NM_024900
2.75	up	3.09	up	1.12	up	PHGDH	NM_006623
1.61	down	4.00	down	2.49	down	PHLDB2	NM_001134438
2.42	down	4.98	down	2.06	down	PI15	NM_015886
2.08	up	2.76	up	1.33	up	PIDD	NM_145886
1.46	down	2.09	down	1.43	down	PIGL	NM_004278
2.06	up	2.46	up	1.19	up	PIK3R3	NM_003629
1.85	down	2.06	down	1.11	down	PITPNM2	NM_020845
5.19	up	2.73	up	1.90	down	PITX1	NM_002653
5.53	up	6.92	up	1.25	up	PKDCC	NM_138370
5.03	up	5.73	up	1.14	up	PKDCC	NM_138370
2.14	up	2.84	up	1.33	up	PKIA	NM_006823
7.28	up	6.75	up	1.08	down	PLAC8	NM_016619
3.38	up	1.62	up	2.09	down	PLAC8L1	NM_001029869
2.65	down	3.87	down	1.46	down	PLB1	BC065041
2.69	down	1.88	down	1.43	up	PLCB1	AX721082
2.35	up	1.96	up	1.20	down	PLCH2	NM_014638
3.33	up	3.62	up	1.09	up	PLEKHG4	NM_015432
3.26	up	3.52	up	1.08	up	PLEKHG4	NM_015432
2.00	up	1.89	up	1.06	down	PLEKHG6	NM_018173
2.85	up	3.26	up	1.14	up	PLGLB1	NM_001032392
2.45	up	1.49	up	1.64	down	PLK4	NM_014264
1.20	down	2.01	down	1.67	down	PLS3	NM_005032
2.97	up	2.50	up	1.19	down	PLXNA1	NM_032242

2.42	up	1.94	up	1.25	down	PLXNB1	NM_002673
1.34	down	2.15	down	1.60	down	PMP22	
2.32	up	2.00	up	1.16	down	PMS2L2	BC010535
1.81	up	2.63	up	1.45	up	PNMAL2	NM_020709
5.38	up	6.30	up	1.17	up	PODXL2	NM_015720
4.20	up	5.79	up	1.38	up	PODXL2	NM_015720
2.62	up	2.37	up	1.11	down	POGZ	BC057773
2.10	up	1.91	up	1.10	down	POLA1	NM_016937
2.02	up	1.67	up	1.21	down	POLA2	NM_002689
2.18	up	2.17	up	1.00	down	POLD1	NM_002691
2.93	up	1.48	up	1.98	down	POLE	NM_006231
2.35	up	2.03	up	1.16	down	POLE	NM_006231
2.76	up	2.80	up	1.02	up	POLH	NM_006502
2.04	up	2.41	up	1.18	up	POLH	NM_006502
2.27	up	1.89	up	1.20	down	POLQ	NM_199420
2.12	down	7.40	down	3.50	down	POPDC3	NM_022361
6.24	up	5.87	up	1.06	down	POU4F1	NM_006237
3.21	up	2.98	up	1.08	down	PP12719	XM_003403527
1.91	up	2.08	up	1.09	up	PPAP2B	NM_003713
2.77	down	1.87	down	1.48	up	PPAPDC3	NM_032728
3.30	down	2.52	down	1.31	up	PPAPDC3	
1.58	down	2.01	down	1.27	down	PPARD	NM_006238
3.18	up	2.84	up	1.12	down	PPARGC1B	NM_133263
2.51	up	2.29	up	1.09	down	PPARGC1B	NM_133263
4.01	up	2.61	up	1.54	down	PPFIA4	NM_015053
2.99	up	3.04	up	1.02	up	PPFIBP2	NM_003621
1.60	down	2.22	down	1.39	down	PPIF	NM_005729
2.23	up	2.16	up	1.03	down	PPM1N	NM_001080401
2.07	up	1.94	up	1.07	down	PPM1N	NM_001080401
2.31	down	3.23	down	1.40	down	PPP1R1C	NM_001080545
2.59	up	2.38	up	1.09	down	PPP1R26	NM_014811
5.42	down	2.73	down	1.99	up	PPP1R27	NM_001007533
1.58	up	2.27	up	1.44	up	PPP1R3E	NR_026862
2.69	down	4.10	down	1.52	down	PPP2R2C	NM_181876
2.79	up	3.16	up	1.13	up	PPP2R3B-	NR_027232

						AS1	
1.75	up	2.28	up	1.30	up	PRC1	NM_003981
2.89	up	2.89	up	1.00	up	PRELID2	NM_138492
2.11	down	1.88	down	1.12	up	PRICKLE 1	NM_153026
6.35	up	6.91	up	1.09	up	PRIMA1	NM_178013
3.93	up	3.79	up	1.03	down	PRINS	NR_023388
4.45	up	2.40	up	1.86	down	PRKXP1	AI016765
2.38	up	1.72	up	1.38	down	PRKY	NR_028062
5.54	up	2.71	up	2.04	down	PRLR	NM_000949
1.61	down	3.35	down	2.08	down	PROC	NM_000312
2.64	down	3.24	down	1.23	down	PROC	NM_000312
1.75	up	2.45	up	1.40	up	PROCA1	NM_152465
2.31	down	3.49	down	1.51	down	PROCR	NM_006404
4.67	up	7.31	up	1.56	up	PRODH	NM_016335
4.64	up	6.17	up	1.33	up	PRODH	NM_016335
2.07	down	2.19	down	1.06	down	PROS1	NM_000313
1.91	up	2.13	up	1.11	up	PRPF40A	NM_017892
2.59	up	2.38	up	1.09	down	PRR19	NM_199285
1.74	down	2.40	down	1.38	down	PRRG1	NM_000950
5.46	up	4.04	up	1.35	down	PRSS12	NM_003619
2.68	down	3.47	down	1.29	down	PRUNE2	NM_015225
2.08	up	2.60	up	1.25	up	PSIP1	NM_033222
1.71	up	2.52	up	1.48	up	PSIP1	NM_021144
2.77	up	1.98	up	1.40	down	PSMC3IP	NM_013290
2.13	up	1.59	up	1.33	down	PSMD5	AK001065
2.03	up	1.33	up	1.53	down	PTCD2	NM_024754
3.30	down	1.76	down	1.88	up	PTGER3	NM_198719
5.40	down	18.45	down	3.42	down	PTHLH	NM_198965
7.81	up	8.61	up	1.10	up	PTN	NM_002825
1.48	down	2.13	down	1.43	down	PTP4A1	NM_003463
3.67	down	2.75	down	1.33	up	PTPLA	BC027709
2.13	up	1.53	up	1.39	down	PTPN13	NM_080685
5.66	up	3.24	up	1.75	down	PTPRF	BC048416
3.00	up	2.11	up	1.42	down	PTPRF	NM_002840
2.06	down	1.12	up	2.31	up	PTPRN2	NM_002847
1.74	up	2.44	up	1.41	up	PTPRS	NM_002850
2.00	down	1.83	down	1.10	up	PTS	NM_000317
2.00	up	1.83	up	1.09	down	PTTG1	NM_004219
1.80	down	2.12	down	1.18	down	PVT1	NR_003367
1.91	down	2.06	down	1.08	down	PVT1	NR_003367
2.10	down	2.25	down	1.07	down	PVT1	NR_003367

2.42	down	3.76	down	1.55	down	PYGL	NM_002863
1.97	down	3.84	down	1.94	down	Q6P4E4	
3.51	down	6.93	down	1.97	down	Q9RWL9	
2.00	up	2.10	up	1.05	up	QRICH2	NM_032134
1.35	down	2.07	down	1.54	down	QSOX1	NM_001004128
1.55	up	2.24	up	1.45	up	RAB11FIP4	NM_032932
2.70	up	4.04	up	1.50	up	RAB26	NM_014353
1.70	up	2.38	up	1.40	up	RAB36	NM_004914
2.01	down	3.78	down	1.88	down	RAB38	NM_022337
3.17	up	3.39	up	1.07	up	RAB42	NM_152304
2.24	down	1.40	down	1.61	up	RAB44	AK125083
2.01	up	1.49	up	1.35	down	RAD54B	NM_012415
2.30	up	1.87	up	1.23	down	RAD54L	NM_003579
5.88	up	4.31	up	1.36	down	RALGPS1	NM_014636
2.39	up	2.29	up	1.04	down	RALGPS1	NM_014636
11.04	up	9.32	up	1.18	down	RANBP17	NM_022897
1.73	up	2.72	down	4.70	down	RAP1GAP2	NM_015085
2.43	up	2.25	up	1.08	down	RARB	NM_000965
3.35	up	2.41	up	1.39	down	RASEF	AK056176
2.58	up	4.83	up	1.87	up	RASEF	NM_152573
2.98	up	2.47	up	1.21	down	RASIP1	NM_017805
2.50	up	1.63	up	1.53	down	RBBP4	NM_005610
2.13	up	1.39	up	1.53	down	RBBP8	NM_002894
2.19	up	1.66	up	1.32	down	RBBP9	NM_006606
1.39	up	2.02	up	1.45	up	RBM10	NM_005676
4.37	up	2.47	up	1.77	down	RBM14	NM_006328
2.11	up	1.83	up	1.16	down	RBM15	NM_022768
2.00	up	2.16	up	1.08	up	RBM19	NM_001146699
2.10	up	2.28	up	1.09	up	RBM26-AS1	NR_038991
2.22	down	2.46	down	1.11	down	RBM44	NM_001080504
1.40	up	3.39	up	2.42	up	RBP5	NM_031491
4.17	up	3.88	up	1.07	down	RDM1	NM_001034836
2.92	up	2.67	up	1.09	down	REC8	NM_001048205
3.25	down	2.40	down	1.35	up	RECK	NM_021111

2.24	up	1.85	up	1.21	down	RECQL4	NM_004260
2.13	up	2.08	up	1.02	down	RELB	NM_006509
6.51	up	6.24	up	1.04	down	REM1	NM_014012
3.53	up	2.18	up	1.62	down	REPS2	NM_004726
2.17	down	2.03	down	1.07	up	REREP3	NR_033735
2.10	up	1.17	up	1.79	down	RFC3	NM_181558
2.16	up	2.57	up	1.19	up	RFPL3-AS1	NR_001450
2.26	down	1.59	down	1.42	up	RFTN2	NM_144629
1.91	up	2.06	up	1.08	up	RFX5	NM_000449
4.48	up	1.56	up	2.87	down	RGNEF	NM_001177693
4.40	up	2.09	up	2.11	down	RGNEF	NM_001177693
1.97	down	2.98	down	1.51	down	RGPD1	NM_001024457
2.77	down	7.63	down	2.76	down	RGS20	NM_170587
1.33	up	2.10	up	1.58	up	RGS5	NM_003617
8.94	up	8.46	up	1.06	down	RHBDL3	NM_138328
2.86	up	1.91	up	1.49	down	RHEBL1	NM_144593
2.10	down	2.13	down	1.01	down	RHOB	NM_004040
2.50	down	2.05	down	1.22	up	RHOB	NM_004040
1.69	down	4.25	down	2.51	down	RHOD	NM_014578
4.49	up	4.90	up	1.09	up	RHOXF1	NM_139282
2.22	up	2.60	up	1.17	up	RHPN1	NM_052924
19.14	up	9.96	up	1.92	down	RIBC2	NM_015653
2.55	up	4.94	up	1.94	up	RIC3	NM_024557
2.31	up	1.36	up	1.70	down	RIC8B	NM_018157
1.86	down	3.38	down	1.81	down	RIMS3	NM_014747
1.47	up	2.18	up	1.49	up	RINL	NM_001195833
3.31	up	1.96	up	1.69	down	RIPK4	NM_020639
2.02	up	1.56	up	1.30	down	RNASEH2A	NM_006397
2.32	down	2.39	down	1.03	down	RNF112	NM_007148
2.04	up	1.12	down	2.29	down	RNF115	NM_014455
4.74	up	4.82	up	1.02	up	RNF150	NM_020724
7.71	up	5.05	up	1.53	down	RNF165	NM_152470
5.50	up	4.88	up	1.13	down	RNF207	BC119780
4.63	up	5.73	up	1.24	up	RNF207	NM_207396
3.22	up	5.02	up	1.56	up	RNF207	NM_207396
14.63	up	16.31	up	1.11	up	RNF212	NM_00113103

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12.23	up	11.52	up	1.06	down	RNF212	NM_194439
2.07	down	3.34	down	1.61	down	RNF217	NM_152553
6.30	up	5.71	up	1.10	down	RNF32	NM_030936
2.99	up	2.56	up	1.17	down	RNF43	NM_017763
1.85	up	2.02	up	1.09	up	RNF44	NM_014901
2.11	up	2.63	up	1.25	up	RNPC3	AK289844
1.85	up	2.25	up	1.22	up	RNPC3	NM_017619
2.18	down	1.95	down	1.12	up	RNU12	NR_029422
4.23	down	3.70	down	1.14	up	RNU2-2	NR_002761
2.24	up	2.32	up	1.03	up	ROBO2	NM_002942
2.48	up	2.30	up	1.08	down	RPA2	NM_002946
2.36	up	2.35	up	1.01	down	RPA2	NM_002946
1.46	down	2.01	down	1.38	down	RPF2	NM_032194
2.19	down	1.84	down	1.19	up	RPL22L1	NM_00109964 5
2.09	up	2.00	up	1.05	down	RPL32P3	AK096589
2.62	down	2.92	down	1.12	down	RPL3L	NM_005061
2.22	up	1.85	up	1.20	down	RPRD2	
2.36	up	1.87	up	1.26	down	RPS15AP 10	NR_026768
2.20	up	2.44	up	1.11	up	RPS23	NM_001025
445.9 2	up	13.57	up	32.87	down	RPS4Y1	NM_001008
427.4 0	up	12.31	up	34.72	down	RPS4Y2	NM_00103956 7
3.71	up	2.31	up	1.61	down	RTKN2	NM_145307
2.65	up	2.25	up	1.18	down	RTKN2	BC025765
50.71	up	16.42	up	3.09	down	RTP3	NM_031440
2.18	down	1.91	down	1.14	up	RUNX2	NM_004348
2.54	up	2.05	up	1.24	down	RUNX3	NM_00103168 0
2.52	up	1.82	up	1.39	down	RUNX3	NM_00103168 0
2.02	down	1.35	down	1.50	up	S100A5	NM_002962
2.10	up	2.16	up	1.03	up	S1PR5	NM_030760
2.27	up	2.65	up	1.17	up	SAMD10	NM_080621
1.68	down	2.46	down	1.46	down	SAMD4A	NM_015589
1.81	down	2.41	down	1.33	down	SAMD4A	NM_015589
1.92	down	2.29	down	1.19	down	SAMD8	NM_144660
2.13	up	2.09	up	1.02	down	SAP18	NM_005870
2.21	up	1.70	up	1.30	down	SAP30	NM_003864

2.14	up	1.92	up	1.12	down	SAP30L	NM_024632
2.07	up	1.54	up	1.34	down	SASS6	NM_194292
3.46	up	2.91	up	1.19	down	SBK1	NM_001024401
2.57	up	2.40	up	1.07	down	SCAI	NM_173690
2.02	up	1.91	up	1.05	down	SCAPER	AB040887
3.14	up	2.56	up	1.23	down	SCARNA23	DW407923
2.53	up	1.90	up	1.33	down	SCD5	NM_001037582
5.88	down	4.31	down	1.36	up	SCG2	NM_003469
1.96	down	3.88	down	1.98	down	SCG5	NM_003020
3.63	up	3.52	up	1.03	down	SCML2	NM_006089
2.31	down	1.93	down	1.20	up	SCN3A	NM_006922
2.18	up	2.53	up	1.16	up	SCPEP1	NM_021626
3.71	up	1.54	up	2.41	down	SDC4	NM_002999
2.69	up	2.16	up	1.24	down	SDHAP1	AK125217
1.42	up	2.15	up	1.51	up	SEC31B	NM_015490
2.04	down	3.04	down	1.49	down	SEMA3C	NM_006379
2.48	up	2.18	up	1.13	down	SEMA4C	NM_017789
1.28	down	1.93	up	2.47	up	SEMA5B	NM_001031702
3.75	up	5.16	up	1.38	up	SEMA6A	NM_020796
2.09	down	1.39	down	1.50	up	SEMA6C	NM_001178061
4.48	up	3.74	up	1.20	down	SEPT3	NM_145733
2.19	down	2.27	down	1.04	down	SEPX1	NM_016332
1.33	down	2.53	down	1.89	down	SERINC2	NM_178865
1.57	up	2.25	down	3.53	down	SERPINB5	NM_002639
2.49	down	4.00	down	1.60	down	SERPINE1	NM_000602
3.14	down	2.37	down	1.32	up	SESN3	NM_144665
1.52	down	2.01	down	1.32	down	SETD3	NM_199123
2.20	up	1.75	up	1.26	down	SETD5	NM_001080517
1.69	up	2.22	up	1.32	up	SFI1	NM_001007467
3.97	down	2.00	down	1.98	up	SGCA	NM_000023
3.25	up	3.16	up	1.03	down	SGPP2	AK096323
1.89	down	3.14	down	1.66	down	SH2D5	NM_001103161

4.03	up	2.62	up	1.54	down	SH3BP2	NM_001145855
3.85	up	2.40	up	1.60	down	SH3TC1	BC068094
2.75	up	2.25	up	1.22	down	SH3TC1	NM_018986
1.43	up	2.29	up	1.60	up	SHE	NM_001010846
3.39	up	1.89	up	1.79	down	SHROOM3	NM_020859
3.32	up	1.92	up	1.73	down	SHROOM3	NM_020859
1.80	up	2.14	up	1.19	up	SIGIRR	NM_021805
9.99	up	13.09	up	1.31	up	SIM2	NM_005069
2.71	down	1.61	down	1.68	up	SIRPB2	
5.44	up	1.98	up	2.75	down	SIX4	NM_017420
2.08	up	1.41	up	1.48	down	SKA1	NM_001039535
2.53	up	1.89	up	1.34	down	SKA3	NM_145061
1.91	down	2.40	down	1.26	down	SLC10A6	NM_197965
1.01	up	2.92	down	2.94	down	SLC11A1	NM_000578
3.12	up	5.12	up	1.64	up	SLC12A7	NM_006598
2.62	up	2.48	up	1.06	down	SLC12A7	NM_006598
1.05	down	3.21	down	3.05	down	SLC16A10	NM_018593
1.45	down	3.26	down	2.24	down	SLC16A10	NM_018593
5.96	up	5.54	up	1.07	down	SLC16A8	NM_013356
4.43	up	4.11	up	1.08	down	SLC1A1	NM_004170
2.22	down	2.52	down	1.14	down	SLC22A23	NM_015482
2.06	up	1.53	up	1.34	down	SLC25A22	NM_024698
2.56	up	3.23	up	1.26	up	SLC25A23	NM_024103
1.65	up	2.21	up	1.34	up	SLC25A35	NM_201520
2.00	up	1.74	up	1.15	down	SLC26A5	NM_206883
1.52	down	2.18	down	1.43	down	SLC28A1	NM_004213
1.84	down	2.07	down	1.12	down	SLC2A14	BC060766
1.33	down	2.37	down	1.79	down	SLC2A3	NM_006931
1.91	down	2.14	down	1.12	down	SLC35D1	NM_015139
2.79	up	2.43	up	1.15	down	SLC35E2	NM_182838
2.17	up	2.47	up	1.14	up	SLC35E2	NM_182838

2.56	down	2.01	down	1.27	up	SLC37A2	NM_198277
2.02	down	1.55	down	1.31	up	SLC38A1	DC378344
2.06	up	1.56	up	1.32	down	SLC45A4	NM_001080431
5.06	down	5.38	down	1.06	down	SLC47A2	NM_152908
1.96	down	3.89	down	1.99	down	SLC5A10	NM_152351
2.43	up	1.76	up	1.39	down	SLC5A6	NM_021095
2.04	up	1.67	up	1.22	down	SLC5A6	NM_021095
1.49	up	2.06	up	1.38	up	SLC6A16	NM_014037
2.25	down	1.82	down	1.23	up	SLC6A17	NM_001010898
7.23	down	10.35	down	1.43	down	SLC6A2	NM_001172501
3.40	down	5.42	down	1.59	down	SLC7A11	NM_014331
2.13	down	3.97	down	1.86	down	SLC7A5	NM_003486
3.80	down	6.15	down	1.62	down	SLC7A8	NM_182728
4.02	down	7.10	down	1.77	down	SLC7A8	NM_182728
1.74	up	2.20	up	1.26	up	SLC9A7	NM_032591
1.55	up	2.31	up	1.49	up	SLC9A7P1	NR_033801
2.22	up	1.91	up	1.16	down	SLC9A8	NM_015266
2.33	down	1.68	down	1.38	up	SLC9B2	NM_178833
5.06	up	6.29	up	1.24	up	SLFN13	NM_144682
2.56	down	6.78	down	2.65	down	SLITRK6	NM_032229
2.43	up	3.36	up	1.38	up	SMA4	NR_029426
2.69	up	2.46	up	1.09	down	SMARCA2	NM_139045
1.96	up	2.16	up	1.10	up	SMARCA2	NM_139045
94.60	up	84.20	up	1.12	down	SMC1B	NM_148674
2.11	up	1.98	up	1.07	down	SMC5	NM_015110
2.07	up	1.81	up	1.14	down	SMG9	NM_019108
5.17	up	4.11	up	1.26	down	SMPDL3B	NM_001009568
1.64	down	2.44	down	1.49	down	SMTN	NM_134269
1.75	down	2.29	down	1.31	down	SNAI2	NM_003068
2.26	down	1.58	down	1.43	up	SNAR-I	NR_024343
2.37	down	1.61	down	1.46	up	SNORA11	NR_002953
2.09	down	1.54	down	1.36	up	SNORA11D	NR_003711
2.23	down	2.30	down	1.03	down	SNORA1	NR_002958

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2.26	down	2.13	down	1.06	up	SNORA19	NR_002917
2.06	down	1.78	down	1.16	up	SNORA21	NR_002576
2.17	down	2.08	down	1.04	up	SNORA23	NR_002962
2.32	down	2.16	down	1.07	up	SNORA27	NR_002575
2.64	down	2.58	down	1.02	up	SNORA28	NR_002964
2.69	down	2.34	down	1.15	up	SNORA3	NR_002580
2.20	down	2.66	down	1.21	down	SNORA43	NR_002975
2.03	down	2.10	down	1.03	down	SNORA52	NR_002585
2.20	down	1.70	down	1.29	up	SNORA5B	NR_002990
2.56	down	2.34	down	1.10	up	SNORA64	NR_002326
2.09	down	2.18	down	1.04	down	SNORA65	NR_002449
1.98	down	2.21	down	1.12	down	SNORA71A	NR_002911
2.27	down	2.33	down	1.03	down	SNORA71B	NR_002910
2.13	down	2.25	down	1.06	down	SNORA71C	NR_003017
2.06	down	1.91	down	1.08	up	SNORA73A	NR_002907
2.09	down	1.92	down	1.09	up	SNORD10	NR_002604
6.04	down	5.09	down	1.19	up	SNORD114-12	NR_003205
2.56	down	2.74	down	1.07	down	SNORD114-14	NR_003207
4.30	down	5.51	down	1.28	down	SNORD114-20	NR_003213
3.10	down	2.86	down	1.08	up	SNORD114-28	NR_003221
3.79	down	3.62	down	1.05	up	SNORD114-28	NR_003221

4.14	down	3.92	down	1.06	up	SNORD114-9	NR_003201
2.06	down	1.74	down	1.18	up	SNORD12	NR_003030
2.16	down	1.80	down	1.19	up	SNORD12B	NR_003695
2.47	down	2.10	down	1.18	up	SNORD16	NR_002440
2.32	down	1.40	down	1.66	up	SNORD17	NR_003045
2.04	down	1.81	down	1.13	up	SNORD24	NR_002447
2.03	down	1.23	down	1.66	up	SNORD34	NR_000019
2.06	down	2.08	down	1.01	down	SNORD37	NR_002602
2.95	down	3.40	down	1.15	down	SNORD3B-1	NR_003271
2.62	down	3.32	down	1.27	down	SNORD42A	NR_000014
1.52	down	2.21	down	1.46	down	SNORD45C	NR_003042
2.26	down	2.19	down	1.03	up	SNORD46	NR_000024
2.33	down	1.97	down	1.18	up	SNORD6	NR_003036
2.50	down	3.45	down	1.38	down	SNORD65	NR_003054
2.13	down	2.69	down	1.27	down	SNORD82	NR_004398
2.12	down	1.88	down	1.13	up	SNORD83A	NR_000027
2.00	down	2.14	down	1.07	down	SNORD92	NR_003074
3.71	down	3.81	down	1.03	down	SNORD93	NR_003075
3.04	up	5.27	up	1.73	up	SNX22	NM_024798
5.71	up	5.61	up	1.02	down	SNX31	NM_152628
6.31	up	2.57	up	2.46	down	SORBS2	NM_021069
4.50	up	2.86	up	1.57	down	SORBS2	NM_021069
2.54	up	1.77	up	1.43	down	SOX13	BC040649
2.25	up	1.67	up	1.34	down	SOX13	NM_005686
1.78	down	5.08	down	2.85	down	SOX15	NM_006942

2.20	down	1.21	down	1.82	up	SOX17	NM_022454
2.41	up	2.63	up	1.09	up	SOX30	NM_178424
3.38	up	5.01	up	1.48	up	SOX8	NM_014587
6.72	up	11.71	up	1.74	up	SP5	NM_001003845
10.01	up	19.05	up	1.90	up	SP9	
2.52	up	2.64	up	1.05	up	SPATA18	NM_145263
2.55	up	1.66	up	1.54	down	SPATA2	NM_006038
3.15	up	1.75	up	1.81	down	SPATA5	NM_145207
1.67	down	2.82	down	1.69	down	SPEG	NM_001173476
2.35	down	1.55	down	1.52	up	SPEG	
9.14	up	15.23	up	1.67	up	SPIB	NM_003121
1.87	up	2.42	up	1.29	up	SPICE1	NM_144718
16.93	down	19.50	down	1.15	down	SPINK6	NM_205841
3.09	up	3.42	up	1.10	up	SPOCK2	NM_014767
4.33	down	2.80	down	1.55	up	SPON1	NM_006108
14.14	down	21.77	down	1.54	down	SPRR2G	NM_001014291
4.83	down	16.91	down	3.50	down	SPRR4	NM_173080
4.15	down	3.05	down	1.36	up	SPTLC3	NM_018327
2.06	down	2.04	down	1.01	up	SPTSSA	NM_138288
4.94	up	5.24	up	1.06	up	SRGAP3	NM_014850
3.78	down	2.47	down	1.53	up	SRRM3	NM_001110199
1.70	down	2.16	down	1.27	down	SSFA2	NM_006751
2.13	down	2.03	down	1.05	up	SSH2	BC011636
2.94	up	2.71	up	1.08	down	SSTR2	NM_001050
2.20	up	2.64	up	1.20	up	SSX2IP	NM_014021
2.31	up	1.78	up	1.30	down	ST5	NM_005418
23.15	up	37.41	up	1.62	up	STAG3	NM_012447
10.78	up	16.03	up	1.49	up	STAG3	NM_012447
5.57	up	9.22	up	1.66	up	STAR	NM_000349
1.83	up	2.15	up	1.18	up	STIM2	
2.53	up	1.88	up	1.35	down	STMN1	NM_203401
1.48	down	2.80	down	1.90	down	STON2	NM_033104
2.60	up	2.94	up	1.13	up	STOX2	NM_020225
1.36	down	2.06	down	1.51	down	STRN3	NM_014574
2.66	down	4.11	down	1.54	down	SUN3	NM_001030019
7.63	up	6.32	up	1.21	down	SUSD4	NM_017982
1.69	up	2.08	up	1.23	up	SUV420H	NM_032701

						2	
6.08	up	6.19	up	1.02	up	SV2B	NM_014848
2.22	up	3.09	up	1.39	up	SVIP	NM_148893
11.37	up	9.59	up	1.19	down	SYCE2	NM_001105578
23.50	up	30.23	up	1.29	up	SYCP2	NM_014258
1.42	up	2.55	up	1.79	up	SYNGR1	NM_145731
4.29	up	4.45	up	1.04	up	SYNGR3	NM_004209
2.51	up	2.92	up	1.17	up	SYNGR3	NM_004209
8.57	up	20.74	up	2.42	up	SYNPO2	NM_133477
9.48	up	11.09	up	1.17	up	TAF7L	NM_024885
3.56	up	4.12	up	1.16	up	TAL2	NM_005421
2.25	up	1.66	up	1.36	down	TBC1D24	NM_020705
2.51	down	1.91	down	1.31	up	TBX1	NM_080647
6.84	down	4.27	down	1.60	up	TBX18	NM_001080508
66.60	up	113.10	up	1.70	up	TCAM1P	NR_002947
17.76	up	17.63	up	1.01	down	TCAM1P	NR_002947
2.41	up	3.50	up	1.45	up	TCEA3	NM_003196
2.43	down	2.23	down	1.09	up	TCEAL7	NM_152278
1.80	up	2.06	up	1.15	up	TCF7	NM_003202
2.20	up	1.91	up	1.15	down	TCF7L1	NM_031283
1.55	up	2.41	up	1.56	up	TCL1B	NM_004918
19.53	up	28.83	up	1.48	up	TCP11	NM_018679
5.29	up	4.34	up	1.22	down	TCP11	NM_018679
2.22	down	2.25	down	1.02	down	TCTEX1D4	NM_001013632
3.34	up	1.72	up	1.94	down	TCTN2	NM_024809
4.22	up	6.42	up	1.52	up	TDRD10	NM_182499
3.49	up	7.83	up	2.24	up	TDRD10	NM_182499
2.32	up	2.80	up	1.21	up	TDRD10	NM_182499
1.87	up	2.14	up	1.14	up	TERT	NM_198253
2.36	down	1.59	down	1.49	up	TFF1	NM_003225
6.86	down	3.98	down	1.73	up	TFPI2	NM_006528
2.42	up	1.38	up	1.76	down	TGIF2	NM_021809
2.18	up	1.57	up	1.39	down	THAP10	NM_020147
2.83	up	2.55	up	1.11	down	THAP2	NM_031435
2.68	down	2.43	down	1.10	up	THBS1	NM_003246
3.03	down	2.59	down	1.17	up	THBS1	NM_003246
2.33	up	2.29	up	1.02	down	THBS4	
2.44	down	2.86	down	1.17	down	THSD1	NM_199263

2.87	up	2.73	up	1.05	down	TIFA	NM_052864
2.19	up	2.25	up	1.03	up	TIGD3	NM_145719
2.58	up	2.51	up	1.03	down	TIMELESS	NM_003920
6.50	up	7.65	up	1.18	up	TJP3	NM_014428
2.06	up	3.86	up	1.87	up	TLR10	NM_030956
2.65	up	2.31	up	1.14	down	TLR5	NM_003268
4.18	up	5.62	up	1.34	up	TLX2	NM_016170
14.76	up	20.76	up	1.41	up	TLX3	NM_021025
7.11	down	9.02	down	1.27	down	TM4SF19	NM_138461
7.88	down	10.75	down	1.36	down	TM4SF19	NM_138461
3.77	up	2.83	up	1.33	down	TM7SF3	NM_016551
2.64	up	2.46	up	1.07	down	TM7SF3	NM_016551
2.24	down	3.98	down	1.78	down	TMC7	NM_024847
1.91	up	3.08	up	1.61	up	TMC8	NM_152468
2.45	up	2.36	up	1.04	down	TMCO4	NM_181719
1.87	up	2.16	up	1.16	up	TMCO4	NM_181719
2.05	down	1.78	down	1.15	up	TMCO7	NM_024562
1.23	down	2.02	down	1.65	down	TMEM105	NM_178520
2.28	up	3.01	up	1.32	up	TMEM150C	NM_001080506
2.76	up	1.52	up	1.81	down	TMEM171	NM_173490
2.36	up	2.22	up	1.06	down	TMEM173	NM_198282
2.76	up	2.17	up	1.27	down	TMEM194A	NM_015257
2.53	up	2.14	up	1.18	down	TMEM237	NM_001044385
2.06	up	1.45	up	1.42	down	TMEM81	NM_203376
1.47	up	3.14	up	2.13	up	TMIE	NM_147196
2.23	up	1.86	up	1.20	down	TMPO	NM_003276
20.58	up	16.07	up	1.28	down	TMPRSS11B	NM_182502
3.58	up	2.82	up	1.27	down	TMPRSS2	NM_005656
4.15	up	3.67	up	1.13	down	TMSB4Y	NM_004202
2.38	up	2.19	up	1.08	down	TMTC2	NM_152588
1.61	down	2.97	down	1.85	down	TNC	NM_002160
3.98	up	3.53	up	1.13	down	TNFAIP2	NM_006291
2.18	up	2.00	up	1.09	down	TNFRSF10B	NM_003842

1.17	up	2.18	up	1.86	up	TNFRSF11A	NM_003839
2.06	up	2.65	up	1.29	up	TNFRSF14	NM_003820
1.78	up	2.63	up	1.48	up	TNFRSF9	NM_001561
4.18	up	2.50	up	1.67	down	TNFSF15	NM_005118
1.67	down	2.08	down	1.24	down	TNRC6C	NM_001142640
1.47	down	1.56	up	2.30	up	TNXB	NM_019105
1.51	down	2.73	up	4.12	up	TNXB	NM_032470
1.62	down	1.96	up	3.17	up	TNXB	NM_019105
2.75	up	1.71	up	1.60	down	TONSL	NM_013432
2.14	up	1.75	up	1.22	down	TOPBP1	NM_007027
3.53	up	1.77	up	1.99	down	TP53	NM_000546
2.50	up	1.86	up	1.34	down	TP53	NM_000546
2.71	up	3.00	up	1.11	up	TP73-AS1	NR_033711
2.63	up	2.55	up	1.03	down	TPD52	NM_001025252
1.55	down	2.11	down	1.36	down	TPM4	NM_003290
1.60	down	2.14	down	1.33	down	TPM4	NM_003290
5.20	up	4.85	up	1.07	down	TRAF1	NM_005658
3.76	up	2.53	up	1.49	down	TRAF2	NM_021138
2.92	up	2.76	up	1.06	down	TRAF2	NM_021138
5.46	down	3.41	down	1.60	up	TREM1	NM_018643
2.43	up	1.22	up	1.98	down	TRIB2	NM_021643
2.35	up	2.09	up	1.12	down	TRIM2	NM_015271
2.11	up	2.34	up	1.11	up	TRIM45	NM_025188
2.17	up	2.20	up	1.02	up	TRIM47	NM_033452
4.98	up	6.13	up	1.23	up	TRIM50	NM_178125
1.95	up	2.38	up	1.22	up	TRIM66	NM_014818
1.66	down	2.77	down	1.67	down	TRMT12	NM_017956
2.69	up	2.54	up	1.06	down	TROAP	NM_005480
1.69	up	4.10	up	2.43	up	TRPM6	NM_017662
2.85	up	2.66	up	1.07	down	TRPV4	NM_147204
3.64	up	5.22	up	1.43	up	TRPV6	NM_018646
3.25	up	3.58	up	1.10	up	TRPV6	NM_018646
2.46	up	2.03	up	1.21	down	TSC2	NM_000548
5.20	down	1.88	down	2.76	up	TSIX	NR_003255
7.31	down	1.78	down	4.11	up	TSIX	NR_003255
1.39	up	1.55	down	2.16	down	TTC26	NM_024926
2.07	down	1.77	down	1.17	up	TTC39B	NM_152574
2.93	down	3.32	down	1.13	down	TTC7B	NM_00101085

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4.08	up	2.51	up	1.63	down	TTC9C	AF289605
3.18	up	2.70	up	1.18	down	TTTY14	NR_001543
42.58	up	6.20	up	6.87	down	TTTY15	NR_001545
15.88	up	4.18	up	3.80	down	TTTY15	NR_001545
1.52	down	2.10	down	1.37	down	TUBA3C	NM_006001
1.83	down	2.40	down	1.31	down	TUBA4A	NM_006000
1.90	down	2.66	down	1.40	down	TUBA4A	NM_006000
1.96	down	2.65	down	1.35	down	TUBA4A	NM_006000
2.09	down	1.41	down	1.48	up	TUBA8	NM_018943
1.80	down	2.48	down	1.37	down	TUBB2A	NM_001069
2.40	down	2.76	down	1.15	down	TUBB2A	NM_001069
2.91	down	4.19	down	1.44	down	TUBB3	NM_006086
1.25	down	2.02	down	1.62	down	TUBB6	NM_032525
2.17	down	3.01	down	1.38	down	TWIST2	NM_057179
34.70	up	8.16	up	4.25	down	TXLNG2 P	NR_045128
23.34	up	5.42	up	4.31	down	TXLNG2 P	NR_045129
22.75	up	6.69	up	3.40	down	TXLNG2 P	NR_045128
2.01	up	1.65	up	1.22	down	TYK2	NM_003331
2.84	up	2.47	up	1.15	down	TYMS	NM_001071
1.94	up	2.34	up	1.21	up	UBA7	NM_003335
7.76	up	6.78	up	1.14	down	UBD	NM_006398
1.44	down	2.17	down	1.50	down	UBE2H	NM_003344
2.56	down	2.04	down	1.26	up	UBE2Q2	NM_173469
2.46	down	1.92	down	1.28	up	UBE2Q2P 1	NR_003661
2.95	down	2.11	down	1.40	up	UBE2Q2P 1	NR_003661
1.56	up	1.40	down	2.18	down	UBQLN1	NM_013438
2.97	up	1.91	up	1.55	down	UBXN11	NM_183008
1.95	up	2.24	down	4.36	down	UCA1	NR_015379
2.49	up	2.08	up	1.20	down	UNC119B	NM_00108053 3
2.12	up	1.79	up	1.18	down	UNC13B	NM_006377
2.18	down	1.76	down	1.24	up	UNCX	NM_00108046 1
2.10	up	1.87	up	1.12	down	UNG	NM_003362
6.67	up	5.58	up	1.19	down	UPB1	NM_016327
1.86	down	3.26	down	1.75	down	UPP1	NM_181597

2.05	down	3.19	down	1.55	down	UPP1	BC047030
2.00	up	2.29	up	1.15	up	URB1	NM_014825
2.57	up	1.82	up	1.41	down	USP18	NM_017414
46.53	up	6.45	up	7.22	down	USP9Y	NM_004654
6.56	up	3.08	up	2.13	down	USP9Y	NM_004654
1.61	down	2.05	down	1.28	down	UST	NM_005715
18.95	up	5.55	up	3.41	down	UTY	BC012581
13.36	up	4.48	up	2.99	down	UTY	NM_182660
5.32	up	3.88	up	1.37	down	UTY	NM_007125
4.75	down	3.68	down	1.29	up	VAX1	NM_00111270 4
6.30	up	7.98	up	1.27	up	VCAM1	NM_001078
2.10	down	2.03	down	1.04	up	VCX2	NM_016378
2.25	down	2.92	down	1.30	down	VEGFC	NM_005429
3.36	down	2.03	down	1.66	up	VGLL3	NM_016206
1.74	up	2.04	up	1.17	up	VHL	NM_000551
2.03	down	1.38	down	1.47	up	VMAC	NM_00101792 1
2.49	down	2.01	down	1.24	up	VPS37D	NM_00107762 1
1.41	down	3.45	down	2.44	down	VSIG1	NM_182607
1.67	up	2.02	up	1.21	up	VSIG10	NM_019086
2.90	down	1.83	down	1.58	up	VTRNA1-2	NR_026704
4.99	up	3.63	up	1.37	down	VWDE	NM_00113592 4
2.47	down	1.82	down	1.36	up	WASF3	NM_006646
1.56	up	2.06	up	1.32	up	WDR33	NM_00100662 3
2.21	up	2.07	up	1.07	down	WDR34	NM_052844
2.71	up	2.68	up	1.01	down	WDR52	NM_018338
4.91	down	7.45	down	1.52	down	WDR66	NM_144668
2.16	up	1.84	up	1.17	down	WDR76	NM_024908
2.20	up	1.82	up	1.20	down	WEE1	NM_003390
29.77	up	10.74	up	2.77	down	WFDC2	NM_006103
24.53	up	7.73	up	3.17	down	WFDC2	NM_006103
2.82	up	2.40	up	1.17	down	WHSC1	NM_133330
2.12	up	1.90	up	1.12	down	WHSC1	NM_007331
2.02	up	1.51	up	1.34	down	WHSC1	NM_133330
3.65	up	5.09	up	1.39	up	WIPF3	AK094250
2.81	up	2.80	up	1.00	down	WIPF3	BC156551
27.26	up	29.32	up	1.08	up	WNK2	NM_006648

6.03	up	8.34	up	1.38	up	WNK2	NM_006648
4.72	up	5.71	up	1.21	up	WNK2	AB051547
1.09	down	2.98	down	2.72	down	WNT7A	NM_004625
1.10	down	2.05	down	1.85	down	WNT7B	NM_058238
2.11	up	1.68	up	1.25	down	WRAP73	NM_017818
3.27	down	1.49	down	2.20	up	XIST	NR_001564
95.21	down	5.26	down	18.11	up	XIST	NR_001564
180.53	down	7.09	down	25.46	up	XIST	NR_001564
289.21	down	7.42	down	38.98	up	XIST	NR_001564
337.75	down	12.65	down	26.69	up	XIST	NR_001564
346.57	down	8.31	down	41.71	up	XIST	NR_001564
8.99	up	13.74	up	1.53	up	XKR4	NM_052898
2.81	up	2.40	up	1.17	down	XLOC_000153	
3.01	up	4.42	up	1.47	up	XLOC_000190	
1.82	up	2.04	up	1.12	up	XLOC_000350	AK125443
4.08	up	3.66	up	1.12	down	XLOC_000363	
2.26	up	3.64	up	1.61	up	XLOC_000377	
2.05	up	1.85	up	1.11	down	XLOC_000390	AW963279
3.09	up	3.06	up	1.01	down	XLOC_000441	AK023394
2.90	up	1.24	up	2.33	down	XLOC_000490	
1.60	down	2.05	down	1.28	down	XLOC_000505	
1.91	down	2.71	down	1.42	down	XLOC_000527	XR_108329
2.37	down	2.87	down	1.21	down	XLOC_000527	XR_108330
2.75	down	5.37	down	1.95	down	XLOC_000587	AK124056
3.27	down	6.25	down	1.91	down	XLOC_000587	

1.57	up	2.13	up	1.36	up	XLOC_000746	
3.24	down	6.18	down	1.91	down	XLOC_000778	
1.69	up	2.07	up	1.23	up	XLOC_000889	
2.54	up	2.76	up	1.09	up	XLOC_000939	
4.59	up	4.61	up	1.00	up	XLOC_000956	BX089534
2.16	down	1.51	down	1.43	up	XLOC_001265	
2.41	up	4.61	up	1.91	up	XLOC_001286	
1.77	up	2.89	up	1.63	up	XLOC_001341	
2.55	up	2.61	up	1.02	up	XLOC_001576	BG219825
5.86	up	1.66	up	3.52	down	XLOC_001595	
2.30	down	2.15	down	1.07	up	XLOC_001784	
1.53	down	2.36	down	1.55	down	XLOC_001826	
1.55	down	4.70	down	3.04	down	XLOC_001826	
1.56	down	2.51	down	1.61	down	XLOC_001826	
1.72	down	3.26	down	1.89	down	XLOC_001856	
1.46	down	2.50	down	1.71	down	XLOC_001869	
2.43	down	1.60	down	1.52	up	XLOC_001910	
2.02	down	1.24	down	1.63	up	XLOC_001931	
2.12	down	2.22	down	1.04	down	XLOC_002484	AK307257
1.45	down	2.22	down	1.53	down	XLOC_002515	
2.19	down	1.83	down	1.20	up	XLOC_002560	

24.31	down	8.47	down	2.87	up	XLOC_002603	
36.03	down	11.62	down	3.10	up	XLOC_002603	
2.18	down	1.65	down	1.32	up	XLOC_002770	
3.41	up	3.33	up	1.02	down	XLOC_002779	BC035247
7.05	up	5.67	up	1.24	down	XLOC_002830	
1.86	down	2.25	down	1.21	down	XLOC_003077	
2.01	up	1.54	up	1.30	down	XLOC_003221	BC030754
2.11	down	1.69	down	1.24	up	XLOC_003422	
1.94	up	2.61	up	1.34	up	XLOC_003498	
1.25	up	2.20	up	1.76	up	XLOC_003878	
5.34	down	1.97	down	2.71	up	XLOC_003986	
2.51	down	2.07	down	1.22	up	XLOC_004108	
2.44	up	1.66	up	1.47	down	XLOC_004144	
1.28	up	2.16	up	1.69	up	XLOC_004165	
2.47	down	5.66	down	2.29	down	XLOC_004198	
3.75	up	2.21	up	1.70	down	XLOC_004456	
3.02	up	2.18	up	1.38	down	XLOC_004456	
2.07	up	2.56	up	1.24	up	XLOC_004467	
1.62	down	4.16	down	2.57	down	XLOC_005105	BX096383
2.23	up	2.56	up	1.15	up	XLOC_005244	
2.37	down	3.83	down	1.62	down	XLOC_005369	

8.04	down	1.66	down	4.85	up	XLOC_005471	BY994446
2.00	up	1.10	down	2.19	down	XLOC_005514	
1.87	down	2.20	down	1.18	down	XLOC_005748	
2.22	down	3.42	down	1.54	down	XLOC_005748	
4.08	up	6.58	up	1.61	up	XLOC_005764	
2.10	down	1.23	down	1.70	up	XLOC_005809	
2.59	down	2.46	down	1.06	up	XLOC_005810	
2.65	down	2.74	down	1.03	down	XLOC_005810	
3.23	down	5.82	down	1.80	down	XLOC_005935	CB123670
3.97	down	8.01	down	2.02	down	XLOC_005935	CB123670
3.12	up	2.01	up	1.55	down	XLOC_006153	
3.74	down	11.41	down	3.05	down	XLOC_006200	BC040593
1.52	up	2.45	up	1.61	up	XLOC_006291	
1.85	up	2.18	up	1.18	up	XLOC_006588	
3.34	down	2.35	down	1.42	up	XLOC_006593	BG185100
2.01	down	1.39	down	1.45	up	XLOC_006688	
2.39	down	2.01	down	1.19	up	XLOC_006915	DA998032
2.16	down	1.57	down	1.38	up	XLOC_007254	
1.63	up	3.06	up	1.88	up	XLOC_007467	
1.18	down	2.69	down	2.28	down	XLOC_007531	
2.27	up	1.82	up	1.25	down	XLOC_007556	

7.47	down	1.83	down	4.08	up	XLOC_007697	
12.35	up	4.38	up	2.82	down	XLOC_007734	BC043560
2.08	down	1.48	down	1.41	up	XLOC_007857	
2.11	down	2.30	down	1.09	down	XLOC_007992	
3.30	down	1.67	down	1.97	up	XLOC_008015	
27.69	down	4.33	down	6.40	up	XLOC_008015	
1.93	down	2.14	down	1.11	down	XLOC_008079	
2.10	down	1.87	down	1.12	up	XLOC_008088	BC030106
1.13	down	3.02	down	2.67	down	XLOC_008151	BC015977
1.62	down	3.60	down	2.22	down	XLOC_008151	BC015977
1.79	up	2.62	up	1.46	up	XLOC_008152	
3.24	up	1.83	up	1.77	down	XLOC_008276	
3.05	up	2.33	up	1.31	down	XLOC_008276	
7.67	up	3.49	up	2.20	down	XLOC_008323	
2.02	down	1.74	down	1.16	up	XLOC_008542	
2.04	up	3.85	up	1.89	up	XLOC_008666	AK056146
3.87	down	6.89	down	1.78	down	XLOC_008700	
2.07	down	2.08	down	1.01	down	XLOC_008703	
2.26	down	7.45	down	3.29	down	XLOC_008711	
1.67	down	2.43	down	1.45	down	XLOC_008802	
4.59	down	4.65	down	1.01	down	XLOC_009152	

2.36	up	1.95	up	1.21	down	XLOC_009181	AK091996
1.36	down	2.71	down	1.99	down	XLOC_009378	
2.59	up	2.52	up	1.03	down	XLOC_009494	
4.84	up	4.50	up	1.08	down	XLOC_009507	AK054718
3.44	down	1.65	down	2.08	up	XLOC_009549	
2.32	up	1.86	up	1.24	down	XLOC_009681	
1.52	down	3.09	down	2.04	down	XLOC_009788	
2.38	down	2.21	down	1.08	up	XLOC_009790	
1.59	down	2.80	down	1.76	down	XLOC_009810	
1.71	down	2.32	down	1.36	down	XLOC_009994	
2.12	up	2.53	up	1.20	up	XLOC_010117	
2.87	up	2.07	up	1.39	down	XLOC_010244	
4.99	up	3.91	up	1.28	down	XLOC_010245	
1.53	down	2.25	down	1.47	down	XLOC_010321	
2.52	down	2.55	down	1.01	down	XLOC_010390	AJ412054
2.10	up	2.58	up	1.23	up	XLOC_010556	
3.42	up	2.27	up	1.51	down	XLOC_010591	
2.14	down	1.47	down	1.45	up	XLOC_010719	
2.48	down	1.69	down	1.47	up	XLOC_010743	AK092053
1.61	down	3.40	down	2.11	down	XLOC_010881	
3.37	down	4.01	down	1.19	down	XLOC_010933	

2.57	up	4.67	up	1.81	up	XLOC_010942	
2.24	down	1.20	down	1.86	up	XLOC_011107	
2.12	up	2.46	up	1.16	up	XLOC_011248	BC035091
2.01	up	2.06	up	1.03	up	XLOC_011309	
2.06	down	1.32	down	1.56	up	XLOC_011408	
4.65	up	7.33	up	1.58	up	XLOC_011545	
2.41	up	3.05	up	1.27	up	XLOC_011545	
4.68	up	7.69	up	1.64	up	XLOC_011546	
2.66	up	2.12	up	1.26	down	XLOC_011837	BC035173
2.39	up	2.98	up	1.25	up	XLOC_011872	
4.18	up	2.77	up	1.51	down	XLOC_012079	
2.10	down	1.53	down	1.37	up	XLOC_012304	
2.33	down	11.21	down	4.82	down	XLOC_012452	BC084573
2.60	up	2.91	up	1.12	up	XLOC_012530	
4.07	up	3.74	up	1.09	down	XLOC_012641	
3.85	up	3.55	up	1.08	down	XLOC_012895	
2.19	down	1.95	down	1.12	up	XLOC_013093	
2.61	down	3.49	down	1.34	down	XLOC_013364	
1.60	down	2.60	down	1.63	down	XLOC_013461	
1.72	down	2.76	down	1.61	down	XLOC_013461	
8.11	up	7.43	up	1.09	down	XLOC_013483	

2.79	down	4.62	down	1.66	down	XLOC_013541	BX116929
2.80	down	5.00	down	1.79	down	XLOC_013542	
2.23	down	2.25	down	1.01	down	XLOC_013770	
3.92	down	3.66	down	1.07	up	XLOC_013832	
1.17	up	2.90	up	2.47	up	XLOC_013868	
1.57	down	2.58	down	1.64	down	XLOC_013940	
2.47	up	2.18	up	1.13	down	XLOC_013973	
2.84	up	2.61	up	1.09	down	XLOC_013981	BX105611
2.15	down	1.93	down	1.11	up	XLOC_014102	
2.69	up	3.02	up	1.12	up	XLOC_014107	
5.61	up	4.20	up	1.33	down	XLOC_014111	DB312214
4.33	up	3.16	up	1.37	down	XLOC_014219	
2.42	down	1.59	down	1.52	up	XLOC_014246	
6.89	up	4.94	up	1.39	down	XLOC_014257	
3.09	up	3.24	up	1.05	up	XLOC_014288	
2.58	up	3.09	up	1.19	up	XLOC_014288	
1.52	up	2.17	up	1.43	up	XLOC_014334	
6.79	up	3.87	up	1.75	down	XLOC_014388	XR_109724
1.27	down	2.75	down	2.16	down	XLOC_014399	
5.92	up	3.73	up	1.59	down	XLOC_014513	BC017979
2.91	up	2.02	up	1.44	down	XLOC_l2_000010	

2.25	up	2.36	up	1.05	up	XLOC_l2_000080	AK311553
3.64	up	3.07	up	1.18	down	XLOC_l2_000101	
2.33	up	3.73	up	1.60	up	XLOC_l2_000417	
1.82	up	2.80	up	1.54	up	XLOC_l2_001091	
2.48	up	2.38	up	1.04	down	XLOC_l2_001332	
2.90	up	2.01	up	1.44	down	XLOC_l2_001953	AL832069
1.62	down	2.66	down	1.65	down	XLOC_l2_002049	
2.67	down	2.19	down	1.22	up	XLOC_l2_002469	
2.28	down	3.27	down	1.43	down	XLOC_l2_002502	
7.37	up	5.87	up	1.26	down	XLOC_l2_003293	
7.23	up	5.63	up	1.28	down	XLOC_l2_003293	XM_003119524
5.42	up	4.72	up	1.15	down	XLOC_l2_003293	XM_003119524
3.66	up	3.72	up	1.02	up	XLOC_l2_003293	XM_001715897
3.42	up	4.18	up	1.22	up	XLOC_l2_003293	XM_003119524
3.68	up	4.03	up	1.09	up	XLOC_l2_003881	
1.52	up	4.30	up	2.82	up	XLOC_l2_004315	
6.33	up	6.19	up	1.02	down	XLOC_l2_004317	CR620068
3.73	up	3.22	up	1.16	down	XLOC_l2_004318	BI821606
2.97	down	2.91	down	1.02	up	XLOC_l2_004562	
2.09	up	2.28	up	1.09	up	XLOC_l2_004611	
2.34	up	2.23	up	1.05	down	XLOC_l2_005179	

1.73	down	2.41	down	1.39	down	XLOC_l2_005952	
1.65	down	4.13	down	2.50	down	XLOC_l2_006021	DB117598
7.57	up	4.78	up	1.58	down	XLOC_l2_006152	
1.72	up	2.34	up	1.36	up	XLOC_l2_006152	AK311448
3.57	up	3.35	up	1.06	down	XLOC_l2_006471	
2.11	down	2.06	down	1.03	up	XLOC_l2_006595	
2.65	up	2.50	up	1.06	down	XLOC_l2_006745	
1.90	down	3.28	down	1.73	down	XLOC_l2_006937	
2.10	down	1.48	down	1.42	up	XLOC_l2_007119	
2.06	up	2.30	up	1.12	up	XLOC_l2_007449	
2.04	down	1.40	down	1.45	up	XLOC_l2_007449	
5.15	up	4.40	up	1.17	down	XLOC_l2_007478	
3.28	up	3.27	up	1.00	down	XLOC_l2_007478	
2.02	down	1.92	down	1.05	up	XLOC_l2_007829	
1.73	up	2.95	up	1.71	up	XLOC_l2_007884	
1.81	down	2.14	down	1.18	down	XLOC_l2_007928	
2.53	up	2.15	up	1.18	down	XLOC_l2_008140	
2.51	up	3.41	up	1.36	up	XLOC_l2_008151	
2.04	up	2.92	up	1.43	up	XLOC_l2_008226	XR_109883
2.08	down	1.38	down	1.51	up	XLOC_l2_008910	BC039367
2.90	up	4.90	up	1.69	up	XLOC_l2_008991	

3.05	up	3.05	up	1.00	down	XLOC_l2_009136	
2.46	down	2.37	down	1.04	up	XLOC_l2_009139	CR614803
3.80	up	3.13	up	1.21	down	XLOC_l2_009273	AK127572
2.52	up	2.66	up	1.05	up	XLOC_l2_009273	AK127572
2.05	up	2.34	up	1.14	up	XLOC_l2_009285	
4.93	up	7.05	up	1.43	up	XLOC_l2_009301	
4.60	up	5.45	up	1.18	up	XLOC_l2_009316	
2.23	up	1.91	up	1.16	down	XLOC_l2_009571	
2.07	up	1.68	up	1.23	down	XLOC_l2_009571	
4.71	up	6.88	up	1.46	up	XLOC_l2_009668	
2.04	down	2.13	down	1.04	down	XLOC_l2_009888	
1.55	down	2.21	down	1.43	down	XLOC_l2_010139	
3.97	down	4.03	down	1.02	down	XLOC_l2_010141	DA697996
2.11	down	1.45	down	1.45	up	XLOC_l2_010239	
2.48	down	2.23	down	1.11	up	XLOC_l2_010267	
3.46	up	2.52	up	1.38	down	XLOC_l2_010558	
2.53	up	2.47	up	1.03	down	XLOC_l2_010558	
3.43	down	2.84	down	1.21	up	XLOC_l2_010661	CD359603
3.44	down	6.09	down	1.77	down	XLOC_l2_010751	
2.51	up	2.05	up	1.23	down	XLOC_l2_011011	BC036795
17.72	up	6.12	up	2.89	down	XLOC_l2_011146	

1.84	up	2.19	up	1.19	up	XLOC_l2_011265	BU852287
2.73	up	2.67	up	1.02	down	XLOC_l2_011649	
1.83	up	2.32	up	1.27	up	XLOC_l2_011987	
2.06	up	2.43	up	1.18	up	XLOC_l2_012083	AL049987
2.02	up	1.47	up	1.38	down	XLOC_l2_012836	
2.81	up	2.25	up	1.25	down	XLOC_l2_013001	DQ272581
6.83	down	7.85	down	1.15	down	XLOC_l2_013124	AJ606328
2.09	down	2.38	down	1.14	down	XLOC_l2_013125	AJ606331
2.87	down	2.66	down	1.08	up	XLOC_l2_013293	BQ441651
2.98	down	2.34	down	1.28	up	XLOC_l2_013293	BQ441651
4.18	down	3.04	down	1.38	up	XLOC_l2_013293	
2.95	up	2.96	up	1.00	up	XLOC_l2_013301	XR_108746
2.95	up	2.53	up	1.17	down	XLOC_l2_013301	XR_108746
2.92	up	2.72	up	1.07	down	XLOC_l2_013301	XR_108746
2.70	up	1.90	up	1.42	down	XLOC_l2_013485	
3.20	up	2.31	up	1.39	down	XLOC_l2_013734	
3.05	up	2.74	up	1.11	down	XLOC_l2_013873	
2.18	up	1.78	up	1.23	down	XLOC_l2_014048	
2.11	down	2.48	down	1.18	down	XLOC_l2_014697	XR_108927
3.52	up	2.65	up	1.33	down	XLOC_l2_014797	XM_001720463
3.41	up	2.37	up	1.44	down	XLOC_l2_014802	AK311573

1.51	up	2.12	up	1.40	up	XLOC_l2_014830	
3.11	up	1.76	up	1.77	down	XLOC_l2_015121	
1.86	up	2.06	up	1.11	up	XLOC_l2_015441	
5.33	up	5.46	up	1.02	up	XLOC_l2_015849	BX111592
5.76	up	3.94	up	1.46	down	XLOC_l2_015892	
2.96	down	2.09	down	1.42	up	XLOC_l2_015907	
2.86	up	2.07	up	1.38	down	XLOC_l2_015950	
2.38	down	2.03	down	1.17	up	XPNPEP3	NM_001204827
2.23	up	2.32	up	1.04	up	XRCC1	NM_006297
2.29	up	1.68	up	1.36	down	XRCC2	NM_005431
2.22	up	1.80	up	1.23	down	XYLB	NM_005108
10.33	up	8.15	up	1.27	down	YBX2	NM_015982
1.79	down	3.30	down	1.85	down	YIF1B	NM_033557
2.11	up	2.60	up	1.23	up	YPEL1	NM_013313
1.64	down	2.01	down	1.23	down	YWHAE	AK296555
1.56	down	2.19	down	1.40	down	YWHAZ	NM_145690
2.18	up	2.03	up	1.07	down	ZADH2	NM_175907
1.65	down	2.49	down	1.51	down	ZAK	NM_016653
1.04	down	2.73	down	2.62	down	ZBED2	NM_024508
1.96	up	2.66	up	1.36	up	ZBED3	NM_032367
2.01	up	1.84	up	1.09	down	ZBTB46	NM_025224
2.01	up	1.83	up	1.09	down	ZBTB5	NM_014872
1.63	up	2.00	up	1.23	up	ZC3H6	NM_198581
2.47	down	1.81	down	1.37	up	ZC4H2	NM_018684
2.38	up	2.84	up	1.20	up	ZCWPW1	NM_017984
2.36	up	3.62	up	1.53	up	ZCWPW1	NM_017984
3.52	up	3.04	up	1.16	down	ZDHHC23	NM_173570
1.41	down	2.11	down	1.50	down	ZDHHC9	NM_016032
3.05	up	3.03	up	1.01	down	ZFHX2	NM_033400
3.02	up	3.33	up	1.10	up	ZFP14	NM_020917
2.07	up	2.25	up	1.09	up	ZFP3	NM_153018
1.70	up	2.02	up	1.19	up	ZFP62	NM_152283
1.64	up	2.04	up	1.25	up	ZFP62	NM_152283

1.24	down	2.06	down	1.66	down	ZFP64	NM_199427
23.00	up	3.93	up	5.85	down	ZFY	NM_003411
2.64	up	4.94	up	1.87	up	ZMAT1	NM_001011657
2.08	up	4.02	up	1.94	up	ZMAT1	NM_001011657
2.50	up	2.79	up	1.11	up	ZMIZ2	NM_031449
1.79	up	2.08	up	1.16	up	ZNF10	NM_015394
2.05	down	2.05	down	1.00	up	ZNF134	NM_003435
2.07	down	2.32	down	1.12	down	ZNF134	NM_003435
1.46	down	2.05	down	1.40	down	ZNF165	NM_003447
2.23	up	2.52	up	1.13	up	ZNF239	NM_005674
2.15	up	1.97	up	1.09	down	ZNF248	NM_021045
2.58	up	1.18	up	2.19	down	ZNF284	NM_001037813
2.77	up	2.26	up	1.23	down	ZNF300	NM_052860
2.31	up	1.82	up	1.27	down	ZNF300	NM_001172831
2.51	up	2.26	up	1.11	down	ZNF311	NM_001010877
2.19	up	1.81	up	1.21	down	ZNF326	NM_182975
3.64	up	2.84	up	1.28	down	ZNF346	NM_012279
2.82	up	2.62	up	1.08	down	ZNF367	NM_153695
2.20	up	2.36	up	1.07	up	ZNF367	NM_153695
2.05	up	1.70	up	1.21	down	ZNF396	AF533251
2.44	up	2.11	up	1.16	down	ZNF397	NM_001135178
2.19	up	1.49	up	1.47	down	ZNF397	NM_032347
2.42	up	2.57	up	1.07	up	ZNF420	NM_144689
2.49	up	1.47	up	1.69	down	ZNF473	NM_015428
2.87	up	2.39	up	1.20	down	ZNF488	NM_153034
2.30	up	2.21	up	1.04	down	ZNF507	AB029007
2.24	up	1.89	up	1.18	down	ZNF512	NM_032434
2.08	up	1.91	up	1.09	down	ZNF514	NM_032788
3.33	up	1.92	up	1.73	down	ZNF519	NM_145287
2.39	up	4.42	up	1.85	up	ZNF540	NM_152606
24.59	up	54.05	up	2.20	up	ZNF541	NM_001101419
2.14	up	1.89	up	1.13	down	ZNF595	NM_182524
1.77	up	2.11	up	1.20	up	ZNF599	NM_001007248
2.12	up	1.77	up	1.20	down	ZNF605	NM_183238

2.03	up	1.83	up	1.11	down	ZNF605	NM_183238
2.09	up	1.67	up	1.25	down	ZNF641	NM_152320
1.68	down	2.32	down	1.38	down	ZNF655	NM_024061
3.24	up	3.56	up	1.10	up	ZNF667	NM_022103
2.55	up	1.44	up	1.77	down	ZNF713	NM_182633
1.20	up	2.03	up	1.70	up	ZNF714	NM_182515
1.97	down	2.33	down	1.18	down	ZNF726	BC046415
4.06	down	1.56	down	2.61	up	ZNF730	AK131472
2.13	up	1.27	up	1.67	down	ZNF77	NM_021217
1.72	up	2.06	up	1.19	up	ZNF783	NM_001195220
2.50	down	2.02	down	1.24	up	ZNF788	NR_027049
2.21	down	1.66	down	1.33	up	ZNF81	BC039609
4.19	up	2.09	up	2.01	down	ZNF827	NM_178835
1.84	up	3.62	up	1.97	up	ZNF862	NM_001099220
2.75	up	2.41	up	1.14	down	ZNF865	NM_001195605
1.97	up	2.39	up	1.21	up	ZNF879	NM_001136116
2.00	up	2.26	up	1.13	up	ZXDC	NM_001040653
24.72	up	8.79	up	2.81	down	ZYG11A	NM_001004339
5.93	up	5.59	up	1.06	down	ZYG11A	NM_001004339
12.36	up	9.86	up	1.25	down		AF452715
10.75	up	6.30	up	1.71	down		XR_111273
8.44	up	8.38	up	1.01	down		AK094554
8.32	up	8.44	up	1.01	up		AK129565
7.66	up	7.66	up	1.00	down		XM_003119524
6.38	up	5.44	up	1.17	down		AK027667
5.71	up	3.69	up	1.55	down		XR_109724
5.29	up	3.16	up	1.67	down		AF461897
4.97	up	8.52	up	1.71	up		AF289562
4.67	up	3.01	up	1.55	down		XR_110030
4.38	up	4.20	up	1.04	down		AL389942
4.11	up	3.29	up	1.25	down		BC119676
3.99	up	4.89	up	1.22	up		AK129520
3.82	up	3.96	up	1.04	up		XM_003403831

3.81	up	3.62	up	1.05	down		XR_109883
3.62	up	3.61	up	1.00	down		AY129018
3.54	up	4.25	up	1.20	up		XM_00340346 6
3.47	up	4.60	up	1.33	up		DA110513
3.45	up	4.34	up	1.26	up		XM_00340385 4
3.38	up	4.45	up	1.32	up		BC069683
3.34	up	4.70	up	1.41	up		AF119797
3.25	up	2.25	up	1.45	down		AK098491
3.13	up	2.35	up	1.33	down		AK127966
2.98	up	2.53	up	1.18	down		AF068294
2.84	up	2.52	up	1.13	down		BG216262
2.78	up	2.25	up	1.23	down		AK127966
2.78	up	2.26	up	1.23	down		AK074492
2.76	up	7.41	up	2.69	up		AJ312026
2.73	up	2.69	up	1.01	down		AK024144
2.72	up	2.03	up	1.34	down		AK001057
2.72	up	2.18	up	1.25	down		AK091705
2.71	up	3.75	up	1.38	up		XM_00340366 6
2.59	up	1.81	up	1.43	down		BC029479
2.55	up	1.84	up	1.38	down		AK130540
2.48	up	1.99	up	1.25	down		AK096917
2.44	up	4.39	up	1.80	up		BC034587
2.40	up	2.24	up	1.08	down		AY203941
2.34	up	4.89	up	2.09	up		AJ312027
2.32	up	2.31	up	1.01	down		DQ272581
2.29	up	1.33	up	1.73	down		AK309441
2.28	up	2.04	up	1.12	down		AK056419
2.24	up	2.17	up	1.03	down		AK096443
2.17	up	1.52	up	1.43	down		AK294208
2.12	up	2.24	up	1.05	up		CR737729
2.11	up	1.91	up	1.11	down		BC104430
2.10	up	3.75	up	1.78	up		BC044655
2.09	up	1.10	up	1.90	down		XR_109115
2.08	up	2.02	up	1.03	down		BC014063
2.07	up	1.61	up	1.29	down		AK097701
2.05	up	1.85	up	1.11	down		BC021857
2.05	up	2.32	up	1.13	up		AF264629
2.02	up	2.09	up	1.04	up		XM_00311885 7

1.90	up	3.02	up	1.58	up		CR594811
1.84	up	2.35	up	1.28	up		AK126778
1.79	up	2.14	up	1.20	up		M15530
1.73	up	2.00	up	1.16	up		AK127601
1.66	up	2.05	up	1.24	up		BC022294
1.61	up	2.30	up	1.42	up		AK057820
1.59	up	2.03	up	1.28	up		AK026667
1.40	up	2.06	up	1.46	up		AF336885
1.39	up	2.17	up	1.57	up		X58736
1.38	up	2.07	up	1.50	up		AK129975
1.36	up	3.97	up	2.92	up		GQ232939
1.05	down	3.81	down	3.62	down		DR007925
1.93	down	2.40	down	1.24	down		AY927633
2.02	down	1.62	down	1.24	up		AF384996
2.02	down	1.47	down	1.38	up		XM_001721393
2.07	down	3.00	down	1.45	down		AK130724
2.20	down	1.51	down	1.45	up		XM_001130683
2.23	down	2.39	down	1.07	down		AF400227
2.26	down	4.76	down	2.11	down		BM457408
2.33	down	3.00	down	1.29	down		DR007930
2.45	down	1.60	down	1.53	up		DA734158
2.55	down	1.47	down	1.73	up		XM_003118996
2.65	down	1.96	down	1.35	up		BX092453
2.77	down	1.92	down	1.44	up		BC104424
2.91	down	2.19	down	1.33	up		L19779
3.83	down	6.13	down	1.60	down		XM_003118909
4.19	down	4.64	down	1.11	down		BC073826
4.92	down	2.81	down	1.75	up		BC034319
4.99	down	2.78	down	1.79	up		BC034319
5.57	down	2.74	down	2.03	up		BC034319

APPENDIX B - DEG EA POPULATION

Table B.1: EA HPV-Negative vs HPV-Inactive vs HPV-Active Tumors - KW p0.02 FC 2

HPV-Active vs -Inactive		HPV-Active vs -Negative		HPV-Inactive vs -Negative		Gene symbol	Genbank accession
FC (Abs)	Direction of change	FC (Abs)	Direction of change	FC (Abs)	Direction of change		
10.16	up	9.18	up	1.11	down	AACSP1	NR_024035
1.41	down	2.70	down	1.92	down	AATK	NM_001080395
3.25	up	9.62	up	2.96	up	ABCA3	NM_001089
2.42	up	1.56	up	1.55	down	ABCB9	NM_019625
2.41	down	1.93	down	1.25	up	ABCC2	NM_000392
4.91	down	2.33	down	2.11	up	ABCC9	NM_005691
2.70	down	2.18	down	1.24	up	ABL1	NM_007313
1.40	down	2.39	down	1.71	down	ABL2	NM_007314
1.53	down	3.47	down	2.28	down	ABL2	NM_007314
2.08	down	1.97	down	1.06	up	ACOT8	
1.71	up	3.04	up	1.78	up	ACOXL	NM_001142807
2.60	up	2.22	up	1.17	down	ACPL2	NM_152282
1.64	down	1.74	up	2.86	up	ACSL5	NM_203380
2.05	up	3.22	up	1.57	up	ACSS1	NM_032501
1.29	down	2.98	down	2.31	down	ACTN1	NM_001102
1.47	down	2.84	down	1.93	down	ACTN3	NM_001104
1.97	up	2.22	up	1.13	up	ACTR3C	BX640643
2.08	up	2.53	up	1.22	up	ADAM1	NR_036636
1.22	down	3.55	down	2.90	down	ADAM12	NM_021641
1.22	down	1.67	up	2.03	up	ADAM28	NM_021777
1.48	down	2.78	up	4.10	up	ADAMDEC1	NM_001145271
1.15	up	3.03	up	2.63	up	ADAMTS17	NM_139057
2.41	down	5.40	down	2.24	down	ADAMTS6	NM_197941
2.68	up	3.64	up	1.36	up	ADARB2	NM_018702
8.66	up	7.64	up	1.13	down	ADARB2	NM_018702
2.20	down	1.04	up	2.29	up	ADCY4	NM_139247
2.13	up	2.08	up	1.03	down	ADCY6	NM_015270
6.75	down	1.10	up	7.42	up	ADIPOQ	NM_004797
1.12	up	2.47	up	2.20	up	ADORA2A	NM_000675
3.50	down	1.90	down	1.84	up	ADPRHL1	NM_138430

5.18	down	4.56	down	1.14	up	AGMO	NM_001004320
1.35	down	2.54	down	1.88	down	AGPAT4	NM_020133
1.26	down	3.10	down	2.46	down	AGPAT4	NM_020133
2.07	down	5.17	down	2.50	down	AGPAT4	NM_020133
2.43	up	1.69	up	1.44	down	AHDC1	NM_001029882
1.17	up	4.12	down	4.81	down	AHNAK2	NM_138420
2.17	down	2.85	down	1.31	down	AIG1	
2.27	up	2.80	up	1.23	up	AKR1E2	NM_001040177
1.64	up	2.04	up	1.24	up	ALDH9A1	NM_000696
1.24	down	1.77	up	2.18	up	ALS2CR8	NM_024744
2.85	down	1.62	up	4.62	up	AMICA1	NM_153206
2.59	down	3.99	down	1.54	down	AMIGO2	NM_181847
2.60	up	4.80	up	1.85	up	AMY1C	NM_001008219
2.84	up	5.23	up	1.84	up	AMY1C	NM_001008219
3.14	down	1.43	down	2.20	up	ANK1	NM_000037
1.43	down	1.68	up	2.40	up	ANKAR	NM_144708
1.53	down	1.78	up	2.72	up	ANKDD1A	NM_182703
2.89	up	1.10	up	2.62	down	ANKRD13B	NM_152345
1.98	up	2.19	up	1.11	up	ANKRD20A1	NM_032250
4.05	up	4.03	up	1.00	down	ANKRD20A5P	NR_040113
2.17	up	4.18	up	1.92	up	ANKRD20A5P	NR_040113
3.74	up	6.99	up	1.87	up	ANKRD20A9P	NR_027995
1.44	up	3.29	up	2.28	up	ANKRD20A9P	NR_027995
2.40	up	2.32	up	1.03	down	ANKRD24	NM_133475
1.67	up	2.06	up	1.23	up	ANKRD32	NM_032290
3.45	up	11.98	up	3.47	up	ANKRD43	NM_175873
2.80	up	2.52	up	1.11	down	ANKRD65	NM_001145210
1.90	down	6.00	down	3.16	down	ANO1-AS2	XR_110889
4.20	down	1.32	up	5.54	up	AOX1	NM_001159
4.45	down	1.17	up	5.21	up	AOX1	NM_001159
1.05	up	1.98	down	2.07	down	AP1S1	NM_001283
4.49	up	5.12	up	1.14	up	AP3B2	NM_004644
1.92	down	2.02	up	3.88	up	APBB1IP	NM_019043
1.52	down	2.12	down	1.39	down	APBB2	NM_004307
2.01	down	1.69	down	1.19	up	APH1B	NM_031301
4.52	up	1.83	up	2.47	down	APOBEC3B	NM_004900
2.19	up	2.16	up	1.01	down	APOBEC3C	NM_014508
2.17	up	2.10	up	1.03	down	APOBEC3F	NM_145298

1.45	down	1.89	up	2.73	up	APOL3	NM_145641
2.22	down	7.05	down	3.18	down	AREG	NM_001657
2.02	down	6.47	down	3.20	down	AREG	NM_001657
3.76	up	2.11	up	1.78	down	ARF3	
1.19	down	1.69	up	2.02	up	ARGLU1	NM_018011
2.28	up	3.80	up	1.67	up	ARHGAP26	NM_015071
2.40	up	1.99	up	1.21	down	ARHGAP33	NM_052948
1.16	up	3.89	up	3.35	up	ARHGAP4	NM_00116474 1
1.67	up	1.37	down	2.29	down	ARHGAP5	NM_00103005 5
1.64	down	1.81	up	2.97	up	ARHGAP9	NM_032496
1.52	down	1.65	up	2.51	up	ARHGDIB	NM_001175
7.01	up	2.60	up	2.70	down	ARHGEF16	NM_014448
4.44	up	2.20	up	2.01	down	ARHGEF19	NM_153213
5.13	up	1.91	up	2.68	down	ARHGEF19	NM_153213
2.29	up	1.96	up	1.17	down	ARL3	NM_004311
1.90	down	3.33	down	1.75	down	ARL4D	NM_001661
5.93	up	6.39	up	1.08	up	ARNT2	NM_014862
1.14	up	3.52	down	4.03	down	ARSJ	NM_024590
1.42	up	5.70	up	4.00	up	ART4	NM_021071
1.00	up	3.12	down	3.13	down	ARTN	NM_057090
3.92	up	6.72	up	1.72	up	ASCL4	NM_203436
3.21	up	1.98	up	1.62	down	ASF1B	NM_018154
3.24	down	2.03	up	6.58	up	ASPA	NM_000049
2.75	up	2.58	up	1.07	down	ATF5	NM_012068
3.04	down	1.08	down	2.82	up	ATOH8	NM_032827
1.74	up	1.37	down	2.39	down	ATP2B4	NM_00100139 6
10.85	up	1.59	up	6.84	down	ATP5B	NM_001686
1.64	up	3.28	up	2.00	up	ATP6V0E2	NM_145230
4.20	down	4.49	down	1.07	down	ATP8B3	NM_138813
1.78	down	3.51	down	1.97	down	ATP9A	NM_006045
1.19	down	2.28	down	1.92	down	ATXN1	NM_000332
1.31	up	3.23	down	4.22	down	B3GNT4	NM_030765
1.08	down	3.36	down	3.10	down	B4GALNT3	NM_173593
4.03	up	2.04	up	1.98	down	BAI2	NM_001703
2.88	up	1.98	down	5.70	down	BAIAP2L1	NM_018842
2.48	up	1.96	up	1.27	down	BARD1	NM_000465
2.32	down	2.47	down	1.07	down	BASP1	NM_006317
1.87	down	2.24	down	1.19	down	BBS5	NM_152384
1.81	down	4.03	down	2.23	down	BCAT1	NM_005504
2.78	down	3.90	down	1.40	down	BCAT1	NM_005504
1.86	up	2.34	up	1.25	up	BCL11A	NM_018014
2.18	up	3.62	up	1.66	up	BCL11A	NM_022893
2.73	up	2.56	up	1.06	down	BCL11A	NM_022893
1.76	up	2.38	up	1.36	up	BCL11A	NM_138559
1.61	up	2.21	up	1.37	up	BCOR	BC128456

1.96	up	2.25	up	1.15	up	BDNF-AS1	NR_002832
1.29	down	3.46	down	2.67	down	BFSP1	NM_001195
1.43	down	3.89	up	5.56	up	BFSP2	NM_003571
5.15	up	3.46	up	1.49	down	BK250D10.8	NR_024355
1.50	down	4.46	down	2.98	down	BMPR1B	NM_001203
3.71	down	1.40	up	5.21	up	BMX	NM_001721
1.19	down	2.16	down	1.81	down	BNIP3	NM_004052
1.11	up	1.86	down	2.06	down	BOP1	NM_015201
2.17	up	1.96	up	1.11	down	BRCA1	NM_007300
2.06	up	2.14	up	1.04	up	BRCA2	NM_000059
2.28	down	3.03	down	1.33	down	BRI3	NM_001159491
2.01	down	2.87	down	1.43	down	BTBD16	NM_144587
1.29	up	1.60	down	2.05	down	BTBD7	NM_001002860
1.45	down	2.05	down	1.41	down	BTBD9	NM_052893
6.46	up	10.01	up	1.55	up	BTNL9	NM_152547
1.51	up	5.03	up	3.33	up	BZRAP1	NM_004758
1.48	down	2.13	down	1.44	down	BZW1	NM_001207068
2.07	down	2.76	up	5.72	up	C10orf105	NM_001164375
1.56	down	3.20	down	2.05	down	C10orf114	NM_001010911
2.40	down	1.13	up	2.71	up	C10orf128	NM_001010863
2.06	down	1.27	down	1.61	up	C10orf32	NM_144591
2.25	down	1.70	down	1.33	up	C11orf71	NM_019021
3.78	up	4.46	up	1.18	up	C11orf85	NM_001037225
7.69	up	23.68	up	3.08	up	C11orf92	NR_034154
3.43	up	6.15	up	1.79	up	C11orf93	NM_001136105
2.05	down	2.08	down	1.02	down	C11orf95	NM_001144936
3.63	up	2.99	up	1.21	down	C12orf34	NM_032829
1.50	down	2.66	down	1.77	down	C13orf16	NM_152324
5.03	down	3.09	down	1.63	up	C13orf33	NM_032849
1.59	down	2.12	down	1.33	down	C14orf109	NM_001098621
1.36	up	2.05	down	2.78	down	C14orf128	NR_027263
1.48	up	2.01	down	2.98	down	C14orf128	NR_027263
2.38	down	3.05	down	1.28	down	C14orf149	NM_144581
1.93	down	1.50	up	2.90	up	C14orf182	AK090420
2.55	down	3.60	down	1.41	down	C14orf33	NR_027123
2.65	down	3.50	down	1.32	down	C14orf33	NR_027123
2.51	down	3.56	down	1.42	down	C14orf33	NR_027123
1.81	down	3.17	down	1.75	down	C14orf37	NM_00100187

							2
3.14	up	1.77	up	1.77	down	C15orf42	NM_152259
2.31	down	3.69	down	1.60	down	C16orf57	NM_00120491 1
1.90	down	2.61	down	1.38	down	C16orf74	NM_206967
2.07	down	2.01	down	1.03	up	C16orf87	NM_00100143 6
1.44	down	3.12	down	2.17	down	C17orf51	NM_00111343 4
3.67	up	1.44	up	2.54	down	C17orf53	NM_024032
1.49	down	1.77	up	2.62	up	C17orf67	NM_00108543 0
1.33	up	2.11	up	1.59	up	C17orf76	NM_207387
1.50	up	1.36	down	2.04	down	C18orf45	NM_032933
2.02	up	1.93	up	1.05	down	C19orf25	NM_152482
11.87	up	6.47	up	1.83	down	C19orf57	NM_024323
2.08	up	1.58	up	1.31	down	C1orf112	NM_018186
2.66	up	1.39	up	1.91	down	C1orf135	NM_024037
5.16	up	1.65	up	3.13	down	C1orf213	NR_033690
2.24	down	2.31	down	1.03	down	C1orf226	NM_00113524 0
5.17	up	4.62	up	1.12	down	C1orf51	NM_144697
2.13	up	1.58	down	3.37	down	C1orf74	NM_152485
1.32	down	1.90	up	2.51	up	C20orf160	NM_080625
2.71	up	7.78	up	2.87	up	C21orf15	NR_026755
1.74	up	2.21	up	1.27	up	C21orf63	NM_058187
1.52	up	2.37	up	1.56	up	C21orf63	NM_058187
2.44	up	4.01	up	1.64	up	C21orf71	NR_024092
1.54	up	4.94	up	3.21	up	C21orf81	NR_027270
1.06	down	2.21	up	2.35	up	C21orf81	BC036580
1.75	up	2.13	up	1.22	up	C2CD2	NM_015500
2.65	down	1.66	down	1.60	up	C2CD3	NM_015531
3.29	up	2.21	up	1.48	down	C2CD4D	NM_00113600 3
3.17	up	2.46	up	1.29	down	C2orf15	NM_144706
7.98	up	6.00	up	1.33	down	C2orf54	NM_024861
5.17	up	5.33	up	1.03	up	C2orf55	NM_207362
4.21	up	3.81	up	1.10	down	C2orf65	NM_138804
1.88	down	1.91	up	3.59	up	C2orf89	NM_00108082 4
2.57	up	2.26	up	1.14	down	C3orf14	NM_020685
2.47	down	7.47	down	3.02	down	C3orf67	NM_198463
2.25	up	1.85	up	1.21	down	C4orf21	AK002193
2.43	down	1.36	down	1.78	up	C4orf32	NM_152400
1.89	up	1.67	down	3.15	down	C4orf47	NM_00111435 7
22.46	up	120.9 5	up	5.39	up	C4orf7	NM_152997

2.84	up	3.31	up	1.17	up	C5	NM_001735
2.03	down	2.50	up	5.07	up	C5orf20	NM_130848
2.59	up	2.04	up	1.27	down	C5orf30	NM_033211
1.71	up	2.76	up	1.61	up	C5orf34	NM_198566
1.13	up	2.07	up	1.83	up	C5orf45	NM_016175
2.24	up	2.02	up	1.11	down	C5orf54	NM_022090
1.34	up	2.82	up	2.11	up	C5orf56	NR_045116
1.89	up	3.29	up	1.74	up	C5orf56	AK025221
1.79	down	2.40	down	1.34	down	C6orf170	NM_152730
1.58	down	2.15	down	1.36	down	C6orf218	NR_027793
2.10	down	1.77	down	1.19	up	C6orf226	NM_001008739
2.11	down	1.80	down	1.17	up	C6orf226	NM_001008739
6.47	up	2.67	up	2.42	down	C7orf13	NR_026865
2.88	up	2.14	up	1.34	down	C7orf13	NR_026865
1.53	up	2.51	up	1.64	up	C7orf46	NM_199136
2.91	up	3.84	up	1.32	up	C8G	NM_000606
5.36	up	6.22	up	1.16	up	C8G	NM_000606
2.21	up	1.62	up	1.37	down	C9orf100	NM_032818
1.79	down	2.64	down	1.47	down	C9orf3	NM_001193329
1.29	up	1.95	down	2.53	down	C9orf30-TMEFF1	NM_001198812
1.39	down	6.35	down	4.58	down	CA12	NM_001218
20.13	up	1.29	up	15.57	down	CA9	NM_001216
1.37	down	2.04	down	1.49	down	CAB39	NM_001130849
1.10	down	2.77	up	3.04	up	CACNB4	NM_001005747
1.42	up	1.61	down	2.28	down	CALU	NM_001219
7.72	up	10.95	up	1.42	up	CAPN14	NM_001145122
1.52	up	2.87	down	4.37	down	CAPSL	NM_144647
1.03	down	2.09	down	2.04	down	CARD10	NM_014550
2.97	down	2.81	down	1.06	up	CARD6	NM_032587
1.15	down	1.97	up	2.27	up	CARD9	NM_052813
2.02	up	2.01	up	1.00	down	CASP2	NM_032982
2.03	down	1.60	down	1.27	up	CASS4	NM_020356
1.63	up	2.02	up	1.24	up	CATSPER2	NM_172097
2.36	down	3.60	down	1.53	down	CAV1	NM_001753
2.28	down	4.17	down	1.83	down	CAV1	NM_001753
1.32	down	2.82	down	2.14	down	CAV2	NM_001233
1.72	down	2.52	up	4.33	up	CBFA2T3	NM_005187
7.88	up	3.93	up	2.01	down	CBS	NM_000071
2.75	up	2.71	up	1.01	down	CBX5	NM_001127322
1.10	up	2.78	up	2.52	up	CBX7	NM_175709

2.04	up	2.14	up	1.05	up	CCDC14	NM_022757
2.22	up	2.04	up	1.09	down	CCDC146	NM_020879
1.32	down	4.36	down	3.30	down	CCDC147	NM_001008723
2.74	up	1.59	up	1.72	down	CCDC150	NM_001080539
2.90	up	1.29	up	2.25	down	CCDC24	NM_152499
2.18	down	2.87	down	1.32	down	CCDC3	NM_031455
2.64	up	1.41	up	1.88	down	CCDC34	NM_030771
1.10	down	2.56	down	2.32	down	CCDC40	NM_001243342
2.09	down	1.53	up	3.20	up	CCDC69	NM_015621
6.49	down	1.64	up	10.63	up	CCL14	NM_032963
1.94	down	4.60	down	2.37	down	CCL26	NM_006072
2.60	up	1.74	up	1.49	down	CCNB1	NM_031966
3.02	up	1.94	up	1.55	down	CCNE2	NM_057749
2.81	up	2.28	up	1.23	down	CCNE2	NM_057749
6.46	up	14.50	up	2.25	up	CCNI2	NM_001039780
1.86	down	2.14	down	1.15	down	CCNK	NM_001099402
5.74	up	2.94	up	1.95	down	CCNO	NM_021147
1.09	up	2.11	up	1.93	up	CCR10	NM_016602
1.92	down	2.03	up	3.90	up	CCR2	NM_001123041
1.34	down	1.64	up	2.20	up	CCR6	NM_031409
2.65	down	2.16	up	5.72	up	CD1C	NM_001765
2.99	down	2.88	up	8.62	up	CD1E	NM_001042583
10.28	down	2.53	down	4.07	up	CD209	NM_001144897
8.50	down	2.18	down	3.90	up	CD209	NM_021155
4.31	down	1.60	down	2.69	up	CD209	NM_021155
10.39	down	1.50	down	6.95	up	CD36	NM_001001547
1.14	down	2.23	up	2.54	up	CD74	NM_001025158
3.59	up	6.73	up	1.88	up	CD8B	NM_004931
3.51	up	5.74	up	1.64	up	CD8B	NM_172102
3.19	up	6.03	up	1.89	up	CD8B	NM_004931
2.12	down	1.45	down	1.46	up	CD93	NM_012072
2.27	up	1.72	up	1.32	down	CDC25A	NM_001789
2.42	up	1.96	up	1.23	down	CDC25C	NM_001790
3.31	up	2.06	up	1.61	down	CDC42EP4	NM_012121
1.60	down	1.64	up	2.62	up	CDC42SE2	NM_020240
2.49	up	1.74	up	1.43	down	CDC45	NM_003504
2.60	up	2.67	up	1.03	up	CDC7	NM_003503
2.52	up	1.36	up	1.85	down	CDCA5	NM_080668

2.77	down	4.95	down	1.79	down	CDH13	NM_001220491
5.14	down	6.66	down	1.30	down	CDH15	NM_004933
2.35	up	1.53	up	1.53	down	CDK2	NM_001798
1.69	down	3.31	down	1.96	down	CDK6	NM_001259
14.90	up	11.57	up	1.29	down	CDKN2A	NM_058197
45.21	up	23.38	up	1.93	down	CDKN2A	NM_000077
3.22	up	3.79	up	1.18	up	CDKN2B-AS	NR_003529
3.34	up	5.43	up	1.63	up	CDKN2C	NM_078626
2.05	down	3.09	down	1.51	down	CDR1	NM_004065
1.39	down	2.17	down	1.56	down	CDR2L	NM_014603
2.33	up	1.67	up	1.40	down	CDT1	NM_030928
3.60	up	4.59	up	1.27	up	CEACAM1	NM_001712
4.40	up	4.22	up	1.04	down	CECR7	NR_015352
1.99	up	4.33	up	2.17	up	CELF4	NM_020180
4.91	up	10.54	up	2.15	up	CELF4	NM_020180
2.83	up	1.46	up	1.94	down	CENPF	NM_016343
2.50	up	2.15	up	1.17	down	CENPH	NM_022909
2.29	up	2.46	up	1.08	up	CENPJ	NM_018451
2.77	up	3.14	up	1.14	up	CENPK	NM_022145
2.55	up	2.38	up	1.07	down	CENPM	NM_001002876
2.04	up	2.39	up	1.17	up	CENPM	NM_024053
2.36	up	1.56	up	1.51	down	CENPO	NM_001199803
2.22	down	2.40	down	1.08	down	CEP112	NM_145036
2.39	up	1.53	up	1.56	down	CEP72	NM_018140
3.06	down	1.09	up	3.33	up	CFI	NM_000204
2.68	down	2.01	up	5.39	up	CFP	NM_002621
2.16	up	3.73	up	1.72	up	CGNL1	NM_032866
2.31	up	2.81	up	1.22	up	CHADL	NM_138481
2.77	up	2.32	up	1.19	down	CHAF1A	NM_005483
2.89	up	2.07	up	1.40	down	CHAF1A	NM_005483
2.82	up	2.76	up	1.02	down	CHAF1B	NM_005441
2.94	up	3.08	up	1.05	up	CHDH	NM_018397
6.13	up	8.19	up	1.34	up	CHDH	NM_018397
14.43	down	5.93	down	2.43	up	CHGB	NM_001819
3.00	down	3.73	up	11.18	up	CHI3L2	NM_001025199
2.79	down	1.96	down	1.42	up	CHN2	NM_004067
2.26	up	2.76	up	1.22	up	CHPT1	NM_020244
8.44	down	1.58	down	5.34	up	CIDEA	NM_001279
2.27	up	2.49	up	1.10	up	CIDEB	NM_014430
3.31	up	2.28	up	1.45	down	CIT	NM_007174
1.63	up	1.37	down	2.24	down	CKAP4	NM_006825
1.89	down	3.61	down	1.91	down	CLCF1	NM_013246
30.07	up	22.52	up	1.34	down	CLDN10	NM_182848
2.93	up	2.04	up	1.44	down	CLDN7	NM_001307

4.15	down	1.69	up	7.00	up	CLEC10A	NM_182906
3.55	down	1.93	up	6.85	up	CLEC3B	NM_003278
13.77	down	1.49	down	9.23	up	CLEC4G	NM_198492
38.78	down	1.96	down	19.79	up	CLEC4G	NM_198492
12.20	down	1.45	down	8.44	up	CLEC4GP1	NR_002931
2.64	down	2.21	up	5.84	up	CLECL1	NM_172004
8.65	up	8.31	up	1.04	down	CLGN	NM_004362
1.43	down	1.88	up	2.68	up	CLIC2	NM_001289
1.12	down	2.64	down	2.36	down	CLIC4	NM_013943
1.83	down	2.81	down	1.54	down	CLIP4	NM_024692
1.61	down	2.12	down	1.32	down	CLIP4	NM_024692
2.11	down	1.66	down	1.27	up	CLIP4	NM_024692
1.23	up	2.38	up	1.93	up	CLK4	NM_020666
2.56	down	2.83	down	1.10	down	CLMP	NM_024769
2.15	up	1.21	up	1.78	down	CLSPN	NM_022111
1.14	up	2.09	down	2.39	down	CNTF	NM_000614
1.23	up	2.17	up	1.77	up	CNTRL	AK097636
16.93	up	2.17	up	7.80	down	COL22A1	NM_152888
1.03	up	6.96	up	6.79	up	COL4A4	NM_000092
4.54	down	13.72	down	3.03	down	COL4A6	NM_033641
5.77	up	3.58	up	1.61	down	COL9A2	NM_001852
1.45	down	2.26	up	3.27	up	CORO1A	NM_007074
1.25	down	5.13	down	4.11	down	CPA4	NM_016352
3.74	down	1.50	up	5.62	up	CR1L	NM_175710
1.55	down	19.14	up	29.65	up	CR2	NM_00100665 8
1.50	up	2.01	up	1.34	up	CREB3L4	NM_130898
1.53	down	3.23	down	2.12	down	CREB5	NM_182898
2.54	down	9.96	down	3.93	down	CREG2	NM_153836
1.26	up	3.69	up	2.92	up	CRIP3	NM_206922
2.06	up	1.39	up	1.48	down	CROCC	NM_014675
2.40	down	1.52	down	1.58	up	CSGALNAC T1	NM_018371
2.47	down	2.00	down	1.23	up	CSGALNAC T1	NM_00113051 8
1.07	down	3.05	down	2.85	down	CTTN	NM_00118474 0
1.20	down	3.24	up	3.87	up	CUL3	NM_003590
1.66	up	2.67	up	1.61	up	CUL9	NM_015089
1.18	down	3.04	up	3.59	up	CX3CR1	NM_001337
3.60	up	4.03	up	1.12	up	CXCL10	NM_001565
3.66	up	4.53	up	1.24	up	CXCL10	NM_001565
4.15	down	6.13	down	1.48	down	CXCL14	NM_004887
2.01	down	3.73	up	7.47	up	CXCR5	NM_032966
2.19	down	1.26	down	1.73	up	CXorf36	NM_176819
1.39	down	2.03	down	1.46	down	CXorf48	NM_00103170 5
5.05	up	3.65	up	1.38	down	CXXC4	NM_025212

4.82	up	2.03	up	2.38	down	CYB5R2	NM_016229
4.98	up	2.01	up	2.48	down	CYB5R2	NM_016229
1.38	down	1.70	up	2.34	up	CYBASC3	NM_153611
1.26	down	2.01	up	2.54	up	CYFIP2	NM_001037332
1.43	down	2.91	up	4.16	up	CYFIP2	NM_001037332
3.97	up	2.26	up	1.75	down	CYP2J2	NM_000775
1.07	down	2.13	up	2.28	up	CYP4V2	NM_207352
5.84	up	10.73	up	1.84	up	CYP4X1	NM_178033
5.62	up	5.77	up	1.03	up	CYP4Z1	NM_178134
4.29	up	4.56	up	1.06	up	CYP4Z1	NM_178134
4.49	up	4.85	up	1.08	up	CYP4Z1	NM_178134
1.60	down	1.71	up	2.73	up	CYSLTR1	NM_006639
2.04	down	1.58	down	1.29	up	CYYR1	NM_052954
2.27	down	2.98	down	1.31	down	DAAM1	NM_014992
1.50	down	2.13	down	1.42	down	DAAM2	BC078153
3.23	down	1.87	up	6.03	up	DARC	NM_002036
1.16	down	3.06	down	2.63	down	DCBLD1	NM_173674
1.17	down	3.09	down	2.64	down	DCBLD1	NM_173674
1.77	down	2.09	down	1.18	down	DCUN1D3	NM_173475
1.58	down	3.25	down	2.06	down	DCUN1D5	NM_032299
2.80	up	1.81	up	1.55	down	DDX11	NM_030653
2.60	up	1.80	up	1.45	down	DDX11	NM_030653
2.90	up	1.63	up	1.78	down	DDX11	NM_152438
1.34	up	2.43	up	1.81	up	DDX26B	NM_182540
1.17	up	2.38	up	2.04	up	DDX26B	NM_182540
1.51	down	2.03	up	3.07	up	DENND1C	NM_024898
1.68	down	2.00	down	1.19	down	DENND2A	NM_015689
1.05	up	2.53	up	2.42	up	DENND2D	NM_024901
1.42	down	1.73	up	2.45	up	DENND4A	NM_001144823
1.18	up	1.94	down	2.29	down	DEPDC7	NM_139160
1.73	down	3.60	down	2.09	down	DFNA5	NM_004403
2.24	up	1.47	up	1.52	down	DGCR14	NM_022719
2.69	up	3.11	up	1.16	up	DHFR	NM_000791
4.66	down	2.31	down	2.02	up	DIO3OS	NR_002770
6.39	down	2.85	down	2.25	up	DIRAS1	NM_145173
5.06	down	4.00	down	1.27	up	DKFZP586K1520	AL050153
1.30	down	2.10	down	1.62	down	DKK3	NM_015881
2.40	up	1.76	up	1.36	down	DLG3	NM_021120
92.23	up	32.77	up	2.81	down	DMRTA2	NM_032110
3.59	up	3.22	down	11.57	down	DNAH17	
1.05	up	2.34	up	2.22	up	DNHD1	NM_144666
2.18	up	1.75	up	1.25	down	DNMT1	NM_001130823
1.22	down	3.23	down	2.65	down	DNMT3B	NM_175850

4.19	up	4.42	up	1.06	up	DOC2B	NM_003585
2.44	up	2.82	up	1.15	up	DOC2B	NM_003585
1.46	down	1.93	up	2.82	up	DOCK10	NM_014689
2.11	up	1.92	up	1.10	down	DONSON	NM_017613
2.24	up	1.69	up	1.33	down	DOT1L	NM_032482
2.81	down	1.02	up	2.88	up	DPP4	NM_001935
6.68	up	7.57	up	1.13	up	DSCR6	NM_018962
2.87	up	2.27	up	1.26	down	DTL	NM_016448
2.25	up	1.68	up	1.34	down	DTX2	NM_020892
3.11	up	1.84	up	1.69	down	DTX2	NM_020892
2.75	up	1.81	up	1.52	down	DTX2	NM_020892
1.34	down	2.24	down	1.66	down	DUSP18	NM_152511
2.11	down	1.69	down	1.25	up	DUSP6	NM_001946
9.41	up	3.28	up	2.87	down	DYDC2	NM_032372
6.54	up	1.84	up	3.56	down	E2F7	NM_203394
3.40	up	1.80	up	1.90	down	E2F7	NM_203394
2.65	up	2.88	up	1.09	up	E2F8	NM_024680
3.26	up	1.79	up	1.82	down	EBF4	NM_00111051 4
2.07	down	1.11	down	1.86	up	ECSCR	NM_00107769 3
1.53	up	1.96	down	2.99	down	EFNB1	NM_004429
3.01	up	2.84	up	1.06	down	EGOT	NR_004428
1.82	down	1.39	up	2.53	up	EGR1	NM_001964
65.79	up	5.06	up	13.01	down	EIF1AY	NM_004681
1.20	up	1.75	down	2.11	down	EIF2C2	NM_012154
3.06	up	1.82	up	1.68	down	EIF3D	
1.63	up	1.92	down	3.14	down	EIF4EBP1	NM_004095
1.56	down	2.00	up	3.12	up	ELANE	NM_001972
2.18	down	1.26	down	1.73	up	ELTD1	NM_022159
2.09	down	1.25	down	1.68	up	ELTD1	NM_022159
2.09	up	1.77	up	1.19	down	EME1	NM_152463
2.11	down	2.64	down	1.25	down	EML1	NM_00100870 7
1.60	down	2.11	down	1.32	down	ENDOD1	NM_015036
2.25	up	1.60	down	3.60	down	ENKUR	NM_145010
3.23	up	1.68	up	1.92	down	ENO2	NM_001975
2.69	down	1.39	up	3.74	up	ENPP3	NM_005021
4.01	up	3.41	up	1.17	down	ENPP5	NM_021572
1.06	up	2.39	down	2.53	down	ENTPD7	NM_020354
1.29	up	2.40	up	1.86	up	EPB41L4A	NM_022140
2.13	up	6.33	up	2.97	up	EPHX2	NM_001979
4.02	up	2.77	up	1.45	down	EPHX3	NM_024794
1.67	up	2.57	up	1.54	up	EPM2AIP1	NM_014805
1.32	down	2.02	down	1.53	down	ERBB2	AB025286
1.37	up	1.64	down	2.26	down	ERC1	NM_178040
2.75	down	1.89	down	1.46	up	ERG	NM_004449
5.37	up	1.13	down	6.06	down	ESM1	NM_007036

2.90	up	2.19	up	1.32	down	ESPL1	NM_012291
2.50	up	1.72	down	4.30	down	ESRP1	NM_017697
2.27	down	3.13	down	1.38	down	ETNK1	NM_00103948 1
2.09	up	1.78	up	1.17	down	ETV6	NM_001987
1.49	up	1.59	down	2.37	down	EXD2	NM_018199
2.74	up	1.52	up	1.81	down	EXO1	NM_003686
2.96	up	10.02	up	3.39	up	EXOC3L4	NM_00107759 4
1.04	up	1.95	down	2.03	down	EXOC6B	AK023791
1.17	down	3.16	down	2.70	down	EXOC6B	NM_015189
1.30	down	2.01	down	1.55	down	EXOC6B	AB384543
1.47	down	2.01	down	1.37	down	EXOC7	BC029432
1.51	up	1.52	down	2.30	down	EXT1	NM_000127
1.35	down	2.05	down	1.52	down	EXT2	NM_000401
2.32	up	2.52	up	1.09	up	EZH2	NM_004456
2.16	up	1.11	up	1.94	down	F11R	NM_016946
1.76	down	2.15	down	1.22	down	F2R	NM_001992
5.03	down	9.77	down	1.94	down	F2RL1	NM_005242
2.96	up	2.31	up	1.28	down	FAAH	NM_001441
2.47	up	3.82	up	1.55	up	FAAH2	NM_174912
34.98	down	3.34	down	10.48	up	FABP4	NM_001442
4.47	up	3.15	up	1.42	down	FADS2	NM_004265
2.05	down	1.69	up	3.46	up	FAM107A	NM_007177
3.85	up	2.93	up	1.32	down	FAM111B	NM_198947
1.32	up	1.83	down	2.41	down	FAM114A1	NM_138389
1.06	up	2.50	up	2.35	up	FAM117A	NM_030802
2.76	down	3.49	down	1.26	down	FAM126A	
2.19	down	2.32	down	1.06	down	FAM126A	NM_032581
1.60	down	2.41	down	1.51	down	FAM126A	NM_032581
5.06	down	2.08	down	2.43	up	FAM134B	NM_00103485 0
1.38	up	2.87	up	2.08	up	FAM151A	NM_176782
1.22	down	2.33	up	2.86	up	FAM159A	NM_00104269 3
2.93	up	1.36	up	2.16	down	FAM161A	NM_032180
1.03	up	4.70	down	4.86	down	FAM176A	NM_00113503 2
2.10	up	1.44	up	1.45	down	FAM200B	NM_00114519 1
3.21	up	1.77	up	1.82	down	FAM27E3	XM_00172046 3
8.73	up	21.85	up	2.50	up	FAM3B	NM_058186
4.37	up	1.40	up	3.13	down	FAM64A	NM_00119522 8
3.35	up	5.63	up	1.68	up	FAM81A	NM_152450
2.70	up	2.10	down	5.66	down	FAM83B	NM_00101087 2

2.33	down	3.45	down	1.48	down	FAM89A	NM_198552
1.11	down	2.68	down	2.42	down	FAM91A1	NM_144963
2.42	up	1.89	up	1.28	down	FANCB	NM_001018113
2.46	up	1.48	up	1.66	down	FANCC	NM_001243744
2.72	up	2.39	up	1.13	down	FANCC	NM_000136
2.42	up	1.98	up	1.23	down	FANCG	NM_004629
2.41	up	2.31	up	1.04	down	FANCL	NM_018062
2.46	up	2.25	up	1.09	down	FANCL	NM_001114636
1.56	up	2.06	up	1.31	up	FAR1	NM_032228
1.24	down	3.78	down	3.05	down	FBLIM1	NM_001024215
1.31	down	3.51	down	2.68	down	FBLIM1	NM_017556
1.34	up	2.38	up	1.77	up	FBXL16	NM_153350
1.39	down	2.15	down	1.54	down	FBXO3	NM_033406
3.62	up	3.60	up	1.01	down	FBXO43	NM_001029860
2.10	down	1.52	up	3.20	up	FCGR2B	NM_004001
2.26	up	1.73	up	1.31	down	FEN1	NM_004111
2.08	down	3.71	down	1.79	down	FERMT2	NM_001135000
1.67	down	2.82	down	1.69	down	FEZ1	NM_005103
5.01	down	2.28	down	2.20	up	FFAR3	NM_005304
1.70	down	1.39	up	2.36	up	FGD2	NM_173558
1.88	down	1.69	up	3.17	up	FGD3	NM_033086
2.10	up	1.31	up	1.59	down	FGD6	NM_018351
2.10	up	2.31	up	1.10	up	FIGNL1	NM_001042762
1.39	down	2.22	down	1.60	down	FKBP14	NM_017946
1.01	up	2.35	down	2.37	down	FKBP9	NM_007270
3.48	down	23.35	down	6.71	down	FLJ13744	AK023806
2.85	down	4.34	down	1.52	down	FLJ22447	NR_039985
1.35	down	1.66	up	2.24	up	FLJ33630	NR_015360
4.71	up	1.99	up	2.36	down	FLJ35024	NR_015375
5.06	up	3.63	up	1.40	down	FLJ35024	BC090887
1.62	up	3.18	up	1.96	up	FLJ38109	AK095428
3.53	up	3.29	up	1.08	down	FLJ40852	NR_015392
6.83	down	2.86	down	2.39	up	FLJ41200	NR_033863
2.39	down	3.68	down	1.54	down	FLJ45248	AK127183
2.01	down	3.34	down	1.66	down	FLJ45248	AK127183
13.63	up	5.12	up	2.66	down	FLJ45482	AK127393
9.82	up	3.87	up	2.54	down	FLJ45482	AK127393
6.60	down	3.71	down	1.78	up	FLJ45983	NR_024256
1.20	down	2.19	down	1.83	down	FLJ46906	NR_033896
1.15	down	2.19	down	1.90	down	FLJ46906	NR_033896
1.18	down	2.22	down	1.88	down	FLJ46906	NR_033896

1.33	down	2.15	down	1.62	down	FLJ46906	NR_033896
2.18	up	1.77	up	1.23	down	FLNA	AK125630
1.95	down	4.78	down	2.46	down	FLRT2	NM_013231
2.65	down	13.57	down	5.12	down	FLRT3	NM_198391
1.17	up	2.00	up	1.71	up	FLT3LG	NM_001459
2.43	up	1.40	up	1.73	down	FMO6P	NR_002601
9.16	down	2.38	down	3.84	up	FONG	NR_034096
1.45	up	3.13	down	4.55	down	FOSL1	NM_005438
10.44	up	9.12	up	1.14	down	FOXD3	NM_012183
1.01	down	2.31	down	2.29	down	FOXF2	NM_001452
2.64	up	1.44	up	1.83	down	FOXP4	NM_00101242 6
5.21	up	3.49	up	1.49	down	FOXRED2	NM_024955
2.52	up	2.40	up	1.05	down	FOXRED2	NM_024955
2.02	up	2.26	up	1.12	up	FRA10AC1	NM_145246
1.00	up	2.44	down	2.45	down	FRMD6	NM_00104248 1
1.20	down	2.44	up	2.93	up	FRZB	NM_001463
1.02	down	2.26	down	2.23	down	FSD1L	NM_031919
1.82	down	4.09	down	2.25	down	FSTL3	NM_005860
2.33	up	4.75	up	2.04	up	FUT7	NM_004479
1.40	up	2.12	up	1.52	up	G3BP1	
1.08	down	2.14	down	1.98	down	GABARAPL1	NM_031412
36.74	up	14.72	up	2.50	down	GABRP	NM_014211
21.34	up	5.96	up	3.58	down	GAD1	NM_000817
1.06	down	2.12	down	2.00	down	GALNT3	NM_004482
3.23	down	3.80	down	1.18	down	GALNT6	NM_007210
5.58	down	4.48	down	1.25	up	GALNTL2	NM_054110
1.57	down	2.54	up	3.97	up	GAPT	NM_152687
1.70	down	4.80	down	2.82	down	GAST	NM_000805
1.69	up	3.81	up	2.25	up	GATM	NM_001482
1.44	up	2.41	up	1.68	up	GBP4	NM_052941
1.53	down	1.62	up	2.48	up	GCA	NM_012198
2.56	up	6.74	up	2.63	up	GCET2	NM_00119025 9
1.85	up	3.41	up	1.84	up	GCET2	NM_00119025 9
1.58	down	1.75	up	2.77	up	GCFC1-AS1	NR_038879
2.27	up	2.95	up	1.30	up	GCHFR	NM_005258
5.23	down	2.02	up	10.59	up	GDF10	NM_004962
3.82	down	1.08	down	3.54	up	GFRA2	NM_001495
1.21	up	2.02	up	1.67	up	GGA2	NM_015044
2.61	down	1.57	up	4.11	up	GGTA1P	NR_003191
1.95	down	2.49	up	4.86	up	GHRL	NM_016362
2.04	down	1.78	up	3.63	up	GIMAP2	NM_015660
1.65	up	2.18	up	1.32	up	GIN1	NM_017676
1.50	down	3.73	down	2.48	down	GJA1	NM_000165
1.74	down	1.49	up	2.59	up	GJA4	NM_002060

1.11	up	2.40	up	2.15	up	GKAP1	NM_025211
4.10	up	4.08	up	1.00	down	GLB1L2	NM_138342
2.69	down	1.74	down	1.55	up	GLIPR1	NM_006851
1.15	down	2.95	down	2.57	down	GLIS1	NM_147193
13.21	up	15.05	up	1.14	up	GLS2	NM_013267
2.59	down	1.24	up	3.21	up	GNA14	NM_004297
2.41	down	1.45	down	1.66	up	GNG11	NM_004126
1.52	up	2.00	up	1.31	up	GOLGA2P5	NR_024261
3.96	down	14.21	down	3.59	down	GOLGA7B	NM_00101091 7
1.31	up	2.05	up	1.56	up	GOLGA8A	NM_181077
5.07	up	5.72	up	1.13	up	GOLT1A	NM_198447
3.10	up	2.15	up	1.44	down	GPC2	NM_152742
2.04	down	1.05	down	1.95	up	GPD1	NM_005276
1.44	down	2.46	up	3.54	up	GPR114	NM_153837
2.17	up	2.37	up	1.09	up	GPR126	NM_020455
1.05	down	2.22	down	2.11	down	GPR135	NM_022571
2.11	up	1.33	up	1.59	down	GPR137	NM_020155
2.45	up	2.59	up	1.06	up	GPR137C	NM_00109965 2
1.04	up	2.53	down	2.63	down	GPR153	NM_207370
2.85	up	1.02	down	2.92	down	GPR161	NM_153832
1.84	down	2.13	down	1.16	down	GPSM1	NM_00114563 8
8.30	up	13.49	up	1.62	up	GRIN2C	NM_000835
2.73	up	2.58	up	1.06	down	GRIN2C	NM_000835
2.37	up	2.94	down	6.98	down	GRIN2D	NM_000836
1.51	down	2.52	down	1.67	down	GRIN3B	NM_138690
2.28	up	1.35	up	1.68	down	GTSE1	NM_016426
1.41	down	2.97	down	2.10	down	GUCY1A2	NM_000855
1.48	down	1.70	up	2.51	up	GYPC	NM_002101
2.88	down	1.69	down	1.71	up	H2AFJ	NM_177925
1.55	down	1.62	up	2.50	up	H3F3B	NM_005324
2.02	down	1.36	down	1.48	up	HABP4	NM_014282
1.44	up	3.89	down	5.59	down	HAS3	NM_005329
2.40	up	2.17	up	1.11	down	HAUS3	NM_024511
2.38	up	2.56	up	1.08	up	HAUS5	NM_015302
1.21	down	2.08	down	1.71	down	HCG18	NR_024052
1.87	down	4.41	down	2.36	down	HCG4	NR_002139
3.56	up	1.66	up	2.14	down	HCN3	NM_020897
2.35	down	1.26	up	2.97	up	HDC	NM_002112
1.57	down	2.72	down	1.73	down	HEATR7A	NM_00109928 0
2.54	up	2.20	up	1.15	down	HELLS	NM_018063
2.28	up	2.11	up	1.08	down	HELLS	NM_018063
1.26	down	1.64	up	2.06	up	HERC2	NM_004667
1.65	up	2.80	up	1.69	up	HESX1	NM_003865
1.53	down	2.63	down	1.72	down	HEYL	NM_014571

1.72	down	1.94	up	3.33	up	HHEX	NM_002729
1.82	down	2.23	down	1.23	down	HIF1A	NM_181054
1.61	down	2.38	down	1.47	down	HIF1A	NM_181054
2.18	down	2.23	down	1.02	down	HIST1H2AD	NM_021065
1.84	down	2.12	down	1.16	down	HIST1H2AE	NM_021052
3.68	down	3.51	down	1.05	up	HIST2H2AA4	NM_001040874
1.53	down	1.69	up	2.59	up	HLA-DMA	NM_006120
2.02	down	1.64	up	3.31	up	HLA-DPB2	NR_001435
1.07	down	3.12	up	3.35	up	HLA-DQA2	NM_020056
1.38	down	1.65	up	2.28	up	HLA-DRB1	NM_002124
1.44	down	2.25	up	3.24	up	HLA-DRB4	NM_021983
1.63	down	1.60	up	2.62	up	HLA-DRB5	NM_002125
2.65	up	12.50	up	4.71	up	HLF	NM_002126
2.05	up	2.40	up	1.17	up	HLTF	NM_003071
1.17	down	3.73	down	3.18	down	HMGA2	NM_003484
2.27	down	1.05	down	2.16	up	HMGCLL1	NM_019036
1.46	down	2.10	up	3.06	up	HMHA1	NM_012292
2.31	down	2.19	down	1.06	up	HMOX1	NM_002133
4.03	up	10.06	up	2.50	up	HMSD	NM_001123366
1.04	down	2.91	down	2.79	down	HOMER3	NM_004838
1.02	down	3.20	down	3.14	down	HOMER3	NM_001145724
1.07	down	2.85	down	2.65	down	HOMER3	NM_001145722
2.78	up	1.22	up	2.28	down	HOOK2	NM_013312
21.67	up	42.46	up	1.96	up	HOXB13	NM_006361
1.63	down	4.88	down	2.98	down	HOXB5	NM_002147
1.42	down	3.23	up	4.58	up	HPGD	NM_000860
3.63	down	4.63	down	1.27	down	HSPA12A	NM_025015
3.02	down	3.42	down	1.13	down	HTR7	NM_019859
2.52	down	2.44	down	1.03	up	HTR7P1	NR_002774
1.18	down	2.34	up	2.77	up	HVCN1	NM_001040107
1.23	down	2.50	up	3.09	up	HVCN1	NM_001040107
1.04	up	2.44	up	2.35	up	ICA1	NM_004968
1.23	up	2.45	up	2.00	up	ICA1	NM_004968
1.32	down	2.00	up	2.63	up	ICAM2	NM_000873
1.36	down	1.97	up	2.67	up	ICAM3	NM_002162
4.10	up	2.92	up	1.41	down	ICAM4	NM_022377
2.53	up	2.55	up	1.01	up	ICOSLG	
1.21	down	2.00	up	2.42	up	ID2	NM_002166
1.75	down	4.20	down	2.40	down	IGF2BP2	NM_006548
2.62	down	9.35	down	3.57	down	IGF2BP2	NM_006548
2.53	up	2.15	up	1.18	down	IGFBPL1	NM_001007563

1.67	down	18.43	down	11.05	down	IGFL3	NM_207393
4.21	up	2.33	up	1.81	down	IGSF9	NM_020789
1.97	up	2.07	up	1.05	up	IKBKE	NM_014002
1.15	up	2.40	up	2.08	up	IL11RA	NM_147162
1.20	down	1.87	up	2.25	up	IL17RA	NM_014339
7.96	up	11.01	up	1.38	up	IL17RB	NM_018725
1.43	down	3.23	up	4.62	up	IL22RA2	NM_052962
1.07	down	2.57	up	2.73	up	IL2RG	NM_000206
1.17	up	2.67	up	2.28	up	IL2RG	NM_000206
1.06	up	2.15	up	2.04	up	IL34	NM_152456
1.79	up	2.47	up	1.38	up	IL4I1	NM_172374
1.22	down	1.92	up	2.34	up	IL7	NM_000880
4.62	up	3.29	up	1.41	down	INA	NM_032727
2.44	up	1.36	up	1.80	down	INADL	NM_176877
2.81	down	5.41	down	1.92	down	INHBB	NM_002193
2.80	up	3.24	up	1.16	up	INPP1	NM_002194
2.21	down	2.30	down	1.04	down	INPP4B	NM_003866
1.18	down	2.98	down	2.53	down	INPP4B	NM_003866
1.61	down	2.13	up	3.43	up	INPP5D	NM_001017915
2.23	up	1.77	up	1.26	down	INPP5F	NM_014937
1.92	up	2.50	up	1.30	up	INPP5J	NM_001002837
1.90	up	1.28	down	2.43	down	IQCD	NM_138451
6.38	up	1.42	down	9.08	down	IRF6	NM_006147
1.82	up	1.20	down	2.18	down	IRGQ	NM_001007561
2.60	down	4.82	down	1.85	down	IRS1	NM_005544
2.66	down	5.61	down	2.11	down	IRS1	NM_005544
5.36	up	4.16	up	1.29	down	IRX6	NM_024335
13.06	up	6.80	up	1.92	down	ISL1	NM_002202
1.92	up	2.53	up	1.31	up	ISOC1	NM_016048
3.50	up	2.39	up	1.47	down	ISYNA1	NM_016368
3.28	up	2.62	up	1.25	down	ISYNA1	NM_016368
1.15	down	2.34	down	2.03	down	ITGA5	NM_002205
1.02	down	3.14	down	3.09	down	ITGA6	NM_000210
1.09	down	2.78	down	2.55	down	ITGA6	NM_000210
1.16	up	2.25	down	2.60	down	ITGB5	NM_002213
1.32	down	1.96	up	2.59	up	ITIH1	NM_002215
2.48	down	1.73	up	4.29	up	ITM2A	NM_004867
1.97	up	3.04	up	1.55	up	IZUMO4	NM_001031735
4.25	down	3.33	down	1.28	up	JAKMIP2	NM_014790
3.55	down	2.63	down	1.35	up	JAKMIP2	NM_014790
2.13	down	1.70	down	1.25	up	JAM3	NM_032801
1.82	down	2.02	down	1.11	down	JPX	NR_024582
4.81	down	3.57	down	1.35	up	KALRN	NR_028136
1.66	down	1.53	up	2.54	up	KAT2B	NM_003884

3.70	up	4.57	up	1.23	up	KATNAL2	NM_031303
2.79	up	3.57	up	1.28	up	KATNAL2	NM_031303
3.91	down	1.62	down	2.41	up	KBTBD11	NM_014867
8.87	up	10.27	up	1.16	up	KCNB2	NM_004770
5.52	up	3.59	up	1.54	down	KCNG3	NM_133329
2.31	up	1.86	up	1.24	down	KCNJ14	NM_170720
2.52	down	1.56	down	1.61	up	KCNJ8	NM_004982
100.24	up	35.60	up	2.82	down	KCNS1	NM_002251
1.32	down	2.27	down	1.72	down	KDM5B	NM_006618
1.22	down	2.68	down	2.20	down	KDM5B	NM_006618
16.71	up	3.28	up	5.09	down	KDM5D	NM_004653
5.67	up	16.06	up	2.83	up	KEL	NM_000420
2.26	up	3.67	up	1.62	up	KHK	NM_000221
2.03	up	2.75	up	1.36	up	KIAA0368	NM_001080398
1.85	up	2.46	up	1.33	up	KIAA0485	AB007954
1.59	down	1.42	up	2.25	up	KIAA1370	NM_019600
2.25	up	1.33	down	2.98	down	KIAA1671	NM_001145206
2.13	down	1.51	down	1.41	up	KIAA1919	NM_153369
1.06	down	2.54	down	2.40	down	KIF13A	NM_022113
2.42	up	1.97	up	1.23	down	KIF15	NM_020242
1.14	up	1.94	down	2.21	down	KIF1B	NM_183416
2.98	up	1.81	up	1.65	down	KIF20A	NM_005733
2.21	up	1.31	up	1.68	down	KIF23	NM_138555
3.27	up	2.62	up	1.25	down	KIF24	NM_194313
5.82	up	10.23	up	1.76	up	KIF25	NM_030615
1.43	down	4.29	down	3.00	down	KIF26B	NM_018012
2.54	up	1.30	up	1.96	down	KIF2C	NM_006845
1.02	up	2.02	down	2.05	down	KIF3C	NM_002254
1.01	down	2.10	down	2.07	down	KIF3C	NM_002254
2.52	up	1.07	up	2.36	down	KIF4A	NM_012310
1.39	down	3.06	down	2.20	down	KIRREL	NM_018240
1.63	down	3.28	down	2.01	down	KIRREL	AK090554
2.37	up	2.34	up	1.01	down	KITLG	NM_000899
1.19	up	3.84	down	4.55	down	KLC3	NM_177417
2.41	down	1.63	up	3.93	up	KLF2	NM_016270
1.22	down	3.23	down	2.65	down	KLF7	NM_003709
2.47	down	1.73	down	1.43	up	KLF9	NM_001206
14.05	up	9.21	up	1.53	down	KLHL35	NM_001039548
1.80	down	2.72	up	4.88	up	KLRB1	NM_002258
2.68	up	2.61	up	1.03	down	KNTC1	NM_014708
1.22	down	5.89	down	4.82	down	KPNA7	NM_001145715
1.05	up	5.43	down	5.72	down	KPNA7	NM_001145715

4.69	up	2.37	up	1.98	down	KREMEN1	NM_001039570
26.58	up	19.48	up	1.36	down	KRT13	NM_002274
7.82	up	4.24	up	1.84	down	KRT15	NM_002275
5.15	up	3.61	down	18.60	down	KRT17	NM_000422
106.74	up	18.57	up	5.75	down	KRT19	NM_002276
83.83	up	15.09	up	5.56	down	KRT19P2	NR_036685
21.60	up	30.25	up	1.40	up	KRT4	NM_002272
2.92	up	4.64	down	13.56	down	KRT42P	NR_033415
3.50	up	1.83	up	1.91	down	KRT8	NM_002273
2.84	up	1.64	up	1.74	down	KRT86	NM_002284
3.90	up	3.09	up	1.26	down	L3MBTL1	NM_032107
1.04	up	2.81	down	2.92	down	LARP6	NM_197958
7.50	down	3.86	down	1.94	up	LCE2A	NM_178428
2.01	up	1.67	up	1.20	down	LCORL	NM_153686
2.59	down	1.56	down	1.66	up	LDB3	NM_001171610
8.25	up	4.39	up	1.88	down	LDHC	NM_002301
1.73	down	3.40	up	5.88	up	LDLRAD2	NM_001013693
2.14	up	3.75	up	1.75	up	LEAP2	NM_052971
1.52	down	2.23	down	1.47	down	LEPROT	NM_001198683
1.90	up	2.18	up	1.14	up	LGALS9	NM_009587
1.42	up	2.14	up	1.51	up	LGALS9C	NM_001040078
3.01	down	15.84	down	5.27	down	LHX1	NM_005568
18.86	up	6.71	up	2.81	down	LHX2	NM_004789
2.00	down	5.29	down	2.64	down	LIF	NM_002309
2.42	up	2.37	up	1.02	down	LIG1	NM_000234
1.27	down	2.07	up	2.63	up	LIMD2	NM_030576
3.75	down	2.41	down	1.56	up	LIMS3L	NM_001205288
2.15	up	2.91	up	1.35	up	LINC00028	NR_024358
1.44	down	2.01	down	1.40	down	LINC00152	NR_024204
1.25	up	2.10	down	2.61	down	LINC00174	NR_026873
3.07	up	1.89	up	1.62	down	LINC00263	NR_026762
6.42	up	1.64	up	3.92	down	LINC00319	NR_026960
1.07	up	2.77	up	2.60	up	LIPE	NM_005357
4.06	up	2.87	up	1.42	down	LMO4	NM_006769
3.97	up	2.92	up	1.36	down	LMO4	NM_006769
3.65	up	1.22	up	3.00	down	LMO7	AK092052
2.60	down	2.39	down	1.09	up	LOC100127891	XR_108812
6.61	up	4.49	up	1.47	down	LOC100127909	XR_111781
2.76	up	2.36	up	1.17	down	LOC1001281	NR_027157

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1.46	up	2.19	up	1.50	up	LOC100128429	AK123323
1.44	up	3.33	down	4.80	down	LOC100128881	NR_036480
9.71	up	13.43	up	1.38	up	LOC100128977	NR_024559
5.84	up	4.25	up	1.38	down	LOC100129148	NR_033999
2.13	up	2.95	up	1.38	up	LOC100129534	NR_024489
3.24	down	4.99	down	1.54	down	LOC100129781	XR_109258
3.19	down	5.32	down	1.67	down	LOC100129781	XR_109259
2.49	up	2.22	up	1.12	down	LOC100130093	NR_024485
1.60	up	2.02	up	1.26	up	LOC100130157	XR_109613
2.19	up	1.55	up	1.41	down	LOC100130275	NR_033910
2.63	up	3.00	up	1.14	up	LOC100130930	AK126579
2.56	down	6.68	down	2.61	down	LOC100130938	XR_110148
2.22	down	5.75	down	2.59	down	LOC100130938	XR_110148
2.75	down	6.95	down	2.53	down	LOC100130938	XR_110148
1.19	up	3.21	up	2.70	up	LOC100131096	NR_040071
1.50	up	2.39	up	1.60	up	LOC100131355	AK124217
1.34	down	2.29	up	3.06	up	LOC100131733	NR_038996
2.65	up	2.49	up	1.07	down	LOC100131929	AK126439
1.47	up	2.08	up	1.41	up	LOC100132352	AK023536
1.76	up	2.10	up	1.19	up	LOC100170939	NR_024054
1.52	down	8.26	down	5.43	down	LOC100216001	NR_024475
1.38	down	5.22	down	3.78	down	LOC100216001	NR_024475
1.33	down	2.12	down	1.59	down	LOC100270746	NR_026776
1.18	up	3.13	up	2.66	up	LOC100287188	XM_003119104

2.83	down	2.34	down	1.21	up	LOC100287216	NR_029193
1.69	down	3.30	down	1.95	down	LOC100287314	NR_040245
1.17	down	4.61	down	3.95	down	LOC100287314	NR_040245
1.47	down	2.46	down	1.67	down	LOC100288092	XR_108415
2.33	up	2.46	up	1.06	up	LOC100288637	NR_038253
2.91	down	2.33	down	1.25	up	LOC100288911	NR_037631
2.73	down	2.23	down	1.22	up	LOC100288911	NR_037631
1.14	up	2.40	up	2.10	up	LOC100289230	NR_036530
1.44	up	2.70	up	1.88	up	LOC100289230	NR_036530
1.57	up	2.53	up	1.61	up	LOC100505483	NR_038926
1.62	down	3.62	down	2.23	down	LOC100505668	XR_112556
1.09	down	2.57	up	2.81	up	LOC100505719	XR_110561
2.65	down	2.19	down	1.21	up	LOC100505729	XR_108524
1.36	down	3.04	up	4.15	up	LOC100505799	XR_111953
13.11	up	2.34	up	5.61	down	LOC100505882	XR_110336
2.24	up	2.48	down	5.57	down	LOC100505912	NR_037877
2.77	up	1.68	up	1.65	down	LOC100505920	XR_108534
1.63	down	2.34	up	3.81	up	LOC100505921	XR_108739
1.58	up	2.01	up	1.27	up	LOC100505960	XR_108741
7.67	up	3.80	up	2.02	down	LOC100506003	XR_109785
2.17	up	2.22	up	1.02	up	LOC100506123	NR_040097
2.34	up	2.34	up	1.00	up	LOC100506123	NR_040097
1.57	down	2.02	down	1.29	down	LOC100506136	NR_038948
2.27	down	1.32	down	1.72	up	LOC100506295	XR_109394
4.31	down	1.02	up	4.39	up	LOC1005063	XR_108932

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2.42	down	1.82	down	1.33	up	LOC100506327	XR_112081
14.57	up	2.60	up	5.60	down	LOC100506328	AK055877
2.75	up	3.43	up	1.25	up	LOC100506503	XR_109701
2.39	up	3.86	up	1.61	up	LOC100506538	XR_108868
2.03	down	3.86	down	1.90	down	LOC100506578	XR_132581
3.58	up	2.31	up	1.55	down	LOC100506660	NR_038927
1.96	down	2.20	down	1.12	down	LOC100506714	NR_038956
3.03	down	8.93	down	2.95	down	LOC100506718	XR_110230
1.43	down	2.87	up	4.10	up	LOC100506779	NR_038410
1.59	down	2.02	up	3.21	up	LOC100506802	XR_132718
3.31	down	15.78	down	4.77	down	LOC100506895	NR_038276
2.02	up	2.42	up	1.20	up	LOC100506930	AK090827
1.93	up	2.89	up	1.50	up	LOC100506992	XR_113296
9.01	up	5.07	up	1.78	down	LOC100506994	NR_038281
2.50	down	3.49	down	1.40	down	LOC100507025	XR_108687
1.61	up	11.72	down	18.86	down	LOC100507033	XR_110380
2.57	up	1.84	up	1.40	down	LOC100507053	NR_037884
5.22	down	11.98	down	2.30	down	LOC100507127	NR_038291
2.86	down	9.34	down	3.26	down	LOC100507127	NR_038291
2.69	up	2.41	up	1.12	down	LOC100507161	XM_003118878
2.08	down	1.70	down	1.22	up	LOC100507241	XR_108695
1.52	down	8.33	down	5.47	down	LOC100507420	XR_110876
5.15	up	7.41	up	1.44	up	LOC100507421	NM_001195278
2.91	down	3.15	up	9.19	up	LOC100507616	XR_110328

1.67	down	3.31	down	1.99	down	LOC100507624	XR_110188
5.67	down	2.10	down	2.70	up	LOC100507632	NR_038236
6.65	up	5.47	up	1.22	down	LOC100507759	XR_111561
1.53	up	3.73	up	2.44	up	LOC100508995	XR_111214
2.44	up	3.82	up	1.57	up	LOC100509075	XR_111772
2.21	up	4.07	up	1.84	up	LOC100509075	XR_111771
114.72	up	5.50	up	20.87	down	LOC100509121	XM_003120334
2.15	up	2.70	up	1.26	up	LOC100616668	NR_038258
2.26	down	1.04	up	2.35	up	LOC100652740	XM_003403462
2.49	down	3.34	down	1.34	down	LOC100652760	XR_132680
1.80	down	2.13	down	1.19	down	LOC100652766	XM_003403438
2.93	down	1.56	down	1.87	up	LOC100652787	XR_132806
1.65	up	2.67	up	1.62	up	LOC100652912	XR_132665
1.46	up	4.31	up	2.95	up	LOC100652917	XR_132741
2.18	down	1.20	up	2.61	up	LOC145820	NR_027132
3.81	down	6.33	down	1.66	down	LOC149773	NR_034147
1.26	down	4.38	down	3.48	down	LOC152225	NR_026934
1.12	up	2.54	up	2.27	up	LOC202025	AL713660
3.42	up	3.81	up	1.12	up	LOC219731	NR_038222
1.61	up	1.73	down	2.78	down	LOC254128	NR_037857
6.89	up	9.82	up	1.43	up	LOC254559	NR_015411
8.84	up	13.97	up	1.58	up	LOC254559	NR_015411
2.84	down	1.68	down	1.69	up	LOC255177	BC031230
5.76	up	9.44	up	1.64	up	LOC283174	NR_024344
5.58	up	10.62	up	1.90	up	LOC283174	NR_024344
3.19	up	3.89	up	1.22	up	LOC283174	NR_024344
4.61	up	8.46	up	1.84	up	LOC283174	NR_024344
1.80	down	6.13	down	3.40	down	LOC283404	NR_027358
7.51	up	33.07	up	4.40	up	LOC283485	AK093862
1.54	up	3.59	up	2.32	up	LOC283713	AK094982
4.42	up	1.57	up	2.82	down	LOC284023	NR_024349
1.50	up	2.21	up	1.47	up	LOC284513	AK096098
3.10	up	5.34	up	1.72	up	LOC284630	AK096384
47.36	up	38.74	up	1.22	down	LOC285084	NR_038897

71.74	up	60.22	up	1.19	down	LOC285084	NR_038897
3.64	down	1.99	down	1.83	up	LOC285419	NR_027105
1.34	up	2.04	up	1.51	up	LOC285540	NR_037934
2.87	down	2.84	down	1.01	up	LOC286068	BC015720
1.78	up	1.27	down	2.27	down	LOC286109	AK092172
1.74	up	2.38	up	1.37	up	LOC286161	AK091672
2.20	down	5.81	down	2.63	down	LOC339240	NR_001443
13.74	up	17.03	up	1.24	up	LOC375196	NR_028386
3.81	down	3.87	down	1.02	down	LOC375295	NR_040001
1.26	down	1.83	up	2.32	up	LOC386758	NR_037161
6.63	up	4.09	up	1.62	down	LOC389831	NM_00124248 0
6.03	up	3.63	up	1.66	down	LOC389831	AK123495
5.83	up	3.38	up	1.73	down	LOC389831	NM_00124248 0
1.45	up	2.63	up	1.81	up	LOC389834	NR_027420
1.18	up	4.12	up	3.49	up	LOC389834	NR_027420
3.41	down	1.24	up	4.25	up	LOC400456	NR_034095
1.58	up	2.31	up	1.46	up	LOC401068	XR_110024
3.98	up	2.44	up	1.63	down	LOC401109	NR_034088
6.63	up	3.90	up	1.70	down	LOC401109	NR_034088
1.48	down	7.36	down	4.98	down	LOC401164	NR_033869
1.72	down	6.64	down	3.87	down	LOC401164	NR_033869
1.81	up	5.09	up	2.81	up	LOC401431	NR_027040
3.74	up	3.82	up	1.02	up	LOC440792	AB051440
2.01	up	3.24	up	1.61	up	LOC441268	AK125166
2.05	up	3.22	up	1.57	up	LOC497257	BC030211
1.41	down	2.03	down	1.44	down	LOC541471	NR_024373
16.89	up	10.20	up	1.65	down	LOC541473	NR_003602
7.39	up	5.15	up	1.44	down	LOC642366	XR_108597
1.69	down	1.87	up	3.16	up	LOC643733	NR_034079
1.52	up	2.55	up	1.68	up	LOC644656	NR_036539
2.10	down	1.54	down	1.37	up	LOC645676	NR_027023
1.54	down	2.68	down	1.74	down	LOC646329	NR_034120
2.14	down	1.42	down	1.51	up	LOC646626	NR_045484
1.54	up	3.03	up	1.97	up	LOC728537	NR_038386
1.22	up	2.57	up	2.10	up	LOC728537	NR_038386
3.97	up	4.33	up	1.09	up	LOC728715	XM_00311952 4
1.16	up	2.10	up	1.82	up	LOC728743	NR_027237
1.05	down	2.22	down	2.12	down	LOC728975	XR_110914
3.55	down	1.79	down	1.99	up	LOC729178	NR_034115
1.23	up	6.24	down	7.65	down	LOC729444	NR_038388
3.07	down	1.24	up	3.80	up	LOC729468	BU567215
2.34	up	3.57	up	1.52	up	LOC729732	XR_132886
2.64	down	2.20	down	1.20	up	LOC729887	BC052334
3.63	up	6.27	up	1.73	up	LOC84856	NR_026827
4.98	up	6.20	up	1.24	up	LOC84856	NR_026827

1.07	down	2.04	down	1.90	down	LOH12CR1	NM_058169
2.11	down	1.25	down	1.69	up	LPAR1	NM_057159
2.17	up	2.28	down	4.96	down	LPAR3	NM_012152
1.24	down	2.31	down	1.86	down	LPCAT2	NM_017839
1.21	up	2.39	down	2.88	down	LRP11	
1.66	down	1.58	up	2.62	up	LRRC33	NM_198565
2.60	up	3.18	up	1.23	up	LRRC56	NM_198075
1.87	up	2.60	up	1.39	up	LRRC61	NM_00114292 8
1.67	down	3.44	down	2.06	down	LRRC69	NM_00112989 0
1.96	down	3.80	down	1.94	down	LRRC69	NM_00112989 0
3.18	down	1.04	up	3.31	up	LRRC70	NM_181506
1.38	up	1.67	down	2.31	down	LRRC8A	NM_019594
2.67	up	2.60	down	6.96	down	LRRC8E	NM_025061
1.83	down	1.74	up	3.17	up	LRRK2	NM_198578
2.11	up	1.33	up	1.59	down	LSM11	NM_173491
2.07	up	1.04	down	2.14	down	LSR	NM_205834
1.25	down	2.23	up	2.77	up	LTA	NM_000595
1.50	down	2.57	down	1.71	down	LTBP1	NM_206943
1.25	up	1.79	down	2.24	down	LTBR	NM_002342
6.38	up	30.14	up	4.72	up	LTF	NM_002343
2.79	down	3.61	down	1.29	down	LY6H	NM_002347
1.23	up	3.27	up	2.66	up	LY75	NM_002349
1.50	down	2.19	up	3.27	up	LYL1	NM_005583
1.41	down	1.76	up	2.49	up	LYSMD2	NM_153374
9.60	down	1.09	up	10.46	up	LYVE1	NM_006691
1.31	down	2.07	down	1.58	down	MACF1	NM_012090
9.17	down	36.18	down	3.94	down	MAGEA12	NM_005367
17.69	down	26.23	down	1.48	down	MAGEA2B	NM_153488
28.64	down	27.63	down	1.04	up	MAGEA4	NM_002362
2.92	down	3.07	down	1.05	down	MAGEA6	NM_175868
18.44	down	104.1 7	down	5.65	down	MAGEA6	NM_175868
2.50	up	1.85	up	1.35	down	MAGI3	NM_152900
5.14	up	25.52	up	4.97	up	MAL	NM_002371
2.31	down	1.15	down	2.01	up	MALAT1	NR_002819
2.49	down	1.26	down	1.98	up	MALAT1	NR_002819
2.91	up	2.73	up	1.06	down	MAMDC4	NM_206920
1.78	down	1.72	up	3.07	up	MAN1C1	NM_020379
1.89	down	1.60	up	3.03	up	MAN1C1	NM_020379
1.01	up	2.23	up	2.20	up	MAN2A2	NM_006122
3.50	up	1.86	up	1.88	down	MAP3K13	NM_004721
1.66	up	3.36	up	2.02	up	MAP3K14	NM_003954
2.26	up	1.72	up	1.31	down	MAP3K6	NM_004672
2.96	up	2.04	up	1.45	down	MAP3K6	NM_004672
2.50	down	1.24	down	2.02	up	MAP3K8	AB209539

1.32	up	2.16	down	2.85	down	MAP3K9	NM_033141
1.18	up	2.60	down	3.07	down	MAP7	NM_003980
1.11	up	1.97	down	2.19	down	MAP7	NM_003980
2.70	up	2.42	up	1.12	down	MAP7D2	NM_152780
6.77	up	10.43	up	1.54	up	MAP7D2	NM_152780
2.09	down	2.07	down	1.01	up	MAP7D3	NM_024597
3.78	down	2.95	down	1.28	up	MAP7D3	NM_001173517
1.40	down	2.05	down	1.47	down	MARK3	NM_001128918
3.60	up	1.40	up	2.57	down	MARVELD2	NM_001038603
3.25	up	1.54	up	2.11	down	MARVELD2	AK055094
2.43	up	1.56	up	1.56	down	MAST4	NM_001164664
2.41	up	5.28	up	2.19	up	MAT1A	NM_000429
2.95	up	3.24	up	1.10	up	MCF2L	NM_024979
2.20	up	2.75	up	1.25	up	MCF2L	NM_024979
3.07	up	1.74	up	1.77	down	MCM10	NM_182751
4.00	up	3.24	up	1.23	down	MCM2	NM_004526
2.34	up	2.25	up	1.04	down	MCM3	NM_002388
2.38	up	1.43	up	1.67	down	MCM4	NM_005914
2.15	up	2.24	up	1.04	up	MCM5	NM_006739
2.17	up	2.35	up	1.08	up	MCM5	NM_006739
2.08	up	2.18	up	1.05	up	MCM6	NM_005915
2.40	up	1.54	up	1.56	down	MCM7	NM_005916
2.56	up	2.12	up	1.21	down	MCM8	NM_182802
1.02	up	2.49	down	2.54	down	MDFI	NM_005586
1.93	up	2.80	up	1.45	up	MDM1	NM_017440
2.06	up	1.67	up	1.23	down	MDM2	NM_002392
2.36	up	2.51	up	1.07	up	MDM2	NM_002392
2.12	up	7.39	up	3.48	up	MEI1	NM_152513
2.84	up	2.22	up	1.28	down	MEIS1	NM_002398
2.51	up	1.33	up	1.88	down	MELK	NM_014791
3.24	down	2.44	up	7.90	up	MEOX2	NM_005924
1.20	down	2.61	down	2.17	down	MET	NM_000245
2.06	down	1.66	up	3.43	up	METTL7A	NM_014033
3.88	up	1.67	up	2.33	down	MFI2	NM_005929
1.78	down	1.73	up	3.08	up	MFNG	NM_002405
3.28	up	9.69	up	2.95	up	MGAT3	NM_002409
1.10	down	2.64	down	2.39	down	MICALCL	NM_032867
2.55	up	2.07	up	1.23	down	MICALL2	NM_182924
1.59	up	1.97	down	3.13	down	MIPOL1	NM_138731
1.79	up	1.73	down	3.11	down	MIPOL1	NM_001195296
1.83	down	2.63	down	1.44	down	MIR143HG	NR_027180
2.58	up	3.85	up	1.49	up	MIR600HG	NR_026677
2.26	up	1.66	up	1.36	down	MIS18A	NM_018944

2.99	up	2.52	up	1.19	down	MLF1IP	NM_024629
1.53	down	3.92	down	2.56	down	MLLT11	NM_006818
1.37	up	2.03	up	1.48	up	MLPH	NM_024101
2.01	up	2.26	up	1.12	up	MMAA	NM_172250
5.45	down	3.19	down	1.71	up	MME	NM_007289
1.19	up	25.03	down	29.78	down	MMP10	NM_002425
4.85	down	23.47	down	4.84	down	MMP13	NM_002427
4.79	down	3.47	up	16.65	up	MMRN1	NM_007351
1.34	down	3.28	down	2.45	down	MMRN2	XR_111094
1.11	up	3.32	down	3.67	down	MN1	NM_002430
3.54	up	1.70	down	6.01	down	MNAT1	NM_002431
3.53	up	3.23	up	1.10	down	MNS1	NM_018365
2.02	up	1.79	up	1.13	down	MORC4	NM_024657
1.64	down	3.00	down	1.83	down	MORN4	BC022054
1.03	down	2.18	down	2.12	down	MPDU1	AK027742
9.94	up	3.26	up	3.05	down	MPP2	NM_005374
2.44	down	5.77	down	2.37	down	MPPED1	NM_00104437 0
1.11	up	2.05	up	1.84	up	MRPS25	NM_022497
1.38	up	2.21	up	1.61	up	MST1	NM_020998
1.49	down	2.53	down	1.69	down	MST1	BC044862
1.74	up	2.17	up	1.25	up	MST1	NM_020998
5.40	up	2.53	up	2.13	down	MST1R	NM_002447
4.58	down	3.75	down	1.22	up	MSX2P1	NR_002307
1.13	up	2.00	up	1.76	up	MTERFD2	NR_028049
1.52	down	2.06	down	1.35	down	MTHFD1L	NM_015440
1.18	down	3.10	down	2.62	down	MTSS1	NM_014751
40.33	up	25.01	up	1.61	down	MUC21	NM_00101090 9
3.31	down	9.16	down	2.77	down	MUM1L1	NM_152423
2.72	up	3.75	up	1.38	up	MXD3	NM_00114293 5
1.38	down	2.41	down	1.75	down	MXRA7	NM_00100852 9
1.04	down	2.03	down	1.95	down	MXRA7	NM_00100852 9
1.57	down	2.17	down	1.38	down	MXRA7	NM_00100852 8
3.22	up	5.84	up	1.81	up	MYB	NM_005375
1.57	down	1.31	up	2.05	up	MYCBP2	NM_015057
3.77	up	3.47	up	1.09	down	MYCN	NM_005378
2.38	down	1.21	down	1.96	up	MYCT1	NM_025107
2.68	up	2.35	up	1.14	down	MYEOV	NM_138768
1.90	up	1.20	down	2.28	down	MYO19	NM_00103358 0
2.08	up	1.38	up	1.51	down	MYO19	NM_025109
1.28	down	2.56	down	2.00	down	MYO1B	NM_012223
1.06	down	2.80	down	2.63	down	MYO1B	NM_012223

1.82	down	1.24	up	2.26	up	MYO1F	NM_012335
11.87	up	9.66	up	1.23	down	MYO3A	BC036079
16.98	up	13.91	up	1.22	down	MYO3A	NM_017433
2.85	down	3.19	down	1.12	down	MYO5A	NM_000259
1.23	up	1.94	down	2.39	down	MYOF	NM_013451
1.47	up	2.25	down	3.30	down	MYOF	NM_133337
4.58	down	6.64	down	1.45	down	MYOM3	NM_152372
3.22	down	1.38	up	4.46	up	MYRIP	NM_015460
1.17	down	3.56	up	4.14	up	MYZAP	NM_001018100
2.66	up	2.28	up	1.17	down	NASP	NM_002482
1.50	down	2.38	down	1.59	down	NAV1	NM_020443
2.74	down	4.51	down	1.65	down	NAV3	NM_014903
1.29	down	2.42	down	1.88	down	NAV3	NM_014903
2.05	up	1.62	up	1.26	down	NCAPD3	NM_015261
2.53	up	2.05	up	1.24	down	NCAPG	NM_022346
1.43	down	2.18	up	3.10	up	NCF1	NM_000265
1.01	down	2.06	up	2.07	up	NCF1	NM_000265
1.22	down	2.42	up	2.96	up	NCF1	NM_000265
1.92	up	2.11	up	1.10	up	NCK1	NM_006153
2.07	down	2.03	up	4.20	up	NCR3	NM_001145467
104.52	up	5.37	up	19.48	down	NCRNA00185	NR_001544
2.36	down	1.91	down	1.23	up	NDST2	BC018681
15.31	down	7.84	down	1.95	up	NEB	NM_004543
10.12	down	7.85	down	1.29	up	NEB	NM_001164507
2.92	up	2.71	up	1.08	down	NEDD1	NM_152905
5.26	up	3.26	up	1.61	down	NEDD4L	NM_001144967
5.26	up	2.69	up	1.95	down	NEDD4L	NM_015277
3.28	up	2.71	up	1.21	down	NEURL1B	NM_001142651
8.65	up	5.28	up	1.64	down	NEURL3	NR_026875
2.30	up	1.80	up	1.28	down	NFKB2	NM_001077493
1.29	up	2.83	up	2.19	up	NFX1	NM_002504
1.88	up	2.01	up	1.07	up	NINJ1	NM_004148
5.41	down	5.19	down	1.04	up	NLGN4X	NM_020742
1.80	down	2.27	up	4.09	up	NLRC3	NM_178844
2.63	down	1.28	down	2.05	up	NLRP3	NM_001079821
2.40	down	1.27	down	1.90	up	NLRP3	NM_001243133
1.29	down	2.20	down	1.70	down	NME4	NM_005009
8.09	up	2.12	up	3.81	down	NMU	NM_006681
2.17	up	6.60	up	3.04	up	NOS2	NM_000625

2.31	down	1.13	up	2.61	up	NOSTRIN	NM_052946
3.74	up	2.53	up	1.48	down	NOTCH1	NM_017617
3.31	up	6.59	up	1.99	up	NPPC	NM_024409
1.09	up	5.61	down	6.12	down	NPTX2	NM_002523
1.59	down	1.31	up	2.09	up	NR2F2	NM_021005
1.44	up	7.50	up	5.21	up	NR3C2	NM_000901
1.45	up	4.18	down	6.07	down	NRG1	AF176921
1.11	up	7.06	down	7.86	down	NRG1	NM_004495
1.42	up	4.13	down	5.88	down	NRG1	NM_004495
1.24	up	4.59	up	3.70	up	NRG2	NM_013982
1.02	down	2.34	down	2.28	down	NRP2	NM_201264
1.31	up	2.08	down	2.72	down	NRP2	NM_201266
3.17	up	1.16	up	2.73	down	NT5DC3	NM_00103170 1
3.39	down	3.71	down	1.09	down	NT5E	NM_002526
2.62	down	3.50	down	1.34	down	NT5E	NM_002526
2.40	up	3.02	up	1.26	up	NT5M	NM_020201
2.13	up	4.34	up	2.04	up	NUP210	NM_024923
2.45	up	2.11	up	1.16	down	NUSAP1	NM_016359
2.95	down	3.28	down	1.11	down	OBSL1	NM_015311
1.31	down	2.09	down	1.59	down	ODF2	NM_153437
1.89	up	1.55	down	2.93	down	ODZ3	NM_00108047 7
1.21	up	2.05	up	1.70	up	OGG1	NM_016828
4.26	up	7.51	up	1.76	up	OLFM1	NM_014279
2.03	up	2.18	up	1.07	up	OLFM1	
1.09	up	2.15	down	2.35	down	OLFM2	NM_058164
2.07	up	2.55	up	1.23	up	ONECUT2	NM_004852
2.07	down	1.64	down	1.26	up	OTUD1	NM_00114537 3
1.79	up	1.17	down	2.09	down	OTUD7B	NM_020205
2.22	up	3.00	up	1.35	up	OXER1	NM_148962
2.78	down	18.50	down	6.66	down	P01115	
3.26	down	2.14	up	6.97	up	P2RY12	NM_022788
1.78	down	2.26	up	4.03	up	P2RY13	NM_176894
2.55	down	1.76	up	4.48	up	P2RY14	NM_014879
1.92	down	2.09	down	1.09	down	P39193	AK056172
1.98	down	2.06	down	1.04	down	P39193	AK056172
2.93	up	1.73	up	1.69	down	PAFAH1B3	NM_002573
2.17	down	3.13	down	1.44	down	PAPPA	NM_002581
2.18	up	1.31	up	1.66	down	PAQR4	NM_152341
1.74	up	2.75	up	1.58	up	PARD6A	NM_016948
2.90	up	2.04	up	1.42	down	PARD6B	NM_032521
2.42	up	1.66	up	1.46	down	PARS2	NM_152268
1.18	down	2.81	up	3.31	up	PASK	NM_015148
1.21	up	1.79	down	2.18	down	PAWR	NM_002583
125.7 3	up	48.41	up	2.60	down	PAX1	NM_006192

2.84	up	1.64	up	1.73	down	PAX9	NM_006194
8.84	up	3.43	up	2.58	down	PAX9	NM_006194
2.06	up	2.84	up	1.38	up	PBX1	NM_002585
2.12	up	2.81	up	1.33	up	PBX4	NM_025245
2.49	down	1.99	down	1.25	up	PCDHB15	NM_018935
2.44	down	3.26	down	1.34	down	PCDHB16	NM_020957
3.16	down	3.49	down	1.10	down	PCDHGA3	NM_032011
2.48	down	3.95	down	1.59	down	PCDHGA5	NM_032054
1.57	down	2.44	down	1.55	down	PCDHGA8	NM_032088
1.22	down	3.90	down	3.20	down	PCDHGB1	NM_032095
2.68	down	2.75	down	1.03	down	PCDHGB4	NM_032098
4.72	up	2.73	up	1.73	down	PCLO	NM_014510
1.10	up	2.29	up	2.09	up	PCM1	NM_006197
2.17	up	2.07	up	1.05	down	PCNA	NM_002592
2.25	up	2.09	up	1.08	down	PCNA	NM_002592
2.14	up	2.06	up	1.04	down	PCNA	NM_002592
1.40	up	2.11	up	1.51	up	PCNA-AS1	NR_028370
2.57	up	2.96	up	1.15	up	PCP2	NM_174895
3.81	down	6.35	down	1.67	down	PCSK1	NM_000439
3.37	down	2.93	down	1.15	up	PCSK5	NM_006200
3.56	down	2.49	down	1.43	up	PCSK5	NM_006200
3.29	down	2.00	down	1.64	up	PDE1C	NM_005020
3.02	down	1.90	down	1.59	up	PDE2A	NM_002599
2.89	down	1.56	down	1.85	up	PDE7B	NM_018945
1.70	down	2.57	down	1.51	down	PDGFC	NM_016205
5.89	down	1.41	down	4.19	up	PDK4	NM_002612
1.10	up	2.17	down	2.38	down	PDLIM7	NM_005451
2.72	up	2.52	up	1.08	down	PDXK	NM_003681
2.20	down	1.44	down	1.53	up	PDZK1	NM_002614
1.60	down	1.33	up	2.13	up	PECAM1	NM_000442
2.20	up	2.27	up	1.03	up	PER3	NM_016831
2.33	up	1.68	up	1.39	down	PER3	NM_016831
1.37	down	2.01	down	1.47	down	PEX13	NM_002618
1.51	down	2.03	down	1.35	down	PGM3	NM_015599
1.34	down	2.13	down	1.59	down	PGM3	NM_00119991 9
3.76	down	1.63	up	6.13	up	PGM5	NM_021965
1.39	up	2.06	up	1.47	up	PGPEP1	NM_017712
2.16	down	1.36	down	1.59	up	PHACTR2	NM_00110016 4
2.38	down	3.87	down	1.63	down	PHEX	NM_000444
1.39	up	2.15	up	1.55	up	PHF17	NM_024900
1.03	down	2.14	up	2.20	up	PHF17	NM_199320
2.98	up	2.27	up	1.31	down	PHGDH	NM_006623
1.18	down	2.26	down	1.91	down	PHLDA1	NM_007350
1.41	down	4.73	down	3.35	down	PHLDB2	NM_00113443 8
3.03	down	7.25	down	2.40	down	PI15	NM_015886

4.74	down	5.83	up	27.64	up	PI16	NM_153370
1.60	up	2.40	up	1.50	up	PIDD	NM_145886
1.48	down	2.09	down	1.41	down	PIGL	NM_004278
1.86	up	2.27	up	1.22	up	PIK3R3	NM_003629
1.93	down	2.25	down	1.17	down	PITPNM2	NM_020845
11.72	up	3.41	up	3.43	down	PITX1	NM_002653
6.53	up	3.18	up	2.05	down	PITX1	NM_002653
2.28	down	1.84	down	1.24	up	PKIG	NM_181805
4.25	up	8.29	up	1.95	up	PLAC8	NM_016619
2.63	up	1.81	up	1.46	down	PLAC8L1	NM_001029869
1.05	down	3.16	down	3.02	down	PLAU	NM_001145031
2.87	down	3.16	down	1.10	down	PLB1	BC065041
2.55	up	1.74	up	1.46	down	PLCH2	NM_014638
1.59	down	2.32	up	3.68	up	PLD4	NM_138790
1.22	up	1.88	down	2.29	down	PLEC	NM_201380
1.36	down	2.20	down	1.62	down	PLEC	NM_201380
1.10	down	3.40	up	3.72	up	PLEK	NM_002664
3.26	up	3.72	up	1.14	up	PLEKHG4	NM_015432
3.39	up	3.74	up	1.10	up	PLEKHG4	NM_015432
1.10	up	2.45	up	2.22	up	PLGLB1	NM_001032392
1.07	up	2.04	down	2.18	down	PLS3	NM_005032
2.94	up	1.68	up	1.75	down	PLXNA1	NM_032242
2.58	up	2.08	up	1.24	down	PMEL	NM_006928
2.05	up	1.62	up	1.27	down	PML	NM_033238
2.37	up	1.97	up	1.20	down	PMS2L2	BC010535
8.37	up	3.67	up	2.28	down	PODXL2	NM_015720
5.81	up	3.87	up	1.50	down	PODXL2	NM_015720
2.06	up	2.03	up	1.02	down	POLA1	NM_016937
2.15	up	1.64	up	1.31	down	POLA2	NM_002689
2.10	up	2.23	up	1.06	up	POLD1	NM_002691
2.43	up	1.87	up	1.30	down	POLE	NM_006231
3.27	up	1.08	up	3.03	down	POLE	NM_006231
2.93	up	1.66	up	1.77	down	POLE2	NM_002692
3.37	up	2.84	up	1.19	down	POLH	NM_006502
2.13	up	2.61	up	1.22	up	POLH	NM_006502
1.81	up	1.18	down	2.13	down	POLR1A	NM_015425
3.90	up	7.41	up	1.90	up	POU4F1	NM_006237
1.34	down	2.66	down	1.98	down	POU6F2	NM_007252
2.86	up	2.01	up	1.42	down	PP12719	XM_003403527
2.59	down	2.11	down	1.23	up	PPAPDC3	
3.27	up	2.99	up	1.09	down	PPARGC1B	NM_133263
2.69	up	2.95	up	1.09	up	PPARGC1B	NM_133263
3.80	up	2.04	up	1.87	down	PPFIA4	NM_015053
1.03	down	2.06	down	1.99	down	PPFIBP1	NM_003622

1.17	down	2.62	down	2.23	down	PPFIBP1	NM_177444
1.29	down	2.53	down	1.96	down	PPFIBP1	NM_003622
2.95	up	3.04	up	1.03	up	PPFIBP2	NM_003621
1.69	up	2.70	up	1.60	up	PPM1N	NM_001080401
1.60	up	2.92	up	1.82	up	PPM1N	NM_001080401
1.37	up	1.54	down	2.11	down	PPP1R14B	NM_138689
1.53	down	4.88	down	3.18	down	PPP1R1C	NM_001080545
2.75	up	2.26	up	1.22	down	PPP1R26	NM_014811
1.00	down	2.15	up	2.16	up	PPP1R3E	NR_026862
1.63	down	7.35	down	4.51	down	PPP2R2C	NM_181876
2.65	up	2.19	up	1.21	down	PPP2R3B-AS1	NR_027232
2.01	down	1.35	down	1.49	up	PQLC3	NM_152391
3.57	up	2.81	up	1.27	down	PRELID2	NM_138492
1.75	down	2.38	down	1.36	down	PRICKLE1	NM_153026
9.84	up	7.82	up	1.26	down	PRIMA1	NM_178013
4.48	up	2.48	up	1.80	down	PRINS	NR_023388
1.46	down	2.20	up	3.21	up	PRKAR2B	NM_002736
1.25	down	2.27	up	2.83	up	PRKAR2B	NM_002736
2.21	down	2.30	up	5.07	up	PRKCB	NM_002738
1.49	down	2.59	down	1.74	down	PRKG1	NM_006258
4.87	up	1.88	up	2.59	down	PRKXP1	AI016765
2.65	up	1.46	up	1.81	down	PRKY	NR_028062
2.50	down	3.73	down	1.50	down	PROC	NM_000312
2.18	down	2.83	down	1.30	down	PROCR	NM_006404
5.11	up	8.27	up	1.62	up	PRODH	NM_016335
4.42	up	5.83	up	1.32	up	PRODH	NM_016335
2.59	down	1.11	up	2.87	up	PRORSD1P	NR_027258
1.64	up	2.01	up	1.23	up	PRPF40A	NM_017892
3.24	up	2.15	up	1.51	down	PRR19	NM_199285
7.62	down	4.00	down	1.90	up	PRUNE2	NM_015225
7.35	down	2.84	down	2.59	up	PRUNE2	NM_015225
1.47	up	2.68	up	1.82	up	PSIP1	NM_021144
1.35	up	3.12	up	2.32	up	PSIP1	NM_033222
4.15	up	1.95	up	2.12	down	PSMC3IP	NM_013290
1.96	down	24.19	down	12.33	down	PTHLH	NM_198965
1.37	up	2.29	down	3.14	down	PTK7	NM_002821
9.55	up	6.12	up	1.56	down	PTN	NM_002825
1.23	down	2.24	down	1.82	down	PTP4A1	NM_003463
4.76	down	3.05	down	1.56	up	PTPLA	BC027709
8.29	up	2.32	up	3.58	down	PTPRF	BC048416
3.68	up	1.61	up	2.29	down	PTPRF	NM_002840
2.49	down	1.53	up	3.80	up	PTPRN2	NM_002847
2.19	up	2.07	up	1.06	down	PTTG1	NM_004219
2.04	up	2.00	up	1.02	down	PTTG3P	NR_002734

1.15	up	1.88	down	2.16	down	PVR	NM_006505
1.14	down	3.20	up	3.64	up	PVRIG	NM_024070
1.73	down	2.07	down	1.20	down	PVT1	NR_003367
1.42	down	3.40	down	2.39	down	PYGL	NM_002863
3.15	up	4.00	up	1.27	up	Q8ZSP1	
1.52	down	9.72	down	6.40	down	Q9RWL9	
3.02	up	1.96	up	1.54	down	QRICH2	NM_032134
1.29	down	2.11	down	1.63	down	QSOX1	NM_00100412 8
1.41	up	1.67	down	2.34	down	RAB23	NM_016277
2.25	up	4.36	up	1.94	up	RAB26	NM_014353
2.15	down	1.95	up	4.19	up	RAB37	NM_175738
1.46	down	4.43	down	3.04	down	RAB38	NM_022337
2.36	up	1.67	up	1.41	down	RAD54B	NM_012415
3.21	up	1.80	up	1.79	down	RAD54L	NM_003579
1.13	down	2.55	down	2.26	down	RAET1K	NR_024045
1.33	down	2.16	down	1.62	down	RAI1	AJ271790
3.15	up	4.91	up	1.56	up	RALGPS1	NM_014636
11.15	up	8.36	up	1.33	down	RANBP17	NM_022897
1.26	down	1.76	up	2.23	up	RAPGEF6	NM_016340
1.03	up	2.08	down	2.14	down	RASAL2	NM_170692
1.00	up	2.24	down	2.25	down	RASAL2	NM_170692
2.36	down	2.41	down	1.02	down	RASD1	NM_016084
3.40	up	3.90	up	1.15	up	RASEF	NM_152573
5.78	up	1.74	up	3.32	down	RASEF	AK056176
1.52	down	2.28	up	3.47	up	RASSF2	NM_014737
1.25	down	1.70	up	2.12	up	RASSF5	NM_182663
2.10	down	1.64	down	1.28	up	RBBP6	NM_032626
1.36	up	2.12	down	2.89	down	RBFOX2	NM_00103169 5
2.70	up	2.13	up	1.27	down	RBM14	NM_006328
1.07	up	2.78	up	2.61	up	RBM26-AS1	NR_038991
2.27	up	1.08	up	2.10	down	RCC2	NM_018715
3.59	down	2.43	down	1.48	up	RECK	NM_021111
2.74	up	1.71	up	1.60	down	RECQL4	NM_004260
1.42	down	2.06	down	1.45	down	REEP3	NM_00100133 0
4.80	up	7.76	up	1.62	up	REM1	NM_014012
1.57	up	2.07	up	1.32	up	REXO1	NM_020695
2.19	down	1.75	down	1.25	up	RFTN2	NM_144629
1.49	up	2.13	up	1.43	up	RFX5	NM_000449
1.79	down	2.14	down	1.20	down	RFX8	NM_00114566 4
5.54	up	1.94	up	2.86	down	RGNEF	NM_00117769 3
3.70	down	3.11	down	1.19	up	RGPD1	NM_00102445 7
2.05	down	4.33	up	8.86	up	RGS13	NM_002927

2.21	down	1.76	down	1.25	up	RGS2	NM_002923
1.31	down	6.16	down	4.70	down	RGS20	NM_170587
1.05	up	2.04	up	1.95	up	RGS5	NM_003617
13.32	up	5.60	up	2.38	down	RHBDL3	NM_138328
14.51	up	7.26	up	2.00	down	RHCG	NM_016321
2.07	up	1.95	up	1.06	down	RHEBL1	NM_144593
1.81	down	2.21	down	1.22	down	RHOB	NM_004040
2.14	down	3.08	down	1.44	down	RHOB	NM_004040
1.73	down	2.05	down	1.19	down	RHOBTB1	NM_00124235 9
2.20	down	1.49	down	1.48	up	RHOJ	NM_020663
2.49	down	1.69	down	1.47	up	RHOQ	NM_012249
3.42	up	4.38	up	1.28	up	RHOXF1	NM_139282
1.72	up	2.76	up	1.61	up	RHPN1	NM_052924
11.40	up	8.65	up	1.32	down	RIBC2	NM_015653
1.20	up	5.64	up	4.71	up	RIC3	NM_024557
1.12	up	3.05	down	3.40	down	RIMS3	NM_014747
1.24	down	2.61	up	3.23	up	RINL	NM_00119583 3
1.30	down	1.96	up	2.54	up	RLTPR	NM_00101383 8
1.65	up	2.40	up	1.46	up	RMND5B	NM_022762
2.72	up	1.41	up	1.92	down	RNASEH2A	NM_006397
3.37	up	3.64	up	1.08	up	RNF207	NM_207396
6.16	up	3.23	up	1.91	down	RNF207	BC119780
4.35	up	3.55	up	1.22	down	RNF207	NM_207396
12.51	up	13.96	up	1.12	up	RNF212	NM_00113103 4
1.43	down	4.53	down	3.16	down	RNF217	NM_152553
7.73	up	7.12	up	1.09	down	RNF32	NM_030936
3.80	up	1.93	up	1.97	down	RNF43	NM_017763
1.72	up	2.33	up	1.36	up	RNPC3	AK289844
7.96	down	4.81	down	1.66	up	RNU2-2	NR_002761
2.72	down	1.15	up	3.13	up	RNU4ATAC	DW419002
1.82	down	2.12	up	3.85	up	RORC	NM_005060
2.00	up	2.42	up	1.21	up	RPA2	NM_002946
1.92	up	2.33	up	1.21	up	RPA2	NM_002946
2.62	down	3.12	down	1.19	down	RPL3L	NM_005061
#####	up	7.60	up	420.10	down	RPS4Y2	NM_00103956 7
2.44	up	1.47	down	3.58	down	RTKN	NM_033046
1.89	up	2.36	up	1.25	up	RTKN2	NM_145307
27.10	up	6.93	up	3.91	down	RTP3	NM_031440
1.12	up	2.04	down	2.28	down	RUNX2	NM_00101505 1
2.15	up	1.46	up	1.48	down	SAC3D1	NM_013299
2.08	up	1.00	up	2.08	down	SAMD1	NM_138352
1.83	up	3.08	up	1.68	up	SAMD10	NM_080621

1.99	down	2.57	down	1.29	down	SAMD4A	NM_015589
1.56	down	2.25	down	1.44	down	SAMD4A	NM_015589
1.32	down	2.25	down	1.70	down	SAMD8	NM_144660
1.62	up	2.10	up	1.30	up	SAP18	NM_005870
2.23	up	1.64	up	1.36	down	SAP30	NM_003864
2.31	up	1.90	up	1.22	down	SASS6	NM_194292
1.68	up	2.52	up	1.50	up	SCAI	NM_173690
1.22	down	1.81	up	2.21	up	SCARNA14	NR_004388
3.71	down	1.12	down	3.32	up	SCARNA16	NR_003013
3.63	down	1.17	down	3.11	up	SCARNA16	NR_003013
8.86	down	4.63	down	1.91	up	SCG2	NM_003469
1.67	down	4.82	down	2.89	down	SCG5	NM_003020
4.82	up	3.06	up	1.57	down	SCIN	NM_033128
3.00	up	4.61	up	1.53	up	SCML2	NM_006089
3.35	down	1.64	down	2.05	up	SCN3B	NM_018400
1.66	up	1.34	down	2.23	down	SDAD1	NM_018115
2.37	up	1.98	up	1.20	down	SDHAP1	AK125217
2.48	down	1.72	up	4.26	up	SELP	NM_003005
2.77	down	2.08	up	5.77	up	SELP	NM_003005
3.94	down	8.60	down	2.18	down	SEMA3A	NM_006080
1.80	down	4.82	down	2.67	down	SEMA3C	NM_006379
1.18	down	1.92	up	2.25	up	SEMA4D	NM_006378
1.08	down	2.33	up	2.51	up	SEMA4D	NM_00114228 7
1.26	down	1.99	up	2.50	up	SEMA5B	NM_00103170 2
2.04	up	1.52	up	1.34	down	SENP1	NM_014554
7.92	up	3.04	up	2.60	down	SEPT3	NM_145733
2.09	down	2.30	down	1.10	down	SEPX1	NM_016332
1.03	down	3.74	down	3.62	down	SERINC2	NM_178865
2.45	down	5.47	down	2.23	down	SERPINE1	NM_000602
2.84	down	2.71	down	1.05	up	SESN3	NM_144665
1.20	up	2.07	up	1.72	up	SFI1	NM_00100746 7
1.06	down	2.71	down	2.56	down	SGMS2	NM_152621
1.40	down	1.76	up	2.46	up	SH2D3C	NM_170600
1.47	down	2.74	down	1.87	down	SH2D5	NM_00110316 1
2.65	down	2.20	down	1.21	up	SHC2	BC034544
1.14	down	2.37	up	2.69	up	SHE	NM_00101084 6
2.21	up	2.23	up	1.01	up	SHMT1	NM_004169
5.04	up	2.46	up	2.05	down	SHROOM3	NM_020859
6.58	up	1.92	up	3.42	down	SHROOM3	NM_020859
1.42	up	2.38	up	1.67	up	SIGIRR	NM_021805
1.27	up	2.10	up	1.66	up	SIGIRR	AY358342
10.90	up	9.90	up	1.10	down	SIM2	NM_005069
2.18	down	1.71	down	1.28	up	SIRPB2	

3.59	up	2.18	up	1.65	down	SKA3	NM_145061
1.82	down	3.63	down	2.00	down	SLC16A10	NM_018593
1.23	down	3.33	down	2.70	down	SLC16A10	NM_018593
2.25	down	1.03	up	2.31	up	SLC16A7	NM_004731
7.42	up	6.33	up	1.17	down	SLC16A8	NM_013356
2.64	up	3.59	up	1.36	up	SLC1A1	NM_004170
1.42	down	3.52	down	2.48	down	SLC22A23	NM_015482
2.77	up	3.35	up	1.21	up	SLC25A23	NM_024103
2.16	up	2.04	up	1.06	down	SLC25A23	NM_024103
2.78	down	2.05	down	1.36	up	SLC2A14	BC060766
2.56	down	2.34	down	1.09	up	SLC2A3	NM_006931
1.72	down	2.32	down	1.35	down	SLC35D1	NM_015139
2.12	up	1.09	up	1.94	down	SLC35E1	NM_024881
1.51	up	2.09	up	1.38	up	SLC35E2	NM_182838
2.12	down	2.09	down	1.01	up	SLC37A2	NM_198277
1.32	up	1.94	down	2.55	down	SLC39A4	NM_017767
1.31	down	2.39	down	1.82	down	SLC3A2	NM_00101266 2
1.29	down	2.86	down	2.22	down	SLC4A3	NM_005070
2.44	up	1.82	up	1.34	down	SLC5A6	NM_021095
1.54	down	5.30	down	3.44	down	SLC6A15	NM_018057
1.18	down	2.09	up	2.47	up	SLC6A16	NM_014037
6.75	down	15.34	down	2.27	down	SLC6A2	NM_00117250 1
1.67	down	4.29	down	2.57	down	SLC7A5	NM_003486
3.40	down	9.64	down	2.83	down	SLC7A8	NM_182728
3.04	down	7.43	down	2.45	down	SLC7A8	NM_182728
2.19	down	1.76	down	1.25	up	SLC9B2	NM_178833
2.51	up	6.73	up	2.68	up	SLFN13	NM_144682
1.26	down	4.09	down	3.24	down	SLITRK6	NM_032229
1.66	down	15.41	down	9.27	down	SLITRK6	NM_032229
1.64	up	2.16	up	1.32	up	SMA4	NR_029426
1.80	up	2.34	up	1.30	up	SMARCA2	NM_139045
74.30	up	100.6 5	up	1.35	up	SMC1B	NM_148674
2.10	up	1.83	up	1.15	down	SMC4	NM_005496
3.73	up	3.86	up	1.04	up	SMPDL3B	NM_00100956 8
1.11	down	2.87	down	2.60	down	SMTN	NM_134269
1.20	up	1.89	down	2.27	down	SMYD3	NM_022743
1.00	up	2.59	down	2.60	down	SNAI2	NM_003068
2.66	down	1.94	up	5.16	up	SNAP91	NM_014841
3.04	down	1.40	up	4.26	up	SNORA12	NR_002954
2.14	down	1.77	down	1.21	up	SNORA17	NR_002958
2.04	down	1.91	down	1.07	up	SNORA43	NR_002975
2.00	down	1.20	down	1.67	up	SNORA5B	NR_002990
5.50	down	4.26	down	1.29	up	SNORD114-12	NR_003205

3.15	down	4.13	down	1.31	down	SNORD114-20	NR_003213
1.35	down	1.75	up	2.37	up	SNORD59B	NR_003046
1.27	down	2.21	down	1.74	down	SNORD72	NR_002583
4.05	down	3.02	down	1.34	up	SNORD93	NR_003075
2.01	down	1.69	down	1.20	up	SNTA1	NM_003098
1.15	up	9.66	up	8.39	up	SNX22	NM_024798
2.31	down	1.69	down	1.37	up	SOCS3	NM_003955
1.01	down	4.07	down	4.04	down	SOX15	NM_006942
2.96	up	3.13	up	1.06	up	SOX30	NM_178424
2.79	up	1.01	down	2.81	down	SOX4	NM_003107
4.30	up	9.74	up	2.27	up	SP5	NM_001003845
37.14	up	11.58	up	3.21	down	SP9	
2.26	up	1.72	up	1.31	down	SPATA5	NM_145207
1.56	down	2.70	down	1.73	down	SPEG	NM_001173476
2.55	up	19.19	up	7.53	up	SPIB	NM_003121
2.29	down	1.51	up	3.45	up	SPNS3	NM_182538
1.36	up	5.09	down	6.91	down	SPOCD1	NM_144569
1.24	up	3.54	up	2.87	up	SPOCK2	NM_014767
4.36	down	3.45	down	1.26	up	SPON1	NM_006108
1.73	down	3.54	down	2.05	down	SPON2	NM_012445
2.44	down	17.24	down	7.07	down	SPRR4	NM_173080
1.17	up	1.81	down	2.11	down	SRGAP1	NM_020762
3.40	up	4.64	up	1.36	up	SRGAP3	NM_014850
1.51	down	2.02	down	1.34	down	SRPK2	NM_182691
1.64	down	2.31	down	1.41	down	SSFA2	NM_006751
3.17	down	1.78	down	1.77	up	SSH2	BC011636
3.16	up	2.52	up	1.25	down	SSX2IP	NM_014021
2.11	down	1.77	down	1.19	up	ST3GAL5	NM_003896
3.65	down	1.53	down	2.38	up	ST6GALNAC3	NM_001160011
2.39	down	1.45	down	1.65	up	ST6GALNAC3	NM_152996
7.80	up	16.05	up	2.06	up	STAG3	NM_012447
10.25	up	30.56	up	2.98	up	STAG3	NM_012447
8.31	up	9.19	up	1.11	up	STAR	NM_000349
1.16	down	1.77	up	2.05	up	STAT5A	NM_003152
2.37	up	1.47	up	1.61	down	STIL	NM_001048166
1.24	up	2.14	up	1.72	up	STIM2	
2.47	up	1.69	up	1.46	down	STMN1	NM_203401
1.17	up	3.24	down	3.78	down	STON2	NM_033104
2.84	up	2.08	up	1.36	down	STOX2	NM_020225
1.17	down	2.30	down	1.97	down	STRN3	NM_014574
1.49	up	1.70	down	2.53	down	STX1A	NM_004603
3.84	down	3.45	down	1.11	up	SUN3	NM_00103001

							9
1.15	up	1.81	down	2.09	down	SUPT3H	NM_003599
6.84	up	8.31	up	1.22	up	SUSD4	NM_017982
1.80	up	4.54	up	2.53	up	SV2B	NM_014848
2.93	down	1.31	down	2.23	up	SVEP1	NM_153366
11.74	up	7.53	up	1.56	down	SYCE2	NM_00110557 8
29.71	up	18.56	up	1.60	down	SYCP2	NM_014258
4.50	up	4.37	up	1.03	down	SYNGR3	NM_004209
3.19	up	3.02	up	1.06	down	SYNGR3	NM_004209
3.78	up	13.71	up	3.63	up	SYNPO2	NM_133477
7.50	down	3.35	down	2.24	up	SYPL2	NM_00104070 9
1.61	up	3.36	up	2.09	up	TAC3	NM_013251
1.45	down	2.08	up	3.01	up	TAGAP	NM_054114
1.37	up	1.81	down	2.47	down	TANC2	NM_025185
2.10	up	1.51	up	1.39	down	TAS2R9	NM_023917
1.48	down	2.26	down	1.52	down	TBC1D16	NM_019020
2.32	up	1.38	up	1.68	down	TBC1D24	NM_020705
1.44	down	1.73	up	2.49	up	TBC1D4	NM_014832
98.83	up	66.72	up	1.48	down	TCAM1P	NR_002947
19.71	up	18.42	up	1.07	down	TCAM1P	NR_002947
2.00	up	3.25	up	1.62	up	TCEA3	NM_003196
2.70	down	2.60	down	1.04	up	TCEAL7	NM_152278
2.02	up	1.73	up	1.16	down	TCF19	NM_007109
2.36	up	1.45	up	1.63	down	TCF7L1	NM_031283
2.14	down	7.77	down	3.63	down	TCHH	NM_007113
1.02	up	2.36	up	2.31	up	TCL1B	NM_004918
7.20	up	4.89	up	1.47	down	TCP11	NM_018679
24.22	up	24.65	up	1.02	up	TCP11	NM_018679
1.20	down	2.28	down	1.90	down	TCP11L1	NM_018393
2.13	down	2.66	down	1.25	down	TCTEX1D4	NM_00101363 2
3.46	up	1.21	up	2.87	down	TCTN2	NM_024809
3.22	up	7.32	up	2.27	up	TDRD10	NM_182499
1.81	up	3.02	up	1.67	up	TDRD10	NM_182499
2.60	up	6.46	up	2.48	up	TDRD10	NM_182499
2.21	up	1.22	up	1.80	down	TEAD2	NM_003598
2.17	up	1.43	up	1.52	down	TECR	NM_138501
2.09	down	1.10	down	1.90	up	TEK	NM_000459
2.37	down	2.05	down	1.15	up	TET2	NM_017628
1.06	up	3.12	down	3.29	down	TFCP2L1	NM_014553
3.38	down	2.05	down	1.65	up	TFF1	NM_003225
7.40	down	4.49	down	1.65	up	TFPI2	NM_006528
1.02	down	2.74	down	2.68	down	TGFB2	NM_003238
3.10	down	1.25	down	2.48	up	TGFBR2	NM_00102484 7
1.27	up	1.72	down	2.19	down	TGIF1	NM_170695

2.41	up	1.74	up	1.38	down	THAP10	NM_020147
1.87	up	2.56	up	1.37	up	THAP2	NM_031435
2.35	up	1.55	up	1.52	down	THAP3	NM_138350
2.06	down	1.89	down	1.09	up	THBD	NM_000361
3.33	down	2.10	down	1.59	up	THBS1	NM_003246
3.05	down	2.27	down	1.34	up	THBS1	NM_003246
2.35	up	2.83	up	1.21	up	THBS4	
2.12	down	2.82	down	1.33	down	THSD1	NM_199263
2.37	down	1.89	down	1.25	up	THSD1	NM_018676
3.35	up	3.35	up	1.00	up	TIFA	NM_052864
1.66	down	3.15	up	5.22	up	TIFAB	NM_00109922 1
2.35	up	2.35	up	1.00	up	TIGD3	NM_145719
1.43	up	1.46	down	2.08	down	TIGD5	NM_032862
2.69	up	2.15	up	1.25	down	TIMELESS	NM_003920
7.13	down	3.51	down	2.03	up	TIMP4	NM_003256
5.60	up	5.30	up	1.06	down	TJP3	NM_014428
2.17	down	5.94	up	12.87	up	TLR10	NM_030956
1.13	down	2.31	up	2.61	up	TLR9	NM_017442
3.27	up	5.03	up	1.54	up	TLX2	NM_016170
25.11	up	23.62	up	1.06	down	TLX3	NM_021025
3.01	down	8.89	down	2.96	down	TM4SF19	NM_138461
3.50	down	9.91	down	2.84	down	TM4SF19	NM_138461
4.77	up	2.52	up	1.89	down	TM7SF3	NM_016551
2.69	up	2.20	up	1.22	down	TM7SF3	NM_016551
1.80	down	2.00	up	3.60	up	TMBIM4	NM_016056
1.55	down	5.63	down	3.64	down	TMC7	NM_024847
1.06	up	2.41	up	2.29	up	TMC8	NM_152468
1.43	up	2.29	up	1.60	up	TMCO4	NM_181719
1.86	up	2.34	up	1.26	up	TMCO4	NM_181719
2.19	down	1.69	down	1.30	up	TMCO7	NM_024562
3.82	up	1.76	up	2.17	down	TMEM171	NM_173490
2.37	up	2.31	up	1.03	down	TMEM194A	NM_015257
1.43	down	2.26	down	1.58	down	TMEM2	NM_013390
2.97	down	2.85	down	1.04	up	TMEM2	
1.46	down	2.10	down	1.44	down	TMEM2	NM_013390
7.08	down	3.74	down	1.89	up	TMEM236	NM_00109884 4
1.40	up	2.07	up	1.48	up	TMEM80	NM_00104246 3
1.28	down	2.22	down	1.73	down	TMEM87B	NM_032824
1.07	down	3.16	up	3.38	up	TMIE	NM_147196
1.62	down	1.64	up	2.65	up	TMIGD2	NM_144615
2.59	up	2.41	up	1.08	down	TMPO	NM_003276
25.33	up	46.53	up	1.84	up	TMPRSS11B	NM_182502
1.53	up	3.17	down	4.87	down	TMPRSS13	NM_00120679 0
5.15	up	2.35	up	2.19	down	TMPRSS2	NM_005656

3.67	up	3.42	up	1.07	down	TMSB4Y	NM_004202
2.58	up	1.57	up	1.64	down	TMTC2	NM_152588
1.82	down	4.76	down	2.61	down	TNC	NM_002160
2.60	up	2.62	up	1.01	up	TNFAIP2	NM_006291
2.13	down	1.55	up	3.31	up	TNFAIP8L2	NM_024575
1.51	down	3.12	down	2.06	down	TNFRSF12A	NM_016639
1.14	up	2.54	up	2.24	up	TNFRSF14	NM_003820
1.32	down	1.94	up	2.55	up	TNFSF14	NM_003807
3.70	up	2.05	up	1.80	down	TNFSF15	NM_005118
2.42	down	2.08	up	5.02	up	TNXB	NM_019105
2.74	down	2.58	up	7.07	up	TNXB	NM_032470
3.92	up	1.41	up	2.77	down	TONSL	NM_013432
2.28	up	1.92	up	1.18	down	TOPBP1	NM_007027
4.04	up	1.93	up	2.09	down	TP53	NM_000546
2.69	up	1.47	up	1.83	down	TP73	NM_00120418 6
1.77	up	2.81	up	1.59	up	TP73-AS1	NR_033711
1.00	up	2.36	down	2.37	down	TPBG	NM_006670
2.46	up	2.89	up	1.17	up	TPD52	NM_00102525 2
1.28	down	2.96	down	2.30	down	TPM1	NM_000366
1.22	down	2.41	down	1.98	down	TPM4	NM_003290
1.14	down	2.36	down	2.07	down	TPM4	NM_003290
1.78	up	3.95	up	2.21	up	TRAF1	NM_005658
1.02	down	2.14	up	2.19	up	TRIM22	NM_006074
2.91	up	1.63	up	1.78	down	TRIM45	NM_025188
3.45	up	5.88	up	1.70	up	TRIM50	NM_178125
1.25	up	2.02	up	1.62	up	TRIM66	NM_014818
1.53	down	2.79	down	1.83	down	TRMT12	NM_017956
3.29	up	2.29	up	1.44	down	TROAP	NM_005480
4.80	up	1.91	up	2.51	down	TRPV4	NM_147204
2.41	up	1.80	up	1.34	down	TSC2	NM_000548
4.36	down	1.46	down	2.99	up	TSIX	NR_003255
7.60	down	1.99	down	3.82	up	TSIX	NR_003255
10.95	down	1.62	down	6.76	up	TSIX	NR_003255
2.35	down	3.63	down	1.55	down	TTC7B	NM_00101085 4
1.19	down	2.00	down	1.69	down	TTC8	NM_144596
2.46	up	1.96	up	1.25	down	TTC9C	AF289605
3.21	up	2.60	up	1.23	down	TTTY14	NR_001543
27.02	up	2.94	up	9.20	down	TTTY15	NR_001545
1.65	down	3.00	down	1.82	down	TUBA4A	NM_006000
1.72	down	2.99	down	1.74	down	TUBA4A	NM_006000
1.73	down	2.75	down	1.59	down	TUBA4A	NM_006000
2.02	down	1.85	down	1.09	up	TUBA8	NM_018943
1.39	down	2.37	down	1.70	down	TUBB2A	NM_001069
1.90	down	2.86	down	1.50	down	TUBB2A	NM_001069
1.72	down	5.07	down	2.95	down	TUBB3	NM_006086

44.51	up	4.37	up	10.18	down	TXLNG2P	NR_045128
57.70	up	4.48	up	12.88	down	TXLNG2P	NR_045128
61.01	up	3.48	up	17.55	down	TXLNG2P	NR_045129
3.01	up	2.58	up	1.17	down	TYMS	NM_001071
1.14	up	2.35	up	2.06	up	UBA7	NM_003335
1.08	down	3.18	up	3.43	up	UBASH3A	NM_018961
3.29	up	5.70	up	1.73	up	UBD	NM_006398
1.10	down	2.41	down	2.18	down	UBE2H	NM_003344
1.98	down	2.09	down	1.05	down	UBE2Q2P1	NR_003661
1.58	down	2.05	down	1.30	down	UBE2Q2P1	NR_003661
2.00	down	1.26	down	1.59	up	UBR1	NM_174916
1.69	down	2.08	down	1.23	down	UBTD1	NM_024954
2.80	up	1.44	up	1.94	down	UHRF1	NM_013282
2.18	up	1.63	up	1.34	down	UHRF1	NM_013282
3.03	up	1.90	up	1.59	down	UNC119B	NM_001080533
2.64	up	1.97	up	1.34	down	UNC13B	NM_006377
1.45	down	1.53	up	2.21	up	UNC13D	NM_199242
2.31	up	1.66	up	1.39	down	UNG	NM_003362
4.83	up	6.33	up	1.31	up	UPB1	NM_016327
2.08	up	2.38	up	1.15	up	URB1	NM_014825
2.56	up	2.12	up	1.21	down	USP18	NM_017414
2.53	up	2.05	up	1.23	down	USP41	XM_036729
10.09	up	2.42	up	4.17	down	USP9Y	NM_004654
140.94	up	4.35	up	32.43	down	USP9Y	NM_004654
28.68	up	4.09	up	7.01	down	UTY	BC012581
5.03	up	3.66	up	1.37	down	UTY	NM_007125
16.10	up	3.38	up	4.77	down	UTY	NM_182660
3.12	up	7.29	up	2.33	up	VCAM1	NM_001078
1.29	down	2.63	down	2.04	down	VCX2	NM_016378
2.62	down	2.52	down	1.04	up	VEGFC	NM_005429
3.76	down	1.75	down	2.15	up	VGLL3	NM_016206
2.49	up	1.12	up	2.23	down	VKORC1	AK125618
2.42	down	1.45	down	1.67	up	VMAC	NM_001017921
1.43	down	2.43	down	1.69	down	VMO1	NM_182566
6.89	up	2.87	up	2.40	down	VWDE	NM_001135924
2.07	down	1.06	down	1.95	up	VWF	NM_000552
2.36	up	1.84	up	1.28	down	WDR34	NM_052844
2.95	down	10.46	down	3.55	down	WDR66	NM_144668
2.58	up	2.29	up	1.13	down	WDR76	NM_024908
1.59	up	1.37	down	2.18	down	WDYHV1	NM_018024
2.39	up	1.86	up	1.28	down	WEE1	NM_003390
2.93	up	2.08	up	1.41	down	WHSC1	NM_133330
3.62	up	4.49	up	1.24	up	WIPF3	AK094250
1.17	down	3.80	down	3.25	down	WISP1	NM_080838

27.62	up	23.03	up	1.20	down	WNK2	NM_006648
6.14	up	6.81	up	1.11	up	WNK2	NM_006648
1.22	down	4.29	down	3.51	down	WNT7A	NM_004625
1.06	down	3.04	down	2.88	down	WNT7B	NM_058238
3.86	down	1.82	down	2.11	up	XIST	NR_001564
235.08	down	3.22	down	73.02	up	XIST	NR_001564
#####	down	5.82	down	241.73	up	XIST	NR_001564
#####	down	7.74	down	151.31	up	XIST	NR_001564
605.15	down	4.06	down	149.01	up	XIST	NR_001564
519.59	down	4.55	down	114.16	up	XIST	NR_001564
#####	down	10.46	down	162.36	up	XIST	NR_001564
#####	down	7.08	down	306.67	up	XIST	NR_001564
4.82	up	14.71	up	3.05	up	XKR4	NM_052898
2.25	up	1.42	up	1.58	down	XLOC_000048	
3.44	up	3.65	up	1.06	up	XLOC_000363	
2.47	up	2.81	up	1.14	up	XLOC_000441	AK023394
1.46	down	3.36	down	2.30	down	XLOC_000527	XR_108329
1.54	down	4.56	down	2.96	down	XLOC_000527	XR_108330
2.26	down	11.52	down	5.11	down	XLOC_000587	AK124056
2.58	down	15.11	down	5.86	down	XLOC_000587	
1.01	up	2.46	up	2.45	up	XLOC_000746	
1.69	down	8.40	down	4.98	down	XLOC_000778	
3.25	up	3.74	up	1.15	up	XLOC_000956	BX089534
6.04	down	2.09	down	2.89	up	XLOC_001011	AB042556
1.82	down	1.55	up	2.81	up	XLOC_001035	
2.01	down	3.14	down	1.56	down	XLOC_001148	EF413001
3.91	down	2.41	down	1.62	up	XLOC_001209	BF216856
2.84	down	1.75	down	1.62	up	XLOC_00126	

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3.51	down	1.44	down	2.44	up	XLOC_001266	
1.39	up	6.15	up	4.43	up	XLOC_001286	
2.39	down	10.78	down	4.51	down	XLOC_001546	
3.48	up	2.78	up	1.25	down	XLOC_001576	BG219825
1.30	up	2.20	down	2.86	down	XLOC_001775	
1.13	down	5.72	down	5.04	down	XLOC_001826	
1.28	down	2.37	down	1.86	down	XLOC_001826	
1.07	down	3.26	down	3.04	down	XLOC_001826	
1.58	down	2.38	down	1.51	down	XLOC_001869	
7.47	down	3.49	down	2.14	up	XLOC_002142	
1.94	down	2.04	down	1.05	down	XLOC_002484	AK307257
2.13	down	2.74	up	5.85	up	XLOC_002749	
9.85	up	6.46	up	1.52	down	XLOC_002830	
1.79	down	3.05	down	1.70	down	XLOC_003077	
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2.41	up	2.88	up	1.19	up	XLOC_003498	
1.73	down	6.50	down	3.76	down	XLOC_003834	
1.82	up	3.06	up	1.68	up	XLOC_004456	
1.62	up	2.39	up	1.48	up	XLOC_004456	
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2.64	up	3.01	up	1.14	up	XLOC_004643	DB301429
1.44	down	4.25	down	2.95	down	XLOC_004929	XR_110563
1.29	down	3.97	down	3.09	down	XLOC_005105	BX096383

1.19	up	2.39	up	2.00	up	XLOC_005244	
1.81	down	2.64	down	1.46	down	XLOC_005303	
2.14	down	4.31	down	2.01	down	XLOC_005369	
1.87	up	1.10	down	2.05	down	XLOC_005514	
1.81	down	3.18	down	1.76	down	XLOC_005748	
1.83	down	7.05	down	3.85	down	XLOC_005935	CB123670
2.50	down	9.46	down	3.79	down	XLOC_005935	CB123670
4.81	up	3.83	up	1.25	down	XLOC_005940	
2.59	down	1.58	down	1.65	up	XLOC_006178	CD693121
4.29	down	14.18	down	3.31	down	XLOC_006200	BC040593
2.16	down	2.08	down	1.04	up	XLOC_006915	DA998032
1.45	up	2.64	down	3.84	down	XLOC_007531	
18.35	up	4.98	up	3.68	down	XLOC_007734	BC043560
76.43	down	2.84	down	26.96	up	XLOC_008015	
4.38	down	1.78	down	2.45	up	XLOC_008015	
1.54	up	2.31	up	1.51	up	XLOC_008152	
38.27	down	2.31	down	16.58	up	XLOC_008185	
4.64	up	2.43	up	1.91	down	XLOC_008276	
4.34	up	2.48	up	1.75	down	XLOC_008276	
18.70	up	2.84	up	6.59	down	XLOC_008323	
2.15	down	1.59	down	1.36	up	XLOC_008542	
2.21	up	1.84	up	1.20	down	XLOC_008583	
5.10	down	7.50	down	1.47	down	XLOC_008700	
1.84	down	12.51	down	6.79	down	XLOC_008711	
2.23	down	1.88	down	1.18	up	XLOC_00918	BM717049

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1.07	down	2.25	up	2.39	up	XLOC_009294	
2.57	up	2.35	up	1.09	down	XLOC_009428	
3.31	up	4.46	up	1.35	up	XLOC_009507	AK054718
1.15	down	3.93	down	3.43	down	XLOC_009788	
2.03	down	7.06	down	3.47	down	XLOC_009788	DA697821
1.89	down	2.84	down	1.51	down	XLOC_009790	
1.86	down	2.80	down	1.51	down	XLOC_009810	
1.30	down	2.36	down	1.81	down	XLOC_009994	
1.66	up	3.67	up	2.21	up	XLOC_010117	
2.69	up	2.93	up	1.09	up	XLOC_010245	
4.79	down	1.74	down	2.75	up	XLOC_010275	
1.00	up	2.00	down	2.01	down	XLOC_010321	
1.17	down	2.72	down	2.32	down	XLOC_010390	AJ412054
2.27	down	4.47	down	1.97	down	XLOC_010825	
2.19	down	2.18	down	1.00	up	XLOC_010879	
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2.33	down	4.24	down	1.82	down	XLOC_011047	BX648502
1.36	down	3.50	down	2.57	down	XLOC_011052	
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4.66	up	5.98	up	1.28	up	XLOC_011545	
2.79	up	2.95	up	1.06	up	XLOC_012079	
3.42	up	3.13	up	1.09	down	XLOC_012237	CR739285
2.10	down	18.16	down	8.64	down	XLOC_012452	BC084573
2.13	down	1.08	down	1.97	up	XLOC_012768	

2.57	down	1.46	down	1.76	up	XLOC_012833	BC031271
3.31	up	3.66	up	1.11	up	XLOC_012895	
1.29	down	2.08	down	1.62	down	XLOC_013093	
1.81	down	3.16	down	1.75	down	XLOC_013364	
5.87	up	7.61	up	1.30	up	XLOC_013483	
2.28	down	6.08	down	2.66	down	XLOC_013541	BX116929
2.42	down	7.79	down	3.22	down	XLOC_013542	
1.60	down	3.10	down	1.93	down	XLOC_013832	
1.21	up	2.66	up	2.19	up	XLOC_013866	
1.35	down	1.79	up	2.41	up	XLOC_013921	
3.58	up	2.10	up	1.70	down	XLOC_013981	BX105611
3.11	down	1.84	down	1.69	up	XLOC_013983	
2.52	up	2.37	up	1.06	down	XLOC_014073	AY204750
4.75	up	3.08	up	1.54	down	XLOC_014111	DB312214
4.01	up	5.74	up	1.43	up	XLOC_014257	
2.01	down	6.34	down	3.16	down	XLOC_014263	
1.45	up	2.16	up	1.49	up	XLOC_014288	
1.70	up	2.16	up	1.27	up	XLOC_014288	
1.62	down	2.09	down	1.29	down	XLOC_014300	
5.60	up	3.89	up	1.44	down	XLOC_014388	XR_109724
4.84	up	3.75	up	1.29	down	XLOC_014513	BC017979
1.46	up	2.59	up	1.78	up	XLOC_l2_000080	AK311553
2.36	up	4.12	up	1.75	up	XLOC_l2_000417	
2.75	up	1.61	down	4.43	down	XLOC_l2_001011	BC030750
1.77	up	2.30	up	1.30	up	XLOC_l2_00	

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6.41	down	1.42	down	4.53	up	XLOC_l2_002171	AF086154
1.81	down	1.81	up	3.28	up	XLOC_l2_002761	
2.83	up	4.44	up	1.57	up	XLOC_l2_003293	XM_003119524
5.72	up	3.92	up	1.46	down	XLOC_l2_003293	XM_003119524
4.56	up	3.29	up	1.38	down	XLOC_l2_003293	XM_003119524
2.94	up	3.75	up	1.28	up	XLOC_l2_003293	XM_001715897
5.61	up	4.15	up	1.35	down	XLOC_l2_003293	
1.13	up	2.15	up	1.91	up	XLOC_l2_003627	
2.68	up	7.62	up	2.84	up	XLOC_l2_003881	
1.41	up	6.52	up	4.62	up	XLOC_l2_004315	
3.75	up	9.08	up	2.42	up	XLOC_l2_004317	CR620068
5.66	down	2.19	down	2.58	up	XLOC_l2_004562	
1.88	up	2.22	up	1.18	up	XLOC_l2_005179	
2.27	up	4.54	down	10.31	down	XLOC_l2_006021	DB117598
6.17	up	3.81	up	1.62	down	XLOC_l2_006152	
1.54	up	2.15	up	1.40	up	XLOC_l2_006152	AK311448
1.68	down	2.10	down	1.25	down	XLOC_l2_006595	
3.36	up	2.42	up	1.39	down	XLOC_l2_006745	
1.18	up	2.27	up	1.92	up	XLOC_l2_007449	
3.57	up	3.68	up	1.03	up	XLOC_l2_007478	
3.06	up	5.10	up	1.66	up	XLOC_l2_007478	
1.19	down	3.25	down	2.74	down	XLOC_l2_007928	
2.15	down	2.24	down	1.04	down	XLOC_l2_007928	
2.79	up	2.33	up	1.20	down	XLOC_l2_007931	

2.10	up	2.74	up	1.31	up	XLOC_l2_00 8151	
1.28	up	1.63	down	2.08	down	XLOC_l2_00 8203	
2.39	up	2.14	down	5.10	down	XLOC_l2_00 8910	BC039367
1.61	up	4.59	up	2.84	up	XLOC_l2_00 9136	
3.72	up	3.09	up	1.20	down	XLOC_l2_00 9273	AK127572
2.60	up	2.56	up	1.02	down	XLOC_l2_00 9273	AK127572
5.24	up	8.46	up	1.61	up	XLOC_l2_00 9301	
4.87	up	5.11	up	1.05	up	XLOC_l2_00 9316	
5.06	up	6.18	up	1.22	up	XLOC_l2_00 9668	
1.15	down	2.36	down	2.05	down	XLOC_l2_01 0139	
2.12	down	5.23	down	2.47	down	XLOC_l2_01 0141	DA697996
2.06	up	1.73	up	1.19	down	XLOC_l2_01 0239	
3.62	down	2.31	down	1.56	up	XLOC_l2_01 0267	
2.08	up	2.16	up	1.04	up	XLOC_l2_01 0558	
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18.37	up	8.46	up	2.17	down	XLOC_l2_01 1146	
1.38	down	2.26	down	1.64	down	XLOC_l2_01 1204	BX104493
1.50	down	2.22	down	1.48	down	XLOC_l2_01 1204	BX104493
1.18	down	2.13	down	1.80	down	XLOC_l2_01 1204	BX104493
1.25	up	2.00	up	1.60	up	XLOC_l2_01 1265	BU852287
2.31	up	2.79	up	1.21	up	XLOC_l2_01 1649	
1.36	up	2.10	up	1.54	up	XLOC_l2_01 2083	AL049987
3.03	down	3.06	down	1.01	down	XLOC_l2_01 2871	AL043857
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1.78	down	2.35	down	1.32	down	XLOC_l2_01	AJ606331

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2.64	down	2.46	down	1.07	up	XLOC_l2_01 3293	BQ441651
4.36	down	2.42	down	1.80	up	XLOC_l2_01 3293	BQ441651
5.22	down	3.24	down	1.61	up	XLOC_l2_01 3293	
3.43	up	4.14	up	1.20	up	XLOC_l2_01 3301	XR_108746
3.35	up	5.19	up	1.55	up	XLOC_l2_01 3301	XR_108746
3.20	up	3.89	up	1.21	up	XLOC_l2_01 3301	XR_108746
2.84	up	1.87	up	1.52	down	XLOC_l2_01 3485	
1.45	up	4.85	down	7.05	down	XLOC_l2_01 3530	BG192435
1.93	down	2.03	down	1.05	down	XLOC_l2_01 5907	
3.86	up	1.76	up	2.19	down	XLOC_l2_01 5950	
2.31	down	1.69	down	1.37	up	XPNPEP3	NM_00120482 7
2.17	up	1.93	up	1.13	down	XRCC1	NM_006297
3.06	up	2.26	up	1.36	down	XYLB	NM_005108
12.89	up	6.74	up	1.91	down	YBX2	NM_015982
1.55	up	2.37	up	1.53	up	YPEL1	NM_013313
1.36	down	2.24	down	1.65	down	YWHAZ	NM_145690
1.31	down	2.49	down	1.90	down	ZAK	NM_016653
1.77	up	2.52	up	1.42	up	ZBED3	NM_032367
2.46	up	1.15	up	2.14	down	ZBTB8A	NM_00104044 1
1.10	up	2.24	up	2.03	up	ZC3H12D	NM_207360
2.19	up	2.43	up	1.11	up	ZCWPW1	NM_017984
2.05	up	2.70	up	1.32	up	ZCWPW1	NM_017984
2.59	up	3.24	up	1.25	up	ZDHHC23	NM_173570
1.09	down	2.54	down	2.32	down	ZDHHC9	NM_016032
1.25	down	2.15	down	1.73	down	ZFAND3	NM_021943
2.42	up	2.69	up	1.12	up	ZFP14	NM_020917
1.91	up	2.88	up	1.51	up	ZFP3	NM_153018
1.50	up	2.21	up	1.47	up	ZFP62	NM_152283
1.13	up	2.26	up	2.01	up	ZFP62	NM_152283
1.54	down	2.54	down	1.65	down	ZFP64	NM_199427
47.55	up	3.03	up	15.70	down	ZFY	NM_003411
1.46	down	2.18	down	1.50	down	ZHX3	NM_015035
1.02	down	3.70	up	3.77	up	ZMAT1	NM_00101165

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1.13	up	4.17	up	3.69	up	ZMAT1	NM_00101165 7
1.82	up	2.15	up	1.18	up	ZMIZ2	NM_031449
3.67	down	7.74	down	2.11	down	ZNF114	NM_153608
1.92	down	2.39	down	1.25	down	ZNF134	NM_003435
2.32	down	2.90	down	1.25	down	ZNF134	NM_003435
1.82	up	2.19	up	1.20	up	ZNF248	NM_021045
2.18	down	1.31	down	1.66	up	ZNF254	NM_203282
2.10	down	1.46	down	1.43	up	ZNF254	NM_203282
2.60	up	1.11	down	2.89	down	ZNF284	NM_00103781 3
2.38	up	2.45	up	1.03	up	ZNF300	NM_052860
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3.68	up	2.78	up	1.32	down	ZNF367	NM_153695
2.51	up	2.35	up	1.07	down	ZNF367	NM_153695
4.06	down	1.75	down	2.32	up	ZNF385D	NM_024697
2.24	up	1.74	up	1.28	down	ZNF397	NM_032347
2.59	up	1.54	up	1.68	down	ZNF473	NM_015428
1.70	up	2.04	up	1.20	up	ZNF512	NM_032434
5.01	up	2.23	up	2.25	down	ZNF519	NM_145287
1.24	up	4.74	up	3.84	up	ZNF540	NM_152606
21.93	up	49.12	up	2.24	up	ZNF541	NM_00110141 9
2.14	down	2.01	down	1.06	up	ZNF608	NM_020747
1.35	up	2.06	up	1.52	up	ZNF620	NM_175888
1.58	up	1.44	down	2.27	down	ZNF623	NM_00108248 0
1.92	down	2.34	down	1.22	down	ZNF655	NM_024061
4.01	down	2.27	down	1.77	up	ZNF726	BC046415
1.83	down	2.16	down	1.18	down	ZNF773	NM_198542
2.57	down	2.25	down	1.14	up	ZNF788	NR_027049
2.38	up	1.49	up	1.60	down	ZNF827	NM_178835
1.48	up	2.39	up	1.61	up	ZNF862	NM_00109922 0
2.07	up	3.51	up	1.70	up	ZNF879	NM_00113611 6
1.91	down	4.64	down	2.44	down	ZP1	NM_207341
2.42	up	1.96	up	1.24	down	ZWINT	NM_032997
27.32	up	9.17	up	2.98	down	ZYG11A	NM_00100433 9
3.22	down	7.20	down	2.24	down		XM_00311890 9
1.62	up	3.26	up	2.01	up		BC034587
1.62	up	3.94	up	2.43	up		AJ312027
4.47	up	3.63	up	1.23	down		XR_109724
8.57	up	6.91	up	1.24	down		AK129565

2.92	up	2.10	up	1.39	down		BC119676
2.09	up	2.10	up	1.00	up		CR737729
1.60	down	2.36	up	3.77	up		AY312959
1.23	up	2.94	up	2.39	up		CR594811
1.08	up	2.86	down	3.09	down		DR007930
1.55	down	5.73	up	8.90	up		GQ232939
1.10	up	1.84	down	2.03	down		XR_110878
4.43	up	2.24	up	1.98	down		AF461897
1.12	up	5.39	up	4.79	up		JF810271
2.01	up	1.67	up	1.21	down		XR_109661
3.67	down	3.00	down	1.22	up		BC034319
1.33	up	1.68	down	2.24	down		CU677870
2.23	up	5.67	up	2.54	up		AJ312026
1.35	up	1.77	down	2.39	down		XR_109904
1.20	down	2.11	up	2.54	up		AK129975
2.95	up	4.52	up	1.53	up		BC069683
1.98	up	4.60	up	2.33	up		DA110513
2.23	up	1.30	up	1.71	down		XR_133123
1.78	up	2.65	up	1.49	up		BC044655
6.67	up	3.98	up	1.67	down		AK027667
3.07	down	1.83	down	1.68	up		BC104424
3.81	down	1.42	down	2.68	up		BF216856
6.96	up	5.34	up	1.30	down		AL832737
1.01	down	2.49	up	2.52	up		AK096443
1.03	down	2.91	up	2.99	up		X58736
6.29	up	4.04	up	1.55	down		XM_003119524
1.12	up	1.85	down	2.07	down		DM107643
3.73	down	3.14	down	1.19	up		BC034319
14.19	up	8.64	up	1.64	down		AF452715
1.00	down	2.17	down	2.17	down		XR_132519
1.24	up	5.72	up	4.62	up		XM_003403666
4.08	down	3.11	down	1.31	up		BC034319
1.37	down	3.31	up	4.53	up		BC043411
1.33	up	2.45	up	1.85	up		AK057820
3.06	up	2.38	up	1.28	down		AY203941
1.72	up	3.75	up	2.18	up		AL389942
1.30	up	7.94	up	6.09	up		Z18824
2.69	up	3.87	up	1.44	up		AK129520
2.47	down	1.25	down	1.98	up		BC039399
1.03	down	7.76	up	8.01	up		XM_002346274
4.44	up	7.76	up	1.75	up		AF289562
3.64	down	3.81	down	1.05	down		L19779
2.56	down	5.01	down	1.95	down		BC073826
3.12	up	1.88	up	1.66	down		AK127966
7.59	up	4.55	up	1.67	down		XR_111273

4.66	down	1.08	down	4.33	up		BC038366
9.80	up	8.09	up	1.21	down		AK094554
3.16	up	3.25	up	1.03	up		AY129018
1.89	up	7.71	up	4.08	up		AF119797
2.22	up	2.07	up	1.07	down		AK096917
2.58	down	3.02	down	1.17	down		AF400227
1.70	down	5.09	down	2.99	down		BM457408

Appendix C - DEG HPV-Inactive vs HPV-Negative

Table C.1: AA and EA HPV-Inactive vs HPV-Negative Tumors - KW - p0.02 FC2

AA - HPV Inact vs AA - HPV Neg		AA - HPV Inact vs EA - HPV Inact		AA - HPV Inact vs EA - HPV Neg		AA - HPV Neg vs EA - HPV Inact		AA - HPV Neg vs EA - HPV Neg		EA - HPV Inact vs EA - HPV Neg		Gene Symbol	Genbank Accession
FC (Abs)	**Direction of change**	**FC (Abs)**	**Direction of change**	**FC (Abs)**	**Direction of change**	**FC (Abs)**	**Direction of change**	**FC (Abs)**	**Direction of change**	**FC (Abs)**	**Direction of change**		
1.65	down	3.00	down	3.25	down	1.81	down	1.96	down	1.08	down	ABHD2	NM_007011
1.73	down	2.91	down	1.87	down	1.69	down	1.08	down	1.56	up	ADAL	NM_001012969
1.13	up	2.37	down	1.15	down	2.68	down	1.30	down	2.06	up	ADAM28	NM_021777
2.74	up	2.02	down	3.23	up	5.54	down	1.18	up	6.53	up	ADIPOQ	NM_004797
2.29	down	1.45	down	1.55	up	1.58	up	3.55	up	2.25	up	ALDH7A1	NM_001182
1.89	down	1.76	down	1.54	up	1.08	up	2.91	up	2.70	up	ALDH7A1	NM_001182
1.45	up	1.75	up	2.24	up	1.21	up	1.54	up	1.28	up	ANKRD43	NM_175873
2.39	down	10.85	down	1.93	down	4.55	down	1.23	up	5.61	up	AOX1	NM_001159
1.37	up	1.19	down	1.57	down	1.64	down	2.15	down	1.31	down	ARHGAP1	NM_004308
2.69	down	1.40	down	1.14	down	1.93	up	2.35	up	1.22	up	ATG4C	NM_032852

2.11	down	1.93	down	3.48	down	1.09	up	1.65	down	1.80	down	ATP2B4	NM_001684
1.75	down	2.10	down	2.36	down	1.20	down	1.35	down	1.12	down	ATP2B4	NM_001001396
2.01	down	1.23	down	2.95	down	1.64	up	1.47	down	2.41	down	ATP2B4	NM_001001396
1.56	up	1.02	down	2.03	down	1.60	down	3.18	down	1.98	down	ATP9A	NM_006045
1.24	down	1.20	down	2.31	down	1.03	up	1.87	down	1.93	down	ATXN1	NM_000332
1.43	up	1.49	down	1.80	down	2.14	down	2.59	down	1.21	down	AVIL	NM_006576
1.94	up	6.01	up	1.01	up	3.09	up	1.93	down	5.97	down	BAIAP2L1	NM_018842
1.35	down	1.77	up	1.10	down	2.38	up	1.22	up	1.95	down	BANF1	NM_003860
1.36	up	1.14	up	1.69	down	1.20	down	2.30	down	1.92	down	BCAS3	NM_017679
2.10	down	1.57	down	1.14	down	1.34	up	1.84	up	1.38	up	BCL2A1	NM_004049
1.90	down	1.73	down	2.15	down	1.10	up	1.13	down	1.24	down	BMS1	NM_014753
1.87	down	1.57	down	2.01	down	1.19	up	1.08	down	1.28	down	BMS1	NM_014753
1.98	down	2.06	down	1.49	down	1.04	down	1.33	up	1.38	up	BNIP2	AK125533
2.28	down	3.65	down	5.74	down	1.60	down	2.52	down	1.57	down	BREA2	NR_015445
2.64	up	2.28	up	1.10	up	1.16	down	2.40	down	2.07	down	C10orf114	NM_001010911
1.22	down	2.25	up	1.59	up	2.75	up	1.95	up	1.41	down	C10orf120	NM_001010912
1.37	down	2.64	down	5.98	down	1.93	down	4.37	down	2.27	down	C11orf70	NM_001195005

1.65	down	2.01	down	3.18	down	1.22	down	1.93	down	1.58	down	C14orf45	NM_025057
1.78	down	2.08	down	1.18	down	1.17	down	1.51	up	1.77	up	C15orf57	NM_052849
1.38	down	1.85	down	2.70	down	1.33	down	1.95	down	1.46	down	C17orf100	NM_0011055520
1.50	up	1.64	up	3.82	up	1.09	up	2.55	up	2.33	up	C17orf105	NM_0011136483
1.14	down	2.94	down	1.83	down	2.58	down	1.60	down	1.61	up	C18orf18	NR_026849
1.54	up	1.80	up	2.34	up	1.17	up	1.52	up	1.30	up	C1orf140	NR_024236
2.13	down	4.29	up	1.30	up	9.13	up	2.76	up	3.31	down	C1orf210	NM_182517
1.19	up	1.16	down	1.76	down	1.38	down	2.10	down	1.52	down	C20orf108	NM_080821
6.15	down	9.77	down	4.17	down	1.59	down	1.48	up	2.35	up	C20orf26	NM_015585
1.17	up	1.79	up	2.48	up	1.53	up	2.12	up	1.38	up	C21orf33	
2.03	up	2.34	up	1.33	down	1.15	up	2.71	down	3.12	down	C4orf26	NM_178497
2.29	down	1.56	down	1.10	down	1.46	up	2.09	up	1.43	up	C5orf44	NR_003545
2.15	down	4.22	down	2.12	down	1.96	down	1.02	up	1.99	up	CATSPER2	NM_172095
1.17	up	1.08	down	2.51	down	1.27	down	2.95	down	2.31	down	CCDC40	NM_0012433342
2.38	down	4.01	down	1.24	down	1.69	down	1.91	up	3.23	up	CCDC69	NM_015621
1.48	down	4.51	down	1.10	down	3.05	down	1.34	up	4.11	up	CD1B	NM_001764
5.79	up	1.03	up	7.61	up	5.65	down	1.31	up	7.41	up	CD36	NM_0011001547

2.27	down	7.41	down	3.33	down	3.27	down	1.47	down	2.22	up	CEACAM21	NM_033543
2.25	down	1.70	down	1.77	down	1.32	up	1.27	up	1.04	down	CGRRF1	NM_006568
1.63	up	2.13	up	1.09	down	1.31	up	1.77	down	2.32	down	CKAP4	NM_006825
1.95	down	1.11	up	2.34	down	2.16	up	1.20	down	2.59	down	CLDN12	NM_012129
2.83	up	2.26	down	3.31	up	6.39	down	1.17	up	7.49	up	CLEC3B	NM_003278
4.79	down	4.83	down	2.09	down	1.01	down	2.29	up	2.31	up	CLEC4A	NM_016184
5.68	down	11.18	down	2.12	down	1.97	down	2.68	up	5.29	up	CLEC9A	NM_207345
1.02	up	1.49	up	1.64	down	1.46	up	1.68	down	2.44	down	CLIC4	NM_013943
1.44	down	1.32	down	2.29	down	1.09	up	1.59	down	1.73	down	CLIC4	NM_013943
1.02	down	1.12	up	2.97	down	1.14	up	2.91	down	3.31	down	COL27A1	BC007696
1.18	up	1.17	up	1.99	down	1.01	down	2.35	down	2.33	down	COL27A1	AK021957
1.05	down	1.24	down	2.06	up	1.18	down	2.16	up	2.55	up	CPA5	NM_001127442
2.36	up	1.30	up	1.79	up	1.82	down	1.32	down	1.38	up	CRIP1	AB527908
1.16	up	3.40	up	3.43	up	2.94	up	2.96	up	1.01	up	CRYBB2	NM_000496
1.14	up	2.96	up	3.22	up	2.59	up	2.82	up	1.09	up	CRYBB2P1	NR_033734
4.29	up	2.29	up	3.45	up	1.87	down	1.24	down	1.51	up	CXCL12	NM_001033886
3.35	down	1.92	down	1.43	down	1.74	up	2.35	up	1.35	up	CYB5RL	BC071735
1.23	up	6.27	down	3.12	down	7.70	down	3.83	down	2.01	up	DIO3OS	NR_00277

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2.88	up	6.36	up	1.76	down	2.21	up	5.08	down	11.22	down	DNAH17	
2.82	down	3.33	down	2.23	up	1.18	down	6.28	up	7.42	up	DNASE1L3	NM_004944
1.30	up	3.15	up	1.70	up	2.42	up	1.30	up	1.85	down	DOK7	AK075037
1.37	up	1.49	up	2.28	up	1.09	up	1.66	up	1.52	up	EFCAB4A	NM_173584
1.18	down	1.50	up	1.44	down	1.77	up	1.22	down	2.16	down	EIF2C2	NM_012154
1.81	up	2.67	up	1.25	down	1.48	up	2.25	down	3.33	down	EIF4EBP1	NM_004095
5.75	up	3.65	up	1.02	up	1.58	down	5.64	down	3.58	down	ENKUR	NM_145010
1.98	down	7.37	down	2.05	down	3.72	down	1.04	down	3.59	up	ENPP3	NM_005021
1.54	up	2.38	up	1.04	up	1.54	up	1.48	down	2.28	down	ERC1	NM_178040
2.77	up	3.88	up	1.18	up	1.40	up	2.35	down	3.29	down	ERVMER34-1	NM_024534
1.57	down	1.16	up	2.03	down	1.83	up	1.29	down	2.36	down	EXD2	NM_018199
1.52	up	1.64	up	1.23	down	1.08	up	1.87	down	2.02	down	F11R	NM_016946
1.65	up	1.51	up	1.62	down	1.09	down	2.66	down	2.44	down	FAM114A1	NM_138389
6.40	down	9.87	down	2.87	down	1.54	down	2.23	up	3.44	up	FAM65B	NM_015864
1.41	down	2.38	down	1.33	down	1.68	down	1.06	up	1.79	up	FAM82A1	NM_144713
2.30	up	1.18	up	1.20	down	1.95	down	2.75	down	1.41	down	FAM87B	XR_112085
2.54	down	2.02	down	1.53	down	1.26	up	1.66	up	1.32	up	FAR1	NM_032228

1.24	up	1.66	up	2.53	down	1.34	up	3.14	down	4.21	down	FAT1	NM_005245
6.27	up	4.22	up	3.21	up	1.49	down	1.95	down	1.31	down	FBLL1	NR_024356
1.18	up	2.42	up	1.55	up	2.06	up	1.32	up	1.56	down	FBXO22-AS1	NR_003136
1.39	up	1.05	down	1.57	down	1.46	down	2.18	down	1.49	down	FLJ20021	NR_033874
1.27	down	1.74	down	1.30	up	1.37	down	1.64	up	2.26	up	FLJ33630	NR_015360
1.11	up	1.98	down	1.48	down	2.20	down	1.64	down	1.34	up	FLJ37453	NR_024279
1.03	down	2.85	down	1.44	down	2.76	down	1.39	down	1.98	up	FLJ39639	NR_033904
4.44	down	7.17	down	5.14	down	1.62	down	1.16	down	1.39	up	FLJ43663	NR_015431
1.09	down	1.87	down	2.57	down	1.71	down	2.35	down	1.37	down	FRG1B	BC095491
2.06	down	1.28	up	1.25	down	2.64	up	1.65	up	1.60	down	GEMIN2	NM_003616
2.33	down	3.78	down	1.04	down	1.63	down	2.24	up	3.64	up	GFRA2	NM_001495
1.46	up	2.76	up	3.26	up	1.89	up	2.24	up	1.18	up	GNASAS	
1.06	up	1.41	up	1.47	down	1.32	up	1.56	down	2.07	down	GPR172A	NM_024531
2.33	down	1.77	down	1.50	down	1.32	up	1.55	up	1.18	up	GTF2H2D	NM_001042490
2.15	up	2.71	up	3.40	up	1.26	up	1.58	up	1.26	up	HAGHL	NM_032304
1.88	down	1.52	down	2.60	down	1.23	up	1.39	down	1.71	down	HCFC1	NM_005334
2.04	up	1.62	up	1.21	up	1.26	down	1.69	down	1.34	down	HGSNAT	NM_152419

2.13	up	1.37	up	1.22	down	1.55	down	2.59	down	1.67	down	HGSNAT	NM_152419
2.42	down	4.03	down	1.20	down	1.67	down	2.02	up	3.37	up	HHEX	NM_002729
2.72	up	7.52	up	2.54	up	2.77	up	1.07	down	2.96	down	HK2	NM_000189
1.49	down	2.22	down	2.44	down	1.49	down	1.63	down	1.10	down	HMBOX1	NM_024567
1.00	up	1.37	up	2.05	down	1.37	up	2.05	down	2.80	down	HOMER3	NM_001145722
1.32	up	2.11	up	2.59	up	1.60	up	1.96	up	1.22	up	HOPX	NM_001145460
11.11	up	4.65	up	2.53	up	2.39	down	4.38	down	1.83	down	HORMAD1	NM_032132
7.61	up	2.86	up	3.22	up	2.66	down	2.37	down	1.13	up	HOXA4	NM_002141
1.50	up	1.95	up	2.07	up	1.30	up	1.38	up	1.06	up	HSPB9	NM_033194
1.67	up	2.14	up	1.26	up	1.28	up	1.32	down	1.69	down	HSPG2	NM_005529
1.00	down	2.06	down	2.36	down	2.05	down	2.35	down	1.15	down	HTATSF1P2	BX648511
1.03	up	1.22	down	5.02	down	1.26	down	5.17	down	4.11	down	IBSP	NM_004967
1.49	up	1.45	up	1.41	down	1.03	down	2.10	down	2.04	down	IER5L	NM_203434
1.21	up	2.05	up	1.89	up	1.70	up	1.57	up	1.08	down	IGF2-AS	NR_028044
6.37	down	1.53	up	1.53	down	9.76	up	4.16	up	2.35	down	IL1R2	NM_004633
3.62	down	8.28	down	1.91	down	2.29	down	1.89	up	4.32	up	IL22RA2	NM_052962
2.41	down	1.09	down	1.97	down	2.21	up	1.22	up	1.81	down	INTS6	NM_01214

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1.61	up	8.96	up	1.03	down	5.57	up	1.66	down	9.24	down	IRF6	NM_006147
1.41	up	1.61	up	1.35	down	1.14	up	1.90	down	2.17	down	IRGQ	NM_001007561
1.78	down	2.39	down	2.35	down	1.34	down	1.32	down	1.01	up	ITGB1BP2	NM_012278
1.94	up	1.29	up	3.22	up	1.51	down	1.66	up	2.51	up	JPH4	BC109228
4.16	down	4.84	down	2.28	down	1.16	down	1.82	up	2.12	up	KBTBD8	NM_032505
2.45	up	4.36	up	2.25	up	1.78	up	1.09	down	1.94	down	KDM4B	NM_015015
1.03	up	1.13	up	1.98	down	1.11	up	2.03	down	2.24	down	KDM5B	NM_006618
2.06	down	2.62	down	4.01	down	1.27	down	1.94	down	1.53	down	KIAA0319L	AB058740
1.55	down	1.75	down	2.29	down	1.13	down	1.48	down	1.31	down	KIAA0556	NM_015202
1.42	up	1.88	up	2.41	down	1.32	up	3.43	down	4.54	down	KIAA1549	NM_001164665
1.48	up	1.48	up	2.15	up	1.00	up	1.45	up	1.45	up	KLRG2	NM_198508
1.67	up	2.43	up	1.20	up	1.45	up	1.39	down	2.03	down	KREMEN1	NM_001039570
1.44	up	1.33	up	1.84	down	1.08	down	2.65	down	2.46	down	LARP6	NM_018357
1.96	down	8.20	down	1.51	down	4.17	down	1.30	up	5.42	up	LDLRAD2	NM_001013693
5.41	up	2.48	up	1.05	down	2.18	down	5.68	down	2.60	down	LIF	NM_002309
1.60	up	1.26	up	2.12	down	1.28	down	3.40	down	2.67	down	LINC00174	NR_026873
1.81	up	6.67	up	1.37	up	3.68	up	1.32	down	4.87	down	LOC100	NR_03648

												128881	0
1.53	up	1.48	up	2.17	up	1.03	down	1.42	up	1.46	up	LOC100 130741	AK127222
4.49	up	1.70	down	1.33	up	7.64	down	3.39	down	2.26	up	LOC100 240735	NR_02665 8
1.66	up	2.38	up	3.67	up	1.43	up	2.21	up	1.54	up	LOC100 289079	XM_00234 4448
1.17	up	2.14	down	1.69	down	2.50	down	1.98	down	1.26	up	LOC100 289097	XM_00234 3891
1.10	down	2.29	down	1.43	down	2.08	down	1.30	down	1.60	up	LOC100 505495	NR_04010 9
1.02	down	2.96	down	1.86	down	2.91	down	1.82	down	1.59	up	LOC100 505495	NR_04010 9
4.63	down	78.65	down	49.21	down	16.99	down	10.63	down	1.60	up	LOC100 505495	NR_04010 9
1.13	down	2.48	down	1.50	down	2.19	down	1.32	down	1.65	up	LOC100 505495	NR_04010 9
1.80	up	2.31	up	2.34	up	1.28	up	1.30	up	1.01	up	LOC100 505657	XM_00311 8895
2.75	down	1.75	down	1.55	down	1.57	up	1.77	up	1.13	up	LOC100 505681	NR_03845 2
1.75	down	1.09	down	6.01	down	1.60	up	3.43	down	5.50	down	LOC100 505912	NR_03787 7
1.06	down	1.55	down	2.03	down	1.47	down	1.91	down	1.30	down	LOC100 506075	XR_10970 6
9.33	down	1.05	down	5.63	down	8.87	up	1.66	up	5.35	down	LOC100 506328	AK055877
6.89	down	1.11	down	3.25	down	6.23	up	2.12	up	2.94	down	LOC100 506328	AK055877
1.12	down	2.71	down	2.19	down	2.43	down	1.96	down	1.24	up	LOC100 506342	XR_10886 2
1.06	up	1.94	down	3.07	down	2.06	down	3.26	down	1.58	down	LOC100 506451	AK090817

1.01	down	2.14	down	1.91	down	2.12	down	1.89	down	1.12	up	LOC100 506516	XR_10876 3
1.30	down	2.80	down	2.10	down	2.16	down	1.62	down	1.33	up	LOC100 506990	NR_04009 2
3.16	up	2.48	up	3.18	up	1.27	down	1.01	up	1.28	up	LOC100 507055	BX379759
5.58	up	1.20	up	1.06	up	4.64	down	5.25	down	1.13	down	LOC100 507150	XR_10853 6
2.76	down	10.56	down	3.66	down	3.82	down	1.32	down	2.89	up	LOC100 507307	XR_10995 2
1.83	up	1.21	down	1.99	down	2.22	down	3.64	down	1.64	down	LOC100 507460	XR_10989 4
1.61	up	1.77	up	2.36	up	1.10	up	1.47	up	1.33	up	LOC100 507558	XR_10878 6
1.77	down	3.64	down	2.58	down	2.06	down	1.46	down	1.41	up	LOC100 507602	XR_11008 1
1.58	up	2.10	up	1.96	up	1.33	up	1.24	up	1.07	down	LOC100 509196	XM_00311 9833
1.09	up	1.79	up	2.28	up	1.65	up	2.10	up	1.27	up	LOC100 652730	XR_13267 0
1.40	up	2.16	up	1.89	up	1.55	up	1.36	up	1.14	down	LOC100 652807	XM_00340 3510
1.51	down	1.44	up	1.02	up	2.17	up	1.53	up	1.42	down	LOC100 652895	XR_13273 9
1.05	down	4.16	down	1.33	down	3.97	down	1.26	down	3.14	up	LOC100 652951	XR_13288 8
1.69	down	3.37	down	1.29	down	2.00	down	1.31	up	2.62	up	LOC145 820	NR_02713 2
2.05	down	1.02	up	2.24	up	2.08	up	4.59	up	2.20	up	LOC219 347	NR_02742 8
2.81	up	1.87	down	1.29	down	5.25	down	3.63	down	1.45	up	LOC283 861	AK098143
1.24	up	2.86	up	1.97	up	2.31	up	1.59	up	1.45	down	LOC388	NR_02724

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1.22	up	2.61	up	2.02	up	2.14	up	1.65	up	1.29	down	LOC388 796	NR_01536 6
1.19	up	1.21	down	1.81	up	1.43	down	1.53	up	2.19	up	LOC400 499	XM_00311 8689
1.59	up	3.74	down	1.68	down	5.94	down	2.67	down	2.22	up	LOC441 204	NR_01536 4
2.71	up	2.07	up	3.27	up	1.31	down	1.21	up	1.58	up	LOC497 257	BC030211
1.57	up	3.36	up	3.16	up	2.14	up	2.01	up	1.06	down	LOC511 45	XR_10899 7
1.47	down	1.49	down	2.66	down	1.01	down	1.81	down	1.79	down	LOC541 471	NR_01539 5
1.02	up	1.04	down	1.97	down	1.06	down	2.02	down	1.89	down	LOC541 471	NR_01539 5
1.23	up	2.28	up	1.85	up	1.85	up	1.51	up	1.23	down	LOC643 529	NR_03838 2
1.79	up	2.79	up	1.73	up	1.56	up	1.04	down	1.62	down	LOC644 242	NR_03654 0
1.11	up	2.14	down	1.51	down	2.38	down	1.68	down	1.42	up	LOC728 903	AK093722
1.52	up	1.51	down	1.20	down	2.29	down	1.83	down	1.26	up	LOC729 013	NR_03413 7
9.30	up	8.15	up	1.15	up	1.14	down	8.09	down	7.09	down	LOC729 444	NR_03838 8
1.74	up	1.28	down	1.06	down	2.22	down	1.85	down	1.20	up	LOC729 887	BC052334
1.19	down	2.02	down	2.31	down	1.69	down	1.93	down	1.14	down	LOC907 84	NR_02698 4
2.17	down	1.38	down	2.15	down	1.57	up	1.01	up	1.56	down	LRRC42	
1.96	up	3.45	up	3.11	up	1.76	up	1.58	up	1.11	down	LRRC72	NM_00119 5280
1.61	up	1.56	up	2.09	up	1.03	down	1.30	up	1.34	up	LTBP4	NM_00104

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4.75	down	16.54	down	6.08	down	3.49	down	1.28	down	2.72	up	LY75	NM_002349
1.21	down	1.95	down	1.33	up	1.61	down	1.61	up	2.58	up	LYSMD2	NM_153374
4.07	up	2.09	up	2.09	up	1.94	down	1.95	down	1.00	down	MAGI2	NM_012301
1.79	down	4.33	down	3.45	down	2.42	down	1.93	down	1.25	up	MAN1B1	CR749534
1.76	down	2.75	down	1.42	down	1.57	down	1.23	up	1.94	up	MAP3K8	NM_005204
1.79	down	2.25	down	1.34	down	1.26	down	1.34	up	1.68	up	MBLAC2	NM_203406
1.53	up	1.22	down	2.47	down	1.86	down	3.79	down	2.03	down	MCOLN3	BC060765
3.06	down	6.32	down	4.39	down	2.07	down	1.44	down	1.44	up	MIAT	NR_003491
1.02	down	1.52	up	2.30	down	1.56	up	2.24	down	3.50	down	MN1	NM_002430
1.57	up	2.07	up	1.76	up	1.32	up	1.12	up	1.18	down	MPND	NM_032868
9.82	down	####	down	16.92	down	16.15	down	1.72	down	9.37	up	MYBPC2	NM_004533
1.63	down	2.41	down	1.13	down	1.48	down	1.44	up	2.13	up	MYCBP2	NM_015057
1.69	up	3.26	up	6.37	up	1.93	up	3.76	up	1.95	up	MZT2A	
1.68	down	3.13	down	2.01	down	1.86	down	1.20	down	1.56	up	N4BP2L2	NM_033111
1.40	down	2.07	down	1.13	down	1.48	down	1.24	up	1.83	up	N4BP2L2	NM_014887
1.37	down	2.44	down	1.71	up	1.78	down	2.35	up	4.18	up	NCR3	NM_001145467
1.07	down	1.64	down	2.27	down	1.53	down	2.13	down	1.39	down	ND4L	AK311996

1.23	down	2.26	down	4.23	down	1.84	down	3.45	down	1.87	down	NEK10	AK057247
1.52	up	2.32	up	1.80	up	1.52	up	1.18	up	1.29	down	NHLRC1	NM_198586
1.02	up	1.39	down	2.32	down	1.42	down	2.37	down	1.67	down	NME7	NM_013330
1.14	down	1.75	down	1.52	up	1.54	down	1.73	up	2.66	up	NOSTRIN	NM_052946
1.91	down	2.04	down	1.14	up	1.07	down	2.18	up	2.33	up	NPHS1	NM_004646
1.04	up	2.41	up	1.86	up	2.31	up	1.78	up	1.29	down	NQO2	NM_000904
1.02	up	1.05	down	2.41	down	1.08	down	2.46	down	2.29	down	NRP2	NM_201264
1.02	down	1.39	up	1.95	down	1.42	up	1.92	down	2.72	down	NRP2	NM_201266
1.28	down	1.20	up	2.26	down	1.54	up	1.76	down	2.72	down	NT5DC3	NM_001031701
1.28	up	2.06	up	1.36	up	1.61	up	1.07	up	1.51	down	OBP2B	NM_014581
1.22	up	2.62	down	1.54	down	3.19	down	1.87	down	1.71	up	OGT	NM_181672
1.74	up	2.16	up	2.77	up	1.24	up	1.59	up	1.28	up	OR10G8	NM_001004464
1.85	up	2.07	up	2.83	up	1.12	up	1.53	up	1.36	up	OR1K1	NM_080859
4.17	down	3.47	down	4.32	down	1.20	up	1.04	down	1.25	down	PAFAH1B2	NM_001184746
1.85	up	1.67	up	1.38	down	1.10	down	2.54	down	2.31	down	PALLD	NM_001166109
1.42	up	1.91	up	1.18	down	1.34	up	1.68	down	2.25	down	PAWR	NM_002583
1.03	up	2.07	up	1.83	up	2.01	up	1.78	up	1.13	down	PCDHGC4	NM_032406

2.27	down	3.64	down	5.05	down	1.60	down	2.23	down	1.39	down	PER3	NM_016831
1.77	up	1.28	down	1.48	up	2.27	down	1.19	down	1.90	up	PGM5	NM_021965
1.76	down	1.14	up	1.29	down	2.00	up	1.36	up	1.48	down	PHF23	NM_024297
4.43	up	12.36	down	9.65	down	54.75	down	42.74	down	1.28	up	PIGR	NM_002644
1.36	up	1.43	up	2.17	up	1.05	up	1.60	up	1.52	up	PKD1	NM_000296
1.67	down	3.14	down	2.07	down	1.88	down	1.24	down	1.52	up	PKIG	NM_181805
1.01	up	1.18	up	2.01	down	1.17	up	2.03	down	2.38	down	PLEC	NM_201380
1.05	down	1.32	up	1.87	down	1.38	up	1.78	down	2.46	down	PLEKHG3	NM_015549
1.66	down	6.66	down	3.02	down	4.02	down	1.82	down	2.21	up	PLGLB1	NM_001032392
1.76	up	1.18	down	1.35	up	2.08	down	1.30	down	1.60	up	PLSCR4	NM_020353
2.26	down	1.73	down	2.66	down	1.30	up	1.18	down	1.54	down	PNMA1	NM_006029
1.14	up	4.38	up	2.03	up	3.83	up	1.78	up	2.16	down	POLR1A	NM_015425
1.60	down	1.94	down	2.58	down	1.21	down	1.61	down	1.33	down	POU5F1	NM_002701
2.40	down	1.75	down	1.81	down	1.37	up	1.33	up	1.03	down	PRDX3	NM_006793
1.86	up	1.60	up	2.75	up	1.16	down	1.48	up	1.72	up	psiTPTE22	AK226145
1.41	down	5.82	up	3.74	up	8.18	up	5.26	up	1.55	down	PSPH	NM_004577
1.87	down	2.06	down	1.45	down	1.10	down	1.29	up	1.42	up	PTP4A2	NM_08039

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1.39	up	1.76	down	2.19	up	2.45	down	1.57	up	3.86	up	PTPRN2	NM_00284 7
4.66	down	13.29	down	2.53	down	2.85	down	1.84	up	5.26	up	PYGM	NM_00560 9
1.19	down	3.00	down	1.10	up	2.53	down	1.30	up	3.29	up	Q6TXI9	
2.07	down	1.69	down	1.57	down	1.22	up	1.31	up	1.07	up	QRSL1	NM_01829 2
2.40	up	1.12	up	1.42	up	2.15	down	1.69	down	1.28	up	RADIL	NM_01805 9
1.38	up	2.39	up	2.72	up	1.73	up	1.97	up	1.14	up	RASGEF 1C	NM_17506 2
2.03	down	4.05	down	1.04	down	1.99	down	1.95	up	3.88	up	RASGRP 2	NM_15381 9
2.33	down	4.12	down	1.10	down	1.77	down	2.12	up	3.75	up	RASGRP 2	NM_15381 9
2.41	down	2.13	down	1.69	down	1.13	up	1.42	up	1.26	up	RB1	NM_00032 1
1.27	down	2.11	down	1.50	down	1.66	down	1.18	down	1.41	up	RBM5	NM_00577 8
1.38	up	2.08	down	1.87	down	2.86	down	2.58	down	1.11	up	RBPMS	AK057533
1.72	up	2.01	up	1.20	up	1.17	up	1.44	down	1.68	down	RFX8	NM_00114 5664
1.55	down	1.71	up	1.67	down	2.66	up	1.07	down	2.86	down	RGNEF	NM_00117 7693
2.13	down	2.04	up	1.90	down	4.34	up	1.12	up	3.87	down	RGNEF	NM_00117 7693
3.18	down	4.02	down	1.65	down	1.26	down	1.93	up	2.44	up	RGS18	NM_13078 2
2.31	down	4.37	down	2.01	down	1.89	down	1.15	up	2.17	up	RGS3	NM_01779 0
1.18	down	2.04	down	2.14	down	1.73	down	1.81	down	1.05	down	RN18S1	NR_00328 6

3.08	down	5.59	down	1.68	down	1.81	down	1.84	up	3.34	up	RNF125	NM_017831
2.46	down	1.84	down	1.88	down	1.34	up	1.31	up	1.02	down	RNF6	NM_005977
2.44	down	4.38	down	1.95	down	1.80	down	1.25	up	2.24	up	RPGR	NM_001034853
1.37	up	1.32	up	2.52	up	1.04	down	1.84	up	1.91	up	RPS26	NM_001029
1.13	up	2.64	up	1.39	down	2.33	up	1.58	down	3.68	down	RTKN	NM_033046
1.60	up	1.68	up	2.39	up	1.05	up	1.50	up	1.42	up	S100A5	NM_002962
1.63	down	2.19	down	1.43	down	1.34	down	1.14	up	1.54	up	SACM1L	NM_014016
1.31	up	2.79	up	1.98	up	2.13	up	1.51	up	1.41	down	SACS-AS1	XR_110106
1.01	down	1.65	up	1.27	down	1.66	up	1.27	down	2.10	down	SAMD1	NM_138352
4.44	down	4.49	down	2.53	down	1.01	down	1.75	up	1.77	up	SAMSN1	NM_022136
1.26	down	2.99	down	1.16	up	2.37	down	1.46	up	3.46	up	SCARNA16	NR_003013
1.28	down	2.92	down	1.11	up	2.28	down	1.42	up	3.24	up	SCARNA16	NR_003013
2.12	down	1.04	down	2.96	down	2.03	up	1.40	down	2.85	down	SDC4	NM_002999
1.70	down	2.07	down	2.78	down	1.22	down	1.64	down	1.35	down	SEC62	NM_003262
3.15	down	4.40	down	1.45	down	1.40	down	2.16	up	3.03	up	SERPINB9	NM_004155
2.14	up	1.69	up	2.17	up	1.27	down	1.02	up	1.29	up	SETMAR	NM_006515
1.47	down	1.50	up	1.52	up	2.20	up	2.23	up	1.01	up	SHMT1	NM_00416

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1.70	up	2.45	up	2.40	up	1.45	up	1.42	up	1.02	down	SHOX	NM_006883
1.07	up	4.74	down	2.35	down	5.08	down	2.52	down	2.01	up	SIGLECP3	NR_002804
2.91	up	1.13	up	1.37	down	2.57	down	3.99	down	1.55	down	SIX5	NM_175875
1.49	up	2.03	up	1.36	up	1.36	up	1.10	down	1.49	down	SLC25A1	NM_005984
1.47	down	3.60	down	2.75	down	2.45	down	1.88	down	1.31	up	SLC25A27	NM_004277
8.44	down	2.27	down	1.56	down	3.72	up	5.41	up	1.45	up	SLC27A2	NM_003645
1.33	down	2.16	down	2.16	down	1.63	down	1.62	down	1.00	up	SLC35E2	NM_182838
1.40	up	1.83	up	2.01	up	1.30	up	1.43	up	1.10	up	SLC9A5	NM_004594
1.62	up	1.24	up	2.62	down	1.31	down	4.24	down	3.24	down	SLITRK6	NM_032229
1.34	up	2.09	up	4.52	down	1.56	up	6.07	down	9.46	down	SLITRK6	NM_032229
1.15	down	1.20	down	2.33	down	1.04	down	2.03	down	1.95	down	SLMO1	NM_006553
1.44	up	2.26	down	1.71	down	3.26	down	2.46	down	1.32	up	SMA4	NR_029426
1.11	up	1.04	up	2.24	up	1.07	down	2.01	up	2.15	up	SNORD105	NR_004381
1.17	down	1.15	down	2.79	up	1.02	up	3.27	up	3.20	up	SNORD34	NR_000019
1.05	up	1.08	down	2.20	up	1.14	down	2.10	up	2.39	up	SNORD59B	NR_003046
1.46	down	2.03	up	1.54	up	2.97	up	2.26	up	1.31	down	SNORD65	NR_003054

2.78	down	8.14	down	1.04	up	2.93	down	2.90	up	8.49	up	SNX22	NM_024798
2.74	down	4.92	down	5.06	down	1.80	down	1.85	down	1.03	down	SNX29	BC029857
2.78	down	6.38	down	2.41	down	2.30	down	1.15	up	2.65	up	SORCS1	NM_052918
1.71	up	2.10	up	1.36	down	1.23	up	2.33	down	2.85	down	SOX4	NM_003107
10.39	up	12.14	up	4.16	up	1.17	up	2.50	down	2.92	down	SP9	
1.41	down	1.62	up	1.96	down	2.29	up	1.39	down	3.18	down	SPAG1	NM_003114
1.24	up	1.38	up	2.56	up	1.12	up	2.07	up	1.85	up	SPEG	
1.18	down	1.52	up	2.68	up	1.80	up	3.17	up	1.77	up	SPINK7	NM_032566
1.70	up	1.84	up	2.27	up	1.08	up	1.34	up	1.24	up	SPTSSB	BC130565
1.28	up	1.48	up	1.45	down	1.16	up	1.85	down	2.14	down	SRGAP1	NM_020762
1.06	down	1.39	up	1.87	down	1.47	up	1.77	down	2.59	down	STX1A	NM_004603
1.47	up	1.70	up	2.18	up	1.15	up	1.48	up	1.28	up	SYNJ2	AK296242
2.07	down	1.28	down	1.27	down	1.62	up	1.63	up	1.01	up	TAF9	NM_001015891
1.60	up	2.35	up	2.47	up	1.47	up	1.54	up	1.05	up	TAT	NM_000353
3.10	down	2.55	down	2.66	down	1.22	up	1.17	up	1.04	down	TBC1D22A	AK125705
3.33	up	2.52	up	1.25	up	1.32	down	2.65	down	2.01	down	TCF7L2	NM_030756
1.32	down	1.10	up	2.55	down	1.46	up	1.93	down	2.81	down	TCTN2	NM_024809
1.51	up	2.11	up	2.28	up	1.40	up	1.52	up	1.08	up	TDRD1	NM_198795
1.08	down	1.54	down	5.08	down	1.42	down	4.68	down	3.29	down	TEKT2	NM_014466

1.77	down	4.67	down	2.10	down	2.65	down	1.19	down	2.23	up	TFPI	NM_006287
1.69	down	4.39	down	2.54	down	2.60	down	1.51	down	1.73	up	TFPI	AB209866
1.06	down	2.06	up	1.29	up	2.18	up	1.36	up	1.60	down	TIMM44	NM_006351
1.56	up	1.49	up	2.03	up	1.05	down	1.31	up	1.37	up	TJP2	AF083893
3.59	down	22.98	down	1.80	down	6.41	down	1.99	up	12.76	up	TLR10	NM_030956
1.06	down	1.18	up	4.02	down	1.25	up	3.79	down	4.75	down	TMEM190	NM_139172
1.35	down	2.48	down	2.18	down	1.84	down	1.62	down	1.14	up	TMEM192	NM_001100389
1.52	up	2.00	up	2.38	up	1.31	up	1.57	up	1.19	up	TMEM50B	BG220668
1.04	up	1.40	down	1.94	up	1.46	down	1.86	up	2.72	up	TMIGD2	NM_144615
2.76	up	1.68	up	3.18	up	1.64	down	1.15	up	1.89	up	TNXB	NM_019105
1.34	up	1.90	down	2.88	down	2.54	down	3.85	down	1.52	down	TOB2P1	NR_002936
1.44	up	1.55	down	1.21	down	2.24	down	1.74	down	1.28	up	TPCN1	NM_001143819
1.98	down	2.75	down	1.24	down	1.39	down	1.60	up	2.22	up	TPK1	NM_022445
5.12	down	4.72	down	1.99	down	1.08	up	2.58	up	2.37	up	TREML2	NM_024807
1.13	down	3.73	down	2.71	down	3.31	down	2.41	down	1.37	up	TSGA10	NM_025244
1.85	down	2.54	down	1.91	down	1.37	down	1.03	down	1.33	up	USP47	NM_017944
1.72	up	3.85	up	1.97	down	2.24	up	3.38	down	7.59	down	VGF	NM_003378
2.21	down	5.46	down	3.60	down	2.47	down	1.63	down	1.52	up	VHLL	NM_00100

													4319
2.92	down	4.73	down	2.64	down	1.62	down	1.11	up	1.79	up	VPRBP	NM_014703
1.30	down	2.29	down	2.14	down	1.75	down	1.64	down	1.07	up	WDR19	NM_025132
1.41	up	1.82	up	2.04	up	1.29	up	1.44	up	1.12	up	WIBG	NM_032345
2.13	up	1.21	down	1.29	down	2.58	down	2.75	down	1.06	down	XIAP	NM_001167
1.08	up	1.41	down	2.45	down	1.52	down	2.64	down	1.73	down	XLOC_000647	CR617576
2.05	down	2.44	down	1.02	down	1.19	down	2.01	up	2.38	up	XLOC_001266	
1.49	up	2.35	up	1.59	up	1.58	up	1.07	up	1.48	down	XLOC_001364	
1.68	up	2.73	up	2.62	up	1.62	up	1.56	up	1.04	down	XLOC_001856	
1.39	up	1.42	up	2.10	up	1.02	up	1.50	up	1.48	up	XLOC_002249	
1.83	up	2.03	up	4.01	up	1.11	up	2.19	up	1.98	up	XLOC_002323	
2.88	up	4.30	up	3.50	up	1.49	up	1.22	up	1.23	down	XLOC_002968	
1.53	up	2.65	up	2.10	up	1.73	up	1.37	up	1.26	down	XLOC_003354	
1.22	up	2.07	up	2.57	up	1.69	up	2.11	up	1.25	up	XLOC_003546	AL833514
1.52	up	1.92	up	2.47	up	1.26	up	1.63	up	1.29	up	XLOC_003825	
1.92	up	1.87	down	2.19	down	3.60	down	4.21	down	1.17	down	XLOC_004229	
1.68	up	1.23	up	2.62	up	1.37	down	1.56	up	2.13	up	XLOC_004263	DB030232

4.64	down	3.72	down	2.22	down	1.25	up	2.09	up	1.67	up	XLOC_0 04456	
1.39	up	1.47	up	2.05	up	1.06	up	1.48	up	1.39	up	XLOC_0 04576	
1.46	up	2.45	up	2.48	up	1.67	up	1.70	up	1.01	up	XLOC_0 05056	
2.37	up	1.04	down	1.45	down	2.46	down	3.43	down	1.40	down	XLOC_0 05361	
2.31	down	1.12	down	2.27	down	2.06	up	1.02	up	2.02	down	XLOC_0 05514	
1.37	up	1.63	up	2.40	up	1.19	up	1.75	up	1.48	up	XLOC_0 05737	BC035191
2.04	up	1.60	up	3.09	up	1.28	down	1.51	up	1.94	up	XLOC_0 05859	
1.27	up	2.38	down	2.35	down	3.02	down	2.98	down	1.01	up	XLOC_0 06721	
2.11	up	2.50	down	1.50	down	5.29	down	3.17	down	1.67	up	XLOC_0 07467	
1.48	up	1.88	up	2.05	up	1.27	up	1.39	up	1.09	up	XLOC_0 07600	
1.43	down	1.04	up	1.51	up	1.49	up	2.16	up	1.45	up	XLOC_0 07607	
1.50	up	2.77	up	2.29	up	1.84	up	1.52	up	1.21	down	XLOC_0 07867	
1.44	up	3.41	up	2.10	up	2.36	up	1.46	up	1.62	down	XLOC_0 07972	
1.36	up	2.13	up	1.53	up	1.56	up	1.12	up	1.39	down	XLOC_0 08061	
1.23	up	2.32	up	1.48	up	1.89	up	1.20	up	1.57	down	XLOC_0 08311	
4.49	up	8.77	up	7.65	up	1.95	up	1.70	up	1.15	down	XLOC_0 08554	
1.39	up	1.54	up	2.04	up	1.11	up	1.47	up	1.32	up	XLOC_0	

												09040	
1.30	up	2.37	up	1.46	up	1.82	up	1.12	up	1.63	down	XLOC_0 10255	
1.55	up	2.69	up	1.74	up	1.73	up	1.12	up	1.55	down	XLOC_0 11014	
3.21	down	3.93	down	6.80	down	1.22	down	2.12	down	1.73	down	XLOC_0 11047	BX648502
1.93	up	1.62	up	2.95	up	1.19	down	1.53	up	1.82	up	XLOC_0 11107	
1.58	up	2.05	up	2.47	up	1.30	up	1.57	up	1.20	up	XLOC_0 12304	
1.55	up	2.01	up	1.99	up	1.29	up	1.28	up	1.01	down	XLOC_0 13562	
1.35	down	2.23	up	2.64	up	3.01	up	3.56	up	1.18	up	XLOC_0 13737	AK090932
1.34	up	2.17	up	2.93	up	1.62	up	2.18	up	1.35	up	XLOC_0 14172	
1.27	up	1.85	up	2.01	up	1.46	up	1.58	up	1.09	up	XLOC_0 14364	AI525606
5.60	up	1.41	up	2.28	up	3.97	down	2.46	down	1.61	up	XLOC_0 14508	XR_11094 0
1.91	up	2.20	up	1.89	down	1.15	up	3.60	down	4.14	down	XLOC_l 2_00101 1	BC030750
1.08	down	1.89	up	1.59	up	2.05	up	1.73	up	1.18	down	XLOC_l 2_00235 5	
2.71	up	1.36	up	1.48	up	2.00	down	1.83	down	1.09	up	XLOC_l 2_00587 1	
1.65	up	2.29	up	2.38	up	1.38	up	1.44	up	1.04	up	XLOC_l 2_00588 0	

1.57	up	1.40	up	2.49	up	1.12	down	1.58	up	1.78	up	XLOC_l2_007802	BC014149
1.40	down	1.22	up	2.20	down	1.70	up	1.57	down	2.67	down	XLOC_l2_007928	
1.09	down	1.72	down	3.39	down	1.58	down	3.11	down	1.97	down	XLOC_l2_008203	
1.23	down	1.14	up	1.84	down	1.41	up	1.49	down	2.10	down	XLOC_l2_008203	
1.39	down	1.32	down	2.48	down	1.06	up	1.78	down	1.88	down	XLOC_l2_008203	BX647931
1.04	down	1.95	down	2.81	down	1.87	down	2.68	down	1.44	down	XLOC_l2_008288	CD557693
1.04	up	2.26	up	2.02	down	2.17	up	2.11	down	4.57	down	XLOC_l2_008910	BC039367
1.72	up	1.92	up	2.54	up	1.11	up	1.47	up	1.33	up	XLOC_l2_008910	BC039367
1.00	down	1.67	down	2.85	down	1.66	down	2.84	down	1.71	down	XLOC_l2_009332	
1.14	down	11.30	down	10.46	down	9.92	down	9.18	down	1.08	up	XLOC_l2_009332	AK096564
1.56	down	4.83	down	2.88	down	3.10	down	1.85	down	1.68	up	XLOC_l2_009905	

1.52	up	1.68	up	2.35	up	1.11	up	1.55	up	1.40	up	XLOC_l2_010239	
2.36	up	3.16	up	3.00	up	1.34	up	1.27	up	1.06	down	XLOC_l2_011901	DA338254
1.76	up	2.31	up	2.18	up	1.31	up	1.24	up	1.06	down	XLOC_l2_014821	
1.51	up	3.27	up	1.72	up	2.17	up	1.14	up	1.90	down	XLOC_l2_015441	
1.57	down	1.53	up	1.17	down	2.39	up	1.34	up	1.79	down	YWHAE	NM_006761
1.49	up	1.14	up	1.50	down	1.31	down	2.24	down	1.71	down	ZBED1	NM_001171135
4.44	down	1.22	down	1.95	down	3.64	up	2.27	up	1.60	down	ZBED2	NM_024508
1.45	down	1.15	up	1.96	down	1.67	up	1.36	down	2.26	down	ZBED4	NM_014838
1.13	up	3.06	up	1.61	up	2.71	up	1.42	up	1.90	down	ZDHHC20	NM_153251
1.66	down	1.09	up	2.60	down	1.80	up	1.56	down	2.82	down	ZNF284	NM_001037813
1.80	down	1.23	up	1.52	down	2.21	up	1.18	up	1.87	down	ZNF286A	NM_020652
1.01	down	1.81	down	2.15	down	1.79	down	2.12	down	1.19	down	ZNF514	NM_032788
1.12	up	2.06	up	1.27	up	1.85	up	1.13	up	1.63	down	ZNF562	NM_001130031
2.00	down	1.77	down	3.26	down	1.13	up	1.62	down	1.84	down	ZNF778	NM_001201407
2.47	down	3.23	down	5.16	down	1.31	down	2.09	down	1.59	down	ZNF827	NM_17883

													5
1.77	down	1.64	up	1.30	down	2.91	up	1.37	up	2.13	down		CU691765
1.89	up	6.63	up	2.14	up	3.51	up	1.13	up	3.10	down		DR007930
1.63	up	1.83	up	2.65	up	1.12	up	1.62	up	1.45	up		DA734158
2.93	up	2.77	down	1.06	up	8.11	down	2.76	down	2.94	up		BC025320
1.06	down	1.69	up	1.94	up	1.78	up	2.04	up	1.15	up		BC071639
1.55	down	1.12	down	2.65	down	1.39	up	1.71	down	2.37	down		XR_10990 4
2.14	up	1.38	down	1.08	up	2.94	down	1.98	down	1.49	up		BC044655
1.34	down	6.93	down	2.18	down	5.17	down	1.63	down	3.17	up		X58740
1.51	down	1.04	up	1.37	up	1.58	up	2.07	up	1.31	up		AF239727
1.38	down	3.73	down	1.02	up	2.70	down	1.41	up	3.81	up		CR625008
2.12	up	2.95	up	2.96	up	1.39	up	1.40	up	1.00	up		XM_00113 0683
2.17	up	1.10	down	1.41	down	2.39	down	3.06	down	1.28	down		AK130638
1.55	up	2.12	up	2.64	up	1.37	up	1.71	up	1.24	up		XM_00172 1393
1.87	down	5.63	down	1.06	up	3.01	down	1.97	up	5.94	up		AK128421
1.62	up	2.29	up	2.79	up	1.42	up	1.72	up	1.22	up		BC131768
1.32	up	2.27	up	1.86	up	1.73	up	1.41	up	1.22	down		BC032956

APPENDIX D-DEG AA HPV-INACTIVE VS HPV-NEGATIVE

Table D.1: AA – HPV-Inactive vs HPV-Negative Tumors - MW 0.02 FC 2

FC (abs)	Direction of change	Gene symbol	Genbank accession
2.01	up	ABCC6	NM_001079528
2.44	down	ABHD13	NM_032859
4.96	down	ABLIM2	NM_032432
3.98	down	ABLIM2	NM_001130083
2.96	down	ABLIM2	NM_001130088
2.51	down	AGER	NM_001206966
2.63	up	ALDH1L2	NM_001034173
3.46	down	ALS2	NM_020919
2.87	down	ANKRD33B	NM_001164440
2.22	up	ARHGAP44	NM_014859
2.12	down	ATP2B4	NM_001684
2.02	down	ATP2B4	NM_001001396
9.97	up	ATP8B3	NM_138813
4.20	up	BCHE	NM_000055
4.10	down	BCL2A1	NM_004049
2.15	down	BCL2A1	NM_004049
2.22	down	BLCAP	NM_006698
2.01	down	BNIP2	AK125533
2.17	up	BRD3	NM_007371
4.33	up	C11orf53	NM_198498
2.84	up	C15orf59	NM_001039614
2.33	up	C17orf82	NM_203425
2.39	down	C20orf106	NM_001012971
5.73	down	C20orf26	NM_015585
2.00	up	C2orf70	NM_001105519
2.31	down	C5orf44	NR_003545
2.48	down	C9orf123	NM_033428
2.16	down	CATSPER2	NM_172095
2.71	down	CDC42	NM_044472
2.01	down	CEP76	NM_024899
2.27	down	CGRRF1	NM_006568
4.90	down	CLEC4A	NM_016184
2.45	up	COPZ2	NM_016429
2.32	up	CRIP1	AB527908
2.02	down	CRTAP	NM_006371
2.09	down	CTRL	NM_001907
4.35	up	CXCL12	NM_001033886

2.07	down	DCAF13	NM_015420
5.22	down	EMR3	NM_032571
2.02	up	EN2	NM_001427
2.10	up	ERBB3	NM_001982
2.54	up	ERBB3	NM_001005915
2.03	down	ERCC8	NM_000082
3.00	up	ERVMER34-1	NM_024534
2.80	up	ERVMER34-1	NM_024534
3.47	down	FADS3	NM_021727
2.19	up	FAM127C	NM_001078173
6.47	down	FAM65B	NM_015864
2.57	down	FAR1	NM_032228
2.65	down	FLJ35024	NR_015375
4.27	down	FLJ43663	NR_015431
3.29	down	FLVCR2	NM_017791
8.21	down	FPR2	NM_001462
2.07	down	GEMIN2	NM_003616
2.04	down	GFM2	NM_170681
3.73	down	GJA3	NM_021954
3.19	up	GPR143	NM_000273
2.38	down	GTF2H2D	NM_001042490
2.18	up	GYLTL1B	NM_152312
3.42	up	HEY1	NM_001040708
11.02	up	HORMAD1	NM_032132
9.83	up	HORMAD1	NM_032132
7.71	up	HOXA4	NM_002141
2.18	up	HOXA5	NM_019102
2.32	up	HOXA6	NM_024014
3.84	up	HOXA6	NM_024014
4.88	up	HOXC6	NM_153693
2.06	down	HSPA8	NM_153201
6.03	down	IL6	NM_000600
3.02	down	IL6ST	NM_002184
2.03	down	INTS4	NM_033547
4.21	down	KBTBD8	NM_032505
2.32	down	KCNE1L	NM_012282
2.21	down	KIAA0040	NM_001162893
2.07	down	KIAA0319L	AB058740
2.39	down	KLHL12	NM_021633
2.93	down	KMO	NM_003679
2.69	up	KRTAP1-3	NM_030966
2.43	up	KRTAP2-4	NM_033184
2.56	up	LEPREL2	NM_014262
3.42	up	LEPREL4	NM_006455
3.05	down	LIMS3L	NM_001205288
2.26	up	LINC00087	NR_024493
2.09	up	LINC00087	NR_024493
2.01	up	LOC100130547	XR_113275

2.78	down	LOC100505681	NR_038452
8.99	down	LOC100506328	AK055877
7.08	down	LOC100506328	AK055877
6.29	down	LOC100506328	AK055877
2.71	up	LOC100506433	NR_039996
5.88	up	LOC100506783	NR_038435
2.93	down	LOC100506860	XR_108813
2.40	down	LOC100652952	XR_132749
2.95	down	LOC100653245	XM_003403831
2.83	up	LOC283861	AK098143
2.20	up	LOC285577	NR_033898
3.92	down	LOC339290	NR_015389
2.17	up	LOC400238	NR_033986
4.24	down	LOC440900	NR_034128
2.73	up	LOC497257	BC030211
2.98	down	LOC646329	NR_034120
2.37	down	LYRM7	NM_181705
4.10	up	MAGI2	NM_012301
2.38	up	MAST1	NM_014975
14.00	up	MATN3	NM_002381
3.21	up	MDK	NM_001012334
2.71	up	MECOM	NM_005241
2.75	up	MECOM	NM_001164000
3.67	up	MECOM	NM_004991
2.19	down	MED23	NM_015979
2.02	down	MIPEP	NM_005932
2.20	up	MIR100HG	NR_024430
2.64	down	MNS1	NM_018365
2.46	down	MTHFD2L	NM_001144978
2.15	down	NEK4	NM_003157
3.52	up	OSR2	NM_053001
6.90	down	OTOP3	NM_178233
2.90	up	OXT	NM_000915
2.93	down	P2RX5	NM_175080
2.67	down	PAG1	NM_018440
3.08	down	PITPNC1	NM_181671
2.32	up	PLD1	NM_002662
2.28	down	PNMA1	NM_006029
2.45	down	PRDX3	NM_006793
2.01	down	PTGR2	NM_152444
5.20	up	PTH2R	NM_005048
2.08	down	QRSL1	NM_018292
2.64	down	RAD17	NM_002873
2.41	up	RADIL	NM_018059
2.06	down	RASGRP2	NM_153819
2.36	down	RASGRP2	NM_153819
2.47	down	RB1	NM_000321
2.43	down	RBBP4	NM_005610

2.19	down	REM2	NM_173527
2.37	up	RHPN2	NM_033103
3.11	down	RNF125	NM_017831
2.47	down	RNF6	NM_005977
2.31	down	RPA1	NM_002945
2.51	down	RRP15	NM_016052
4.53	down	SAMSN1	NM_022136
2.16	down	SDC4	NM_002999
2.09	down	SEC61A2	NM_018144
4.74	down	SHC3	NM_016848
3.22	up	SHOX2	NM_003030
2.05	up	SIGLEC15	NM_213602
2.12	down	SLA2	NM_032214
2.54	up	SLC26A10	NM_133489
8.14	down	SLC27A2	NM_003645
9.18	up	SP9	
2.33	up	SPHK1	NM_182965
2.18	up	SRPX2	NM_014467
3.52	up	SSC5D	NM_001144950
5.55	up	SYN2	NM_003178
2.11	down	TAF9	NM_001015891
3.36	up	TCF7L2	NM_030756
4.11	up	TET1	NM_030625
2.22	up	TMEM145	NM_173633
2.90	up	TMEM63C	NM_020431
2.77	up	TNXB	NM_019105
2.86	down	TPM3	NM_001043352
4.79	down	TREML2	NM_024807
3.00	down	TRIB2	NM_021643
2.08	down	TRIM23	NM_001656
4.55	down	UNC5CL	NM_173561
2.95	down	VPRBP	NM_014703
2.17	up	VWA5B1	AK057346
2.61	up	WWOX	NM_130844
5.44	down	XLOC_001595	
2.90	up	XLOC_002968	
4.34	down	XLOC_004456	
2.54	up	XLOC_010570	BX091314
2.81	up	XLOC_012170	XR_109456
3.05	up	XLOC_014246	
2.14	down	XLOC_014388	XR_109724
5.04	up	XLOC_014508	XR_110940
2.65	up	XLOC_l2_005871	
2.37	up	XLOC_l2_011901	DA338254
2.25	up	XLOC_l2_015034	
2.06	down	XPO4	NM_022459
3.09	down	XPO6	NM_015171
4.60	down	ZBED2	NM_024508

2.67	up	ZNF423	NM_015069
2.53	up	ZNF771	NM_016643
2.02	down	ZNF778	NM_001201407
4.76	up		XM_002342405
2.17	up		AK130638
4.08	up		XM_002342405

APPENDIX E - DEG EA HPV-INACTIVE VS HPV-NEGATIVE

Table E.1: EA – HPV-Inactive vs HPV-Negative Tumors - MW p0.02 FC 2

FC (abs)	Regulation	GeneSymbol	GenbankAccession
2.91	up	ACSL5	NM_203380
2.32	up	ADCY4	NM_139247
7.21	up	ADIPOQ	NM_004797
2.46	down	AGPAT4	NM_020133
3.84	up	AIRE	NM_000658
4.73	up	AMICA1	NM_153206
2.67	up	ANKDD1A	NM_182703
2.60	down	ANKRD13B	NM_152345
5.54	up	AOX1	NM_001159
5.24	up	AOX1	NM_001159
5.50	down	AP1M2	NM_005498
2.08	down	AP1S1	NM_001283
3.06	up	APBB1IP	NM_019043
3.96	up	APBB1IP	NM_019043
3.39	down	APLN	NM_017413
2.74	up	APOL3	NM_145641
2.05	up	AQP1	NM_198098
3.64	up	ARHGAP15	NM_018460
2.47	down	ARHGAP39	NM_025251
2.29	down	ARHGAP5	NM_001030055
2.04	down	ARHGAP5	NM_001030055

3.02	up	ARHGAP9	NM_032496
3.16	down	ARTN	NM_057090
2.74	down	ARVCF	NM_001670
6.48	up	ASPA	NM_000049
2.00	down	ATN1	NM_001007026
2.82	up	ATOH8	NM_032827
2.35	up	ATP2A3	NM_174958
2.39	down	ATP2B4	NM_001001396
2.00	down	B4GALT2	NM_003780
5.80	down	BAIAP2L1	NM_018842
8.79	up	BANK1	NM_017935
2.09	up	BDH2	NM_020139
5.15	up	BMX	NM_001721
2.08	down	BOP1	NM_015201
2.05	down	BTBD7	NM_001002860
5.60	up	C10orf105	NM_001164375
2.73	up	C10orf128	NM_001010863
2.17	up	C11orf21	NM_001142946
3.62	down	C11orf41	NM_012194
3.60	down	C12orf70	NM_001145010
2.80	down	C14orf128	NR_027263
3.00	down	C14orf128	NR_027263
2.90	up	C14orf182	AK090420
4.53	up	C16orf54	NM_175900
2.59	up	C17orf67	NM_001085430
2.04	down	C18orf45	NM_032933
3.39	down	C1orf74	NM_152485

2.49	up	C20orf160	NM_080625
3.15	down	C4orf47	NM_001114357
5.14	up	C5orf20	NM_130848
2.28	down	C6orf228	NM_001135575
7.13	up	C7	NM_000587
3.11	up	C8orf68	BC038783
2.53	down	C9orf30-TMEFF1	NM_001198812
15.19	down	CA9	NM_001216
4.30	down	CAPSL	NM_144647
2.87	up	CARD8	NM_014959
2.29	up	CARD9	NM_052813
4.39	up	CBFA2T3	NM_005187
2.56	up	CBX7	NM_175709
3.25	down	CCDC147	NM_001008723
2.22	down	CCDC19	NM_012337
2.30	down	CCDC40	NM_001243342
3.21	up	CCDC69	NM_015621
10.90	up	CCL14	NM_032963
3.93	up	CCR2	NM_001123041
2.41	up	CD163L1	NM_174941
4.08	up	CD1B	NM_001764
5.63	up	CD1C	NM_001765
8.48	up	CD1E	NM_001042583
7.11	up	CD36	NM_001001547
3.13	up	CD3D	NM_000732
2.58	up	CD74	NM_001025158
7.76	up	CD79B	NM_001039933

2.11	down	CDC42BPA	NM_003607
2.67	up	CDC42SE2	NM_020240
2.88	up	CEACAM21	NM_001098506
2.39	up	CELF2	NM_001025077
3.38	up	CFI	NM_000204
5.50	up	CFP	NM_002621
11.39	up	CHI3L2	NM_001025199
2.51	up	CHST8	NM_022467
5.29	up	CIDEA	NM_001279
2.27	down	CKAP4	NM_006825
3.95	up	CLCN4	NM_001830
7.14	up	CLEC10A	NM_182906
7.07	up	CLEC3B	NM_003278
2.28	up	CLEC4A	NM_016184
9.37	up	CLEC4G	NM_198492
20.33	up	CLEC4G	NM_198492
5.87	up	CLECL1	NM_172004
2.72	up	CLIC2	NM_001289
2.39	down	CLIC4	NM_013943
2.15	down	CLOCK	NM_004898
3.35	up	CNR2	NM_001841
3.29	down	COL27A1	BC007696
6.85	up	COL4A4	NM_000092
2.06	up	COTL1	NM_021149
5.59	up	CR1L	NM_175710
6.35	up	CTSG	NM_001911
3.62	up	CX3CR1	NM_001337

7.54	up	CXCR5	NM_032966
2.36	up	CYBASC3	NM_153611
2.00	up	CYLD	NM_015247
2.75	up	CYSLTR1	NM_006639
6.06	up	DARC	NM_002036
3.10	up	DENND1C	NM_024898
11.62	down	DNAH17	
7.12	up	DNASE1L3	NM_004944
3.18	up	DNM1P46	NR_003260
2.13	up	DNMT3A	NM_175630
2.67	down	DNMT3B	NM_175850
2.29	up	DOK2	NM_003974
2.90	up	DPP4	NM_001935
2.56	up	EGR1	NM_001964
2.13	down	EIF2C2	NM_012154
3.05	up	ELANE	NM_001972
3.61	down	EN1	NM_001426
3.55	down	ENKUR	NM_145010
3.64	up	ENPP3	NM_005021
2.52	down	ENTPD7	NM_020354
2.67	down	EPB41L5	NM_001184938
3.00	up	EPHX2	NM_001979
2.26	down	ERC1	NM_178040
6.07	down	ESM1	NM_007036
6.67	down	ETV4	NM_001079675
3.44	up	EVI2B	NM_006495
2.36	down	EXD2	NM_018199

2.32	down	EXT1	NM_000127
2.22	up	FAIM2	NM_012306
3.30	up	FAIM3	NM_005449
3.47	up	FAM107A	NM_007177
2.42	down	FAM114A1	NM_138389
3.42	up	FAM65B	NM_015864
2.42	down	FAM91A1	NM_144963
2.39	down	FAM92A3	NR_003612
2.67	down	FBN2	NM_001999
4.61	up	FCER1A	NM_002001
3.23	up	FCGR2B	NM_004001
3.93	up	FCN1	NM_002003
3.35	up	FCN1	NM_002003
8.57	up	FCRL3	AK301257
6.33	up	FCRLA	NM_032738
2.36	up	FGD2	NM_173558
3.22	up	FGD3	NM_033086
3.73	up	FGL2	NM_006682
2.64	up	FLI1	NM_002017
2.25	up	FLJ33630	NR_015360
4.51	down	FOXD1	NM_004472
2.16	up	FRMD3	NM_174938
2.25	up	FSCN3	NM_020369
2.20	down	FSD1L	NM_031919
3.94	up	GAPT	NM_152687
2.51	up	GCA	NM_012198
2.75	up	GCFC1-AS1	NR_038879

10.56	up	GDF10	NM_004962
3.58	up	GFRA2	NM_001495
4.14	up	GGTA1P	NR_003191
4.89	up	GHRL	NM_016362
3.67	up	GIMAP2	NM_015660
2.61	up	GJA4	NM_002060
2.53	up	GLRX	NM_002064
2.57	down	GLT25D1	NM_024656
3.22	up	GMFG	NM_004877
3.16	up	GNA14	NM_004297
3.34	down	GNG4	NM_001098722
2.21	up	GPR132	NM_013345
2.12	down	GPR135	NM_022571
2.94	down	GPR161	NM_153832
2.01	down	GPR172A	NM_024531
2.27	up	GPR34	NM_001097579
3.08	down	GPRIN1	NM_052899
4.88	down	GRHL2	NM_024915
6.99	down	GRIN2D	NM_000836
2.53	up	GYPC	NM_002101
2.07	down	H2AFY2	NM_018649
2.54	up	H3F3B	NM_005324
3.00	up	HDC	NM_002112
2.06	up	HERC2	NM_004667
3.34	up	HHEX	NM_002729
3.12	down	HILS1	NR_024193
2.79	up	HLA-DMA	NM_006120

2.63	up	HLA-DMA	NM_006120
3.31	up	HLA-DOA	NM_002119
3.37	up	HLA-DPB1	NM_002121
2.78	up	HLA-DPB1	NM_002121
2.87	up	HLA-DPB1	NM_002121
3.37	up	HLA-DPB2	NR_001435
3.30	up	HLA-DRB4	NM_021983
2.66	up	HLA-DRB5	NM_002125
2.12	up	HMGCLL1	NM_019036
3.11	up	HMHA1	NM_012292
2.84	down	HOMER3	NM_004838
2.70	down	HOMER3	NM_001145722
2.71	up	ICAM3	NM_002162
2.45	up	ID2	NM_002166
2.64	down	IFT81	NM_031473
3.41	up	IGFN1	NM_001164586
3.84	up	IL16	NM_004513
2.42	up	IL2RB	NM_000878
3.30	up	INMT	NM_001199219
3.50	up	INPP5D	NM_001017915
2.44	down	IQCD	NM_138451
9.13	down	IRF6	NM_006147
2.15	down	IRGQ	NM_001007561
2.56	up	ITIH1	NM_002215
4.39	up	ITM2A	NM_004867
3.21	up	JAK3	NM_000215
2.14	up	KANK3	NM_198471

2.56	up	KAT2B	NM_003884
3.29	up	KCNA3	NM_002232
2.30	up	KCNH2	NM_000238
2.59	down	KCNQ1OT1	NR_002728
2.21	down	KDM5B	NM_006618
2.17	up	KIAA0748	NM_001098815
2.32	down	KIAA1217	NM_001098500
2.28	up	KIAA1370	NM_019600
4.50	down	KIAA1549	NM_001164665
2.95	down	KIAA1671	NM_001145206
2.40	down	KIF13A	NM_022113
3.01	down	KIF26B	NM_018012
2.06	down	KIF3C	NM_002254
2.36	down	KIF4A	NM_012310
4.00	up	KLF2	NM_016270
4.96	up	KLRB1	NM_002258
2.40	up	KLRC4	NM_013431
2.92	up	LAT2	NM_032464
5.74	up	LDLRAD2	NM_001013693
2.63	down	LINC00174	NR_026873
3.58	up	LINC00426	NR_024464
2.64	up	LIPE	NM_005357
2.94	down	LMO7	AK092052
3.46	up	LOC100128420	NR_038461
4.82	down	LOC100128881	NR_036480
2.09	down	LOC100130009	XM_001718914
6.86	up	LOC100288273	XR_110262

5.56	down	LOC100505882	XR_110336
5.47	down	LOC100505912	NR_037877
3.75	up	LOC100505921	XR_108739
2.79	up	LOC100505976	XR_110096
4.37	up	LOC100506304	XR_108932
2.01	up	LOC100506651	XR_110002
4.13	up	LOC100506779	NR_038410
2.81	up	LOC100506882	XR_109418
18.58	down	LOC100507033	XR_110380
4.89	up	LOC100507492	XR_109121
9.14	up	LOC100507616	XR_110328
3.84	up	LOC100508196	XR_111691
3.83	up	LOC100508196	XR_111691
4.08	up	LOC100508196	XR_111691
2.37	up	LOC100652740	XM_003403462
3.11	up	LOC100652951	XR_132888
2.61	up	LOC145820	NR_027132
2.73	down	LOC254128	NR_037857
6.10	up	LOC283663	NR_024433
2.27	down	LOC286109	AK092172
3.46	up	LOC389834	NR_027420
4.19	up	LOC400456	NR_034095
2.18	up	LOC400499	XM_003118689
2.63	up	LOC440149	AK057085
3.77	up	LOC572558	NR_015423
2.65	up	LOC643733	NR_034079
3.17	up	LOC643733	NR_034079

3.72	up	LOC729468	BU567215
4.96	down	LPAR3	NM_012152
2.61	up	LRRC33	NM_198565
3.33	up	LRRC70	NM_181506
6.98	down	LRRC8E	NM_025061
3.52	up	LRRK2	AK127729
3.17	up	LRRK2	NM_198578
2.74	up	LTA	NM_000595
2.26	down	LTBR	NM_002342
2.53	up	LYSMD2	NM_153374
10.56	up	LYVE1	NM_006691
2.03	up	MALAT1	NR_002819
3.03	up	MAN1C1	NM_020379
3.08	up	MAN1C1	NM_020379
2.03	up	MAP3K8	AB209539
2.85	down	MAP3K9	NM_033141
3.09	down	MAP7	NM_003980
3.31	down	MARVELD3	NM_001017967
7.74	up	MEOX2	NM_005924
3.49	up	METTL7A	NM_014033
5.49	down	MEX3A	NM_001093725
3.11	up	MFNG	NM_002405
2.45	up	MGC39372	NR_033851
2.04	down	MIB2	NM_080875
3.11	down	MIPOL1	NM_138731
3.08	down	MIPOL1	NM_001195296
16.75	up	MMRN1	NM_007351

2.55	down	MOV10L1	NM_018995
2.01	up	MSRA	NM_012331
3.01	down	MTMR11	NM_181873
2.08	up	MYCBP2	NM_015057
2.31	down	MYO19	NM_001033580
2.29	up	MYO1F	NM_012335
4.42	up	MYRIP	NM_015460
3.29	up	NAPSA	NM_004851
4.12	up	NCR3	NM_001145467
4.13	down	NLGN4Y	NM_014893
4.15	up	NLRC3	NM_178844
2.06	up	NLRP3	NM_001079821
2.63	up	NOSTRIN	NM_052946
2.12	up	NR2F2	NM_021005
5.12	up	NR3C2	NM_000901
2.25	down	NRP2	NM_201264
2.28	down	NRP2	NM_201264
2.71	down	NRP2	NM_201266
2.71	down	NT5DC3	NM_001031701
2.21	up	NTN3	NM_006181
3.40	down	ODF3L1	NM_175881
2.89	down	ODZ3	NM_001080477
2.10	down	OTUD7B	NM_020205
2.58	down	OXTR	NM_000916
4.08	up	P2RY10	NM_014499
6.89	up	P2RY12	NM_022788
3.97	up	P2RY13	NM_176894

4.53	up	P2RY14	NM_014879
2.98	up	PATL2	NM_001145112
2.20	down	PAWR	NM_002583
3.13	down	PCDHGB1	NM_032095
2.09	up	PCM1	NM_006197
2.82	up	PDE1A	NM_001003683
2.15	up	PECAM1	NM_000442
6.06	up	PGM5	NM_021965
28.33	up	PI16	NM_153370
5.12	up	PLA1A	NM_015900
3.64	up	PLD4	NM_138790
2.32	down	PLEC	NM_201380
2.47	down	PLEKHA5	NM_019012
2.40	down	PLEKHG3	NM_015549
2.41	down	PLEKHG3	NM_015549
2.03	down	PLEKHG4B	NM_052909
2.98	down	POLE	NM_006231
2.14	down	POLR1A	NM_015425
2.01	down	POMT2	NM_013382
4.20	down	PPAP2C	NM_177543
2.24	down	PPFIBP1	NM_177444
2.14	down	PPP1R14B	NM_138689
2.06	up	PPP1R16B	NM_015568
3.20	down	PPP1R1C	NM_001080545
2.31	up	PRG2	NM_002728
3.23	up	PRKAR2B	NM_002736
2.85	up	PRKAR2B	NM_002736

5.14	up	PRKCB	NM_002738
6.60	up	PTGDS	NM_000954
5.10	up	PTGFR	NM_001039585
3.15	down	PTK7	NM_002821
3.53	down	PTPRF	BC048416
3.82	up	PTPRN2	NM_002847
3.90	up	PYHIN1	NM_198930
3.27	up	Q6TXI9	
2.42	up	RAB33A	NM_004794
4.24	up	RAB37	NM_175738
2.21	up	RAI2	NM_021785
2.36	up	RAMP3	NM_005856
3.63	up	RASAL3	NM_022904
2.49	up	RASGRP1	NM_005739
3.76	up	RASGRP2	NM_153819
3.67	up	RASGRP2	NM_153819
5.31	up	RASGRP2	NM_153819
3.53	up	RASSF2	NM_014737
2.10	down	RCC2	NM_018715
2.84	down	RGNEF	NM_001177693
8.77	up	RGS13	NM_002927
3.29	up	RINL	NM_001195833
2.55	up	RLTPR	NM_001013838
3.29	up	RNF125	NM_017831
3.18	down	RNF217	NM_152553
2.21	down	RNF7	NR_037702
3.10	up	RNU4ATAC	DW419002

2.43	down	RPL28	NM_001136136
2.09	up	RPP30	NM_001104546
439.85	down	RPS4Y2	NM_001039567
3.62	down	RTKN	NM_033046
3.28	down	S100A11	NM_005620
2.92	up	S1PR1	NM_001400
3.80	up	S1PR4	NM_003775
2.09	down	SAMD1	NM_138352
3.38	up	SCARNA16	NR_003013
3.17	up	SCARNA16	NR_003013
3.25	up	SCARNA9	NR_002569
4.50	up	SCML4	NM_198081
2.63	down	SCN8A	NM_014191
2.94	down	SDK2	NM_001144952
4.29	up	SELP	NM_003005
5.81	up	SELP	NM_003005
2.54	up	SEMA4D	NM_001142287
2.05	up	SEPT8	NM_001098811
2.67	up	SERP2	NM_001010897
2.50	up	SH2D3C	NM_170600
2.68	up	SHE	NM_001010846
2.67	up	SIDT1	NM_017699
2.59	down	SLC39A4	NM_017767
2.26	up	SMAD9	NM_005905
2.29	down	SMYD3	NM_022743
4.33	up	SNORA12	NR_002954
4.17	up	SNORA12	AA378382

2.80	up	SNORD71	NR_003059
3.06	up	SNX20	NM_182854
8.33	up	SNX22	NM_024798
2.83	down	SOX4	NM_003107
3.28	down	SPAG1	NM_003114
2.33	up	SPARCL1	NM_004684
2.53	up	SPI1	NM_001080547
7.66	up	SPIB	NM_003121
2.25	down	SPIRE1	NM_001128626
3.49	up	SPNS3	NM_182538
2.12	down	SRGAP1	NM_020762
2.01	down	STIP1	NM_006819
2.55	down	STX1A	NM_004603
2.08	down	SUPT3H	NM_003599
3.00	up	SUSD3	NM_145006
2.24	up	SVEP1	NM_153366
4.76	up	SVEP1	BC030816
3.04	up	TAGAP	NM_054114
4.97	up	TBC1D10C	NM_198517
2.63	down	TBX3	NM_016569
3.18	down	TBX3	NM_016569
2.82	down	TCTN2	NM_024809
7.89	up	TDRD12	NM_001110822
3.01	up	TESC	NM_017899
2.52	up	TGFBR2	NM_001024847
5.25	up	TIFAB	NM_001099221
12.81	up	TLR10	NM_030956

3.65	up	TMBIM4	NM_016056
4.16	up	TMEM100	NM_018286
2.59	up	TMEM170B	NM_001100829
4.68	down	TMEM190	NM_139172
3.34	up	TMIE	NM_147196
3.35	up	TNFAIP8L2	NM_024575
4.69	down	TNFRSF19	NM_018647
2.56	up	TNFSF14	NM_003807
5.12	up	TNXB	NM_019105
7.27	up	TNXB	NM_032470
2.77	down	TONSL	NM_013432
2.19	up	TPK1	NM_022445
2.01	down	TPM4	NM_003290
2.09	down	TPM4	NM_003290
2.54	down	TRIP13	NM_001166260
3.20	up	TSPAN33	NM_178562
2.01	down	TTLL5	NM_015072
4.06	down	TUBAL3	NM_024803
17.62	down	TXLNG2P	NR_045129
2.71	up	TXNIP	NM_006472
2.20	down	UBE2H	NM_003344
2.22	up	UNC13D	NM_199242
7.49	down	VGF	NM_003378
2.19	down	VKORC1	AK125618
2.13	up	WDFY4	NM_020945
3.83	up	WDFY4	NM_020945
2.19	down	WDYHV1	NM_018024

2.53	down	XLOC_000282	
4.96	down	XLOC_000778	
2.82	up	XLOC_001035	
2.40	up	XLOC_001266	
4.36	up	XLOC_001286	
2.19	up	XLOC_002221	
5.74	up	XLOC_002749	
4.91	up	XLOC_003738	BC040914
2.11	up	XLOC_004263	DB030232
2.02	down	XLOC_005514	
3.77	down	XLOC_007531	
2.12	up	XLOC_007775	XR_108974
4.35	down	XLOC_l2_001011	BC030750
3.30	up	XLOC_l2_002761	
4.22	up	XLOC_l2_004840	BG107090
2.70	down	XLOC_l2_007928	
2.09	down	XLOC_l2_008203	
4.87	down	XLOC_l2_008910	BC039367
2.03	down	XLOC_l2_010139	
2.83	up	XLOC_l2_010636	
2.60	up	XLOC_l2_010636	
2.56	up	XLOC_l2_012847	
2.65	up	XLOC_l2_012847	
2.04	up	XLOC_l2_013267	
6.83	down	XLOC_l2_013530	BG192435
2.14	down	XLOC_l2_013873	
2.27	down	ZBED4	NM_014838

2.16	down	ZBTB8A	NM_001040441
2.35	down	ZDHHC9	NM_016032
2.28	up	ZFYVE28	NM_020972
2.02	up	ZNF117	NM_015852
2.84	down	ZNF284	NM_001037813
2.49	down	ZNF618	NM_133374
2.27	down	ZNF623	NM_001082480
3.42	down	ZNF695	NM_001204221
2.23	down		XM_003118909
8.11	up		BX161420
3.77	up		AY312959
2.56	down		XR_109904
2.21	down		CU677870
2.36	down		XR_109904
3.26	up		X58740
2.05	down		DM107643
2.16	down		XR_132519
4.04	up		CR625008
2.44	up		M21784
4.30	up		BC038366
2.84	up		AV659465
3.24	up		AB209470

APPENDIX F - DEG AA HPV-NEGATIVE VS EA HPV-NEGATIVE

Table F.1: AA HPV-Negative vs EA HPV-Negative tumors p 0.02, FC 2

FC (abs)	Direction of change	Gene Symbol	Genbank Accession
2.52	down	AADAT	NM_016228
2.87	down	ABCC6	NM_001079528
4.09	down	ADAM12	NM_021641
2.25	down	ADC	NM_052998
3.75	down	ADRA2C	NM_000683
2.46	up	AIF1L	NM_001185096
3.59	up	ALDH7A1	NM_001182
2.95	up	ALDH7A1	NM_001182
2.80	down	ANKK1	NM_178510
2.13	down	ARHGAP1	NM_004308
2.37	up	ATG4C	NM_032852
3.23	down	ATP9A	NM_006045
2.48	down	ATP9A	NM_006045
2.60	down	AVIL	NM_006576
3.16	down	BBS5	NM_152384
2.33	down	BCAS3	NM_017679
2.59	up	BFSP2	NM_003571
2.54	down	BHLHB9	NM_030639
2.42	down	C10orf114	NM_001010911
5.76	down	C11orf53	NM_198498
4.42	down	C11orf70	NM_001195005
3.46	down	C11orf70	NM_032930
2.43	down	C14orf132	NR_023938
2.58	up	C17orf105	NM_001136483
3.74	down	C19orf21	NM_173481
2.79	up	C1orf210	NM_182517
2.09	down	C20orf108	NM_080821
2.13	up	C21orf33	
2.53	down	C4orf47	NM_001114357
2.11	up	C5orf44	NR_003545
2.17	down	C8orf42	NM_175075
2.96	down	CCDC40	NM_001243342
2.03	down	CD151	NM_004357
2.57	down	CDH13	NM_001257
6.94	down	CFHR4	NM_006684
4.15	down	CHST6	NM_021615
2.34	down	COL27A1	AK021957

2.70	down	COL7A1	NM_000094
2.16	up	CPA5	NM_001127442
2.68	down	CPAMD8	NM_015692
3.00	up	CRYBB2	NM_000496
2.85	up	CRYBB2P1	NR_033734
6.27	down	CST2	NM_001322
2.71	down	CXCR7	NM_020311
2.37	up	CYB5RL	BC071735
4.18	down	CYP27C1	NM_001001665
2.18	down	DCBLD1	NM_173674
3.39	down	DDX11L9	NR_034090
2.26	down	DHRS3	NM_004753
5.16	down	DNAH17	
8.43	down	DNAH5	NM_001369
6.31	up	DNASE1L3	NM_004944
2.76	down	DYNLRB2	NM_130897
2.18	up	ECEL1P2	NR_028501
2.41	down	EFCAB1	NM_001142857
2.61	down	EFHC2	NM_025184
4.40	up	EIF2A	NM_032025
2.06	down	ENC1	NM_003633
5.71	down	ENKUR	NM_145010
2.92	down	EPHA3	NM_005233
2.69	down	FAM114A1	NM_138389
4.00	down	FAM164A	NM_016010
2.79	down	FAM87B	XR_112085
3.14	down	FAT1	NM_005245
3.02	down	FBXO32	NM_058229
2.06	up	FCER1G	
3.13	down	FHOD3	NM_025135
2.19	down	FLJ20021	NR_033874
4.39	down	FLJ37644	XR_109424
2.73	down	FLJ45671	AK127576
3.62	down	FLJ45983	NR_024256
2.36	down	FRG1B	BC095491
4.56	up	FUT7	NM_004479
2.39	down	FZD1	NM_003505
3.03	down	GHR	NM_001242462
2.26	up	GNASAS	
2.20	down	GOLGA6L10	NM_001164465
2.10	down	GOLGA6L10	NM_001164465
2.12	down	GOLGA6L9	NM_198181
2.07	down	GOLGA6L9	NM_198181
2.42	down	GPR125	NM_145290
2.33	up	GPR31	NM_005299
2.35	down	GPR56	NM_201525
6.94	down	GUCY1B2	NR_003923
2.60	down	HGSNAT	NM_152419
2.01	down	HHAT	NM_018194

2.04	up	HHEX	NM_002729
2.03	down	HOMER3	NM_001145722
2.55	down	HSPG2	NM_005529
2.35	down	HTATSF1P2	BX648511
5.34	down	IBSP	NM_004967
2.11	down	IER5L	NM_203434
4.20	up	IL1R2	NM_004633
2.11	down	ITGAV	NM_002210
2.07	down	ITGB4	NM_000213
2.11	down	ITGB5	NM_002213
2.25	down	JAG1	NM_000214
2.04	down	KDM5B	NM_006618
3.49	down	KIAA1549	NM_001164665
2.12	down	KIF16B	NM_001199866
2.02	down	KIF16B	NM_024704
3.63	down	KIF26B	NM_018012
4.27	down	LARP6	NM_197958
2.66	down	LARP6	NM_018357
2.39	down	LCA5	NM_181714
2.58	down	LEPR	NM_001003680
5.78	down	LIF	NM_002309
3.49	down	LIMCH1	NM_014988
3.45	down	LINC00174	NR_026873
8.75	down	LINGO2	NM_152570
2.11	up	LOC100128164	NR_027622
2.13	down	LOC100130027	XR_110587
2.07	up	LOC100131581	AK092544
2.44	up	LOC100132147	BC036435
2.80	down	LOC100133299	XR_108564
2.08	up	LOC100133612	NR_024455
2.01	down	LOC100170939	NR_024054
3.75	down	LOC100216001	NR_024475
3.46	down	LOC100216001	NR_024475
3.45	down	LOC100240735	NR_026658
2.64	down	LOC100270746	NR_026776
3.15	down	LOC100288748	NR_034034
3.46	up	LOC100294145	NR_037177
2.69	up	LOC100294145	NR_037177
10.94	down	LOC100505495	NR_040109
3.04	down	LOC100505634	XR_109905
3.47	down	LOC100505912	NR_037877
2.58	up	LOC100506302	XR_108708
2.80	up	LOC100506328	XR_109927
3.30	down	LOC100506451	AK090817
4.30	down	LOC100506718	XR_110230
5.50	down	LOC100507150	XR_108536
2.52	down	LOC100507299	NR_039990
3.57	up	LOC100507429	XR_110179
3.52	up	LOC100507429	XR_110179

3.69	down	LOC100507460	XR_109894
3.42	down	LOC100507460	XR_109894
3.36	down	LOC100507474	XR_109895
4.82	down	LOC100507580	XR_109752
2.04	down	LOC100507624	XR_110188
2.99	up	LOC100508384	XM_003119544
2.31	up	LOC100652730	XR_132670
2.12	up	LOC100652730	XR_132670
2.06	down	LOC100652838	XR_132689
4.97	up	LOC146880	NR_026899
4.72	up	LOC219347	NR_027428
3.70	down	LOC283861	AK098143
3.10	up	LOC388906	NR_036498
2.25	up	LOC440570	XR_113295
2.74	down	LOC441204	NR_015364
2.01	down	LOC541471	NR_015395
2.13	down	LOC645954	XR_109026
8.39	down	LOC729444	NR_038388
2.50	down	LRP12	NM_013437
2.02	down	MAGI2	NM_012301
10.38	up	MAL	NM_002371
3.83	down	MCOLN3	BC060765
2.96	down	MECOM	NM_004991
3.60	down	MGC4294	XR_109628
2.78	down	MIR143HG	NR_027180
26.40	down	MMP7	NM_002423
2.26	down	MN1	NM_002430
2.40	up	MPRIP	
2.57	down	MRC2	NM_006039
3.82	up	MZT2A	
2.08	down	ND4L	AK311996
2.06	down	NEAT1	AF001893
3.51	down	NEK10	AK057247
4.66	down	NLGN4X	NM_020742
3.82	down	NLGN4Y	NM_014893
2.18	up	NPHS1	NM_004646
2.49	down	NRP2	NM_201264
2.12	down	NRP2	NM_201264
2.62	down	NUAK1	NM_014840
6.01	up	OTOP3	NM_178233
2.54	down	PALLD	NM_001166109
2.03	down	PALLD	NM_016081
2.05	down	PBX3	NM_006195
2.23	down	PDXDC2P	BX647358
2.24	down	PER3	NM_016831
2.20	down	PGM5P2	NR_002836
4.12	down	PLCB4	NM_182797
2.02	down	PLEC	NM_201380
3.50	down	PMEPA1	NM_020182

3.12	down	PMEPA1	NM_020182
2.58	down	PNMA6C	NM_001170944
3.01	down	PPARGC1A	NM_013261
2.54	down	PPP1R1C	NM_001080545
2.11	down	PRICKLE1	NM_153026
2.14	down	PROCA1	NM_152465
5.19	up	PSPH	NM_004577
2.22	down	PTPRG	NM_002841
2.38	down	PTPRU	NM_005704
2.32	down	RAI14	NM_015577
2.42	down	RASGEF1A	NM_145313
2.13	up	RASGRP2	NM_153819
2.00	up	RAX	NM_013435
2.27	down	RBMS3	NM_014483
2.63	down	RBPMS	AK057533
2.01	down	RHOBTB1	NM_001242359
2.50	up	RNF112	NM_007148
2.48	down	RPS23	NM_001025
2.07	up	RSPH9	AK055407
2.03	up	RXRG	NR_033824
5.41	down	SALL4	NM_020436
2.19	down	SEC14L2	NM_033382
3.20	down	SEPW1	NM_003009
2.44	down	SH3PXD2A	NM_014631
2.01	down	SH3PXD2A	NM_014631
7.50	down	SHISA2	NM_001007538
2.24	up	SHMT1	NM_004169
4.01	down	SIX5	NM_175875
5.51	up	SLC27A2	NM_003645
6.11	down	SLITRK6	NM_032229
4.32	down	SLITRK6	NM_032229
2.04	down	SLMO1	NM_006553
2.49	down	SMA4	NR_029426
2.02	up	SNORD105	NR_004381
2.17	up	SNORD119	NR_003684
3.31	up	SNORD34	NR_000019
3.15	up	SNORD45B	NR_002748
2.12	up	SNORD59B	NR_003046
2.28	up	SNORD65	NR_003054
2.16	up	SNORD67	NR_003056
2.35	down	SOX4	NM_003107
2.07	up	SPEG	
3.16	up	SPINK7	NM_032566
3.63	down	SPOCK1	NM_004598
2.72	down	STRA6	NM_001142620
2.68	down	TCF7L2	NM_030756
2.17	down	TCP11L1	NM_018393
4.78	down	TEKT2	NM_014466
2.14	down	TJP2	

3.25	down	TMCC2	NM_014858
4.15	down	TMEM108	NM_023943
3.83	down	TMEM190	NM_139172
2.26	down	TMEM63C	NM_020431
4.43	down	TNFRSF12A	NM_016639
3.93	down	TOB2P1	NR_002936
2.43	down	TPST1	NM_003596
2.59	up	TREML2	NM_024807
3.73	down	TTC25	NM_031421
3.62	down	TTLL7	NM_024686
2.39	down	TTLL7	NM_024686
3.43	down	VGF	NM_003378
2.18	up	VTRNA1-1	NR_026703
3.34	down	WDR86	NM_198285
2.78	down	WNT3	NM_030753
2.37	down	WNT5B	NM_030775
2.77	down	XIAP	NM_001167
4.61	down	XLOC_000587	
3.77	down	XLOC_000587	AK124056
2.66	down	XLOC_000647	CR617576
2.21	up	XLOC_002323	
2.12	down	XLOC_003515	BX110533
2.12	up	XLOC_003546	AL833514
4.34	down	XLOC_004229	
2.09	up	XLOC_004456	
3.13	up	XLOC_004643	DB301429
3.54	down	XLOC_005361	
2.50	up	XLOC_005490	
3.02	down	XLOC_006721	
3.20	down	XLOC_007467	
2.17	up	XLOC_007607	
4.23	up	XLOC_009120	
3.35	down	XLOC_011052	
2.80	down	XLOC_012467	
3.62	up	XLOC_013737	AK090932
3.67	down	XLOC_l2_001011	BC030750
5.61	up	XLOC_l2_003897	
2.48	up	XLOC_l2_008009	
2.01	down	XLOC_l2_008031	
3.16	down	XLOC_l2_008203	
2.73	down	XLOC_l2_008203	
2.69	down	XLOC_l2_008288	CD557693
9.53	down	XLOC_l2_009332	AK096564
2.91	down	XLOC_l2_009332	
3.62	up	XLOC_l2_009539	
2.12	down	XLOC_l2_011204	BX104493
2.01	down	XLOC_l2_011204	BX104493
2.90	down	XLOC_l2_012925	
2.25	up	XLOC_l2_015878	

2.26	down	ZBED1	NM_001171135
2.15	down	ZNF514	NM_032788
2.10	up	ZNF799	NM_001080821
3.10	down		AK130638
3.02	up		BX115224
2.62	up		Y15200
2.30	up		BU535024
2.22	up		X15019
2.17	down		AF264629
2.13	up		DB028131
2.08	up		AF239727
2.07	down		XM_003118656
2.05	up		BC071639
2.02	down		AK025716

APPENDIX G-DEG EA HPV-INACTIVE VS AA HPV-INACTIVE

Table G.1: EA HPV-Inactive vs AA HPV-Inactive tumors p 0.05, FC 2

FC (abs)	Direction of change	Gene symbol	Genbank accession
4.59	up	ABCA6	NM_080284
5.33	up	ABCB1	NM_000927
2.37	up	ABHD13	NM_032859
7.76	up	ABI3BP	NM_015429
7.85	up	ABI3BP	NM_015429
2.06	up	ABP1	NM_001091
2.39	up	ABTB1	NM_032548
2.27	up	ACBD4	NM_024722
6.13	down	ACBD4	NM_024722
2.12	down	ACPT	NM_033068
2.73	up	ACSM3	NM_202000
4.59	up	ACSM5	NM_017888
227.45	up	ACTA1	NM_001100
2.84	up	ADAL	NM_001012969
3.67	down	ADAM11	NM_002390
2.27	up	ADAM19	NM_033274
2.31	up	ADAM28	NM_021777
2.50	up	ADAM8	NM_001109
2.55	up	ADCY4	NM_139247
5.50	up	ADCYAP1	NM_001099733
2.88	up	ADHFE1	NM_144650
3.32	up	ADHFE1	NM_144650
5.37	up	ADORA2A	NM_000675
2.95	up	ADRBK2	NM_005160
2.78	up	AGER	NM_001206966
2.43	up	AGTPBP1	NM_015239
4.00	up	AIF1	NM_004847
2.94	down	AK4	NM_001005353
3.84	up	AKAP2	NM_001004065
2.24	up	ALS2	AK090992
3.65	up	ALS2CR8	NM_024744
6.85	up	AMICA1	NM_153206
11.66	up	AMPD1	NM_000036
2.10	up	AMZ2P1	NR_026903
12.75	up	ANGPTL1	NM_004673
4.73	up	ANK1	NM_000037
2.77	up	ANKDD1A	NM_182703

3.36	up	ANKDD1A	NM_182703
2.58	up	ANKRD10	NM_017664
2.51	up	ANKRD10-IT1	XR_109155
2.06	up	ANKRD12	NM_001204056
2.46	down	ANKRD13B	NM_152345
5.61	up	ANKRD23	NM_144994
2.07	down	ANKRD24	NM_133475
3.23	up	ANKRD33B	NM_001164440
2.24	up	ANKRD42	NM_182603
2.35	down	ANO8	NM_020959
2.87	up	ANTXR2	NM_058172
9.09	down	ANXA10	NM_007193
8.04	up	AOX1	NM_001159
10.37	up	AOX1	NM_001159
6.27	down	AP1M2	NM_005498
2.66	up	AP1S2	NM_003916
2.02	down	AP4M1	NM_004722
4.17	up	APBB1IP	NM_019043
5.09	up	APBB1IP	NM_019043
2.72	down	APC2	NM_005883
2.15	down	APOA1BP	NM_144772
3.30	up	APOL6	NM_030641
4.75	down	ARG2	NM_001172
2.17	up	ARHGAP12	NM_018287
6.15	up	ARHGAP15	NM_018460
3.10	up	ARHGAP24	NM_001025616
3.50	up	ARHGAP24	AK130576
3.92	up	ARHGAP25	NM_001007231
4.74	up	ARHGAP30	NM_001025598
2.09	down	ARHGAP39	NM_025251
3.01	up	ARHGAP6	NM_013427
5.82	up	ARHGAP9	NM_032496
3.78	up	ARHGDIB	NM_001175
2.21	up	ARHGEF3	NM_019555
6.07	up	ARHGEF6	NM_004840
3.97	up	ARHGEF7	NM_145735
2.32	up	ARL17A	NM_016632
2.41	up	ARL6IP5	NM_006407
2.15	down	ARMC10	NM_031905
3.32	up	ARMCX4	NR_028407
2.30	down	ARPC1A	NM_006409
3.62	up	ARSG	AB023218
3.08	down	ARTN	NM_057090
3.23	up	ASGR2	NM_080912
4.54	up	ASPA	NM_000049
2.20	up	ASRGL1	NM_001083926
2.24	up	ATG16L2	NM_033388
5.15	up	ATOH8	NM_032827
29.99	up	ATP1A2	NM_000702

9.65	up	ATP2A3	NM_174953
2.11	up	ATP2B4	NM_001001396
6.77	up	ATP8A1	NM_006095
8.37	down	ATP8B3	NM_138813
4.17	up	B2M	NM_004048
2.21	down	B4GALT2	NM_003780
5.84	down	BAIAP2L1	NM_018842
6.28	down	BAIAP2L2	NM_025045
18.36	up	BANK1	NM_017935
2.63	up	BDH2	NM_020139
2.00	up	BEST1	NM_004183
4.99	up	BHMT2	NM_017614
5.21	up	BIRC3	NM_001165
24.11	up	BLK	NM_001715
2.32	up	BMF	NM_001003940
4.00	up	BMX	NM_001721
2.06	up	BNIP2	AK125533
2.22	up	BRWD1	NM_018963
2.69	up	BST1	NM_004334
2.80	up	BTD	NM_000060
2.34	up	BTG2	NM_006763
4.46	up	BTK	NM_000061
4.80	up	BTK	NM_000061
9.44	up	BTLA	NM_181780
2.23	down	C10orf120	NM_001010912
5.66	up	C10orf128	NM_001010863
3.77	up	C14orf64	NR_015430
2.06	up	C15orf57	NM_052849
9.26	up	C16orf54	NM_175900
3.11	up	C16orf86	NM_001012984
4.16	up	C17orf87	AK057142
2.87	up	C18orf18	NR_026849
3.59	up	C1orf162	NM_174896
2.07	down	C1orf183	NM_019099
2.91	down	C1orf61	XR_108361
2.76	up	C20orf106	NM_001012971
9.08	up	C20orf26	NM_015585
4.85	up	C21orf7	NM_020152
2.11	down	C2CD4C	NM_001136263
3.82	up	C2orf84	NM_001040710
5.06	down	C3orf67	NM_198463
3.04	up	C3orf71	NM_001123040
4.95	up	C4B	NM_001002029
6.15	up	C5orf20	NM_130848
2.17	up	C6orf192	NM_052831
2.63	up	C7orf41	NM_152793
2.07	up	C8orf60	AK022255
2.44	up	C9orf102	NM_001010895
3.67	up	C9orf123	NM_033428

5.26	up	C9orf128	NM_001012446
2.14	down	C9orf131	NM_203299
2.10	up	C9orf64	
2.82	up	C9orf72	NM_145005
2.14	up	CA5B	NM_007220
2.82	up	CA5B	
3.10	up	CA8	NM_004056
6.80	down	CA9	NM_001216
2.10	up	CAB39L	NM_030925
2.18	down	CACNB3	NM_000725
4.77	up	CACNB4	NM_001005747
15.82	up	CACNG6	NM_145814
4.94	down	CAMK2N2	NM_033259
2.48	up	CANX	NM_001746
2.87	up	CAPN3	NM_000070
5.10	up	CAPN7	NM_014296
2.42	up	CARD8	NM_001184904
3.36	up	CARD8	NM_014959
2.44	up	CARD9	NM_052814
2.99	up	CARD9	NM_052813
4.01	up	CARNS1	NM_001166222
2.55	up	CASP8	NM_033358
13.62	up	CASQ2	NM_001232
4.06	up	CATSPER2	NM_172095
4.72	up	CATSPER2	NM_172097
2.17	up	CBR4	NM_032783
4.19	up	CBX7	NM_175709
3.87	up	CCDC69	NM_015621
10.61	up	CCL14	NM_032963
16.52	up	CCL18	NM_002988
4.32	up	CCL2	NM_002982
33.06	up	CCL21	NM_002989
33.56	up	CCL21	NM_002989
9.38	up	CCL23	NM_005064
2.00	down	CCNE1	NM_001238
3.67	up	CCNG2	NM_004354
2.28	up	CCR1	NM_001295
9.28	up	CCR2	NM_001123041
5.33	up	CCR4	NM_005508
2.78	up	CCR6	NM_031409
9.17	up	CCR7	NM_001838
3.66	up	CD163L1	NM_174941
4.38	up	CD1B	NM_001764
12.59	up	CD1C	NM_001765
10.66	up	CD1E	NM_001042583
2.68	up	CD200	NM_001004196
3.18	up	CD200R1	NM_138939
7.04	up	CD200R1	NM_138806
5.23	up	CD209	NM_021155

6.49	up	CD209	NM_001144897
8.32	up	CD209	NM_021155
9.06	up	CD22	NM_001771
2.53	down	CD244	NM_001166663
10.79	up	CD247	NM_198053
9.51	up	CD28	NM_006139
2.58	up	CD300A	NM_007261
3.13	up	CD302	NM_014880
3.47	up	CD302	NM_014880
5.82	up	CD3G	NM_000073
2.09	up	CD40	NM_001250
2.51	up	CD40	NM_001250
12.34	up	CD40LG	NM_000074
5.80	up	CD53	NM_001040033
5.68	up	CD6	NM_006725
8.76	up	CD69	AK303383
11.41	up	CD69	NM_001781
4.30	up	CD74	NM_001025158
11.26	up	CD79B	NM_001039933
6.75	up	CD96	NM_198196
2.81	up	CD97	NM_078481
2.65	down	CD99P1	NR_033381
2.86	down	CD99P1	NR_033381
3.97	up	CDC42SE2	NM_020240
3.73	down	CDC6	NM_001254
3.40	down	CEACAM20	NM_001102598
6.39	up	CEACAM21	NM_033543
7.62	up	CEACAM21	NM_001098506
2.88	up	CELF2	NM_001025077
3.52	up	CELF2	NM_001025076
2.16	up	CFH	NM_001014975
2.36	up	CFH	NM_000186
2.54	up	CFH	NM_001014975
2.18	up	CFHR3	NM_021023
3.50	up	CFI	NM_000204
4.36	up	CFI	NM_000204
7.33	up	CFP	NM_002621
2.26	up	CG030	NR_026928
2.90	down	CHAT	NM_020549
2.11	up	CHCHD7	NM_001011667
16.53	up	CHI3L2	NM_001025199
25.95	up	CHRDL1	NM_001143981
3.93	up	CHURC1	NM_145165
16.70	up	CKMT2	NM_001825
5.05	up	CLEC10A	NM_182906
4.95	up	CLEC2D	NM_013269
4.68	up	CLEC4A	NM_016184
12.22	up	CLEC4G	NM_198492
72.21	up	CLEC4G	NM_198492

12.56	up	CLEC4GP1	NR_002931
10.57	up	CLEC9A	NM_207345
6.14	up	CLECL1	NM_172004
3.19	up	CLIC2	NM_001289
2.64	up	CLIC5	NM_016929
4.63	up	CLIC5	NM_016929
2.16	up	CLK1	NM_004071
2.39	up	CLN5	NM_006493
2.11	down	CLPS	NM_001832
2.21	up	CLSTN3	NM_014718
2.17	up	CMAHP	NR_002174
2.29	up	CMAHP	NR_002174
2.61	up	CMAHP	NR_002174
3.33	up	CMKLR1	NM_001142343
2.71	up	CMTM7	NM_138410
7.46	up	CNR1	NM_033181
2.09	up	CNTRL	NM_007018
3.49	up	CNTRL	
4.65	up	COL14A1	NM_021110
5.76	up	COL4A3	NM_000091
4.66	down	CORIN	NM_006587
4.30	up	CORO1A	NM_007074
2.86	up	COTL1	NM_021149
4.22	up	CPA3	NM_001870
2.11	down	CPT1C	NM_001199752
2.49	down	CPT1C	NM_001199752
5.59	up	CPVL	NM_019029
4.23	up	CR1L	NM_175710
6.40	down	CRB3	NM_139161
2.95	up	CREBL2	NM_001310
5.33	up	CRTAC1	NM_018058
2.54	down	CRYBA2	NM_005209
3.31	down	CRYBB2	NM_000496
2.89	down	CRYBB2P1	NR_033734
2.54	up	CSF1R	NM_005211
3.01	up	CSF2RA	NM_172249
2.11	up	CTC1	NM_025099
7.13	up	CTLA4	NM_005214
9.23	up	CTLA4	NM_005214
8.38	up	CTSG	NM_001911
2.11	up	CX3CR1	NM_001337
3.10	up	CXCL12	NM_000609
9.74	up	CXCL12	NM_199168
3.90	up	CXCL2	NM_002089
3.37	up	CXCR4	NM_001008540
5.76	up	CXCR6	NM_006564
3.98	up	CXorf21	NM_025159
3.48	down	CXorf48	NM_001031705
14.26	up	CXorf65	NM_001025265

2.59	up	CXXC5	NM_016463
2.09	up	CYB5B	NM_030579
2.42	up	CYBASC3	NM_153611
4.23	up	CYBB	NM_000397
2.73	up	CYLD	NM_015247
2.59	down	CYP11A1	NM_000781
3.43	up	CYP2E1	NM_000773
3.04	down	CYP51A1	NM_000786
3.03	up	CYSLTR1	NM_006639
3.80	up	CYTH4	NM_013385
5.82	up	CYTIP	NM_004288
7.96	up	CYTL1	NM_018659
8.41	up	CYTL1	NM_018659
2.76	up	DACH1	NM_080759
2.99	up	DACH1	NM_080759
2.49	up	DBNL	AB209486
2.28	down	DCAKD	NM_024819
3.11	down	DDX11L2	NR_024005
2.20	up	DDX17	NM_006386
3.52	up	DDX26B	NM_182540
3.57	up	DDX26B	NM_182540
2.17	up	DENND1B	NM_001195215
4.15	up	DENND1C	NM_024898
2.36	up	DENND3	AK125506
2.76	up	DENND3	NM_014957
4.29	up	DENND4C	AK000627
3.50	down	DHCR7	NM_001360
5.79	up	DIO3OS	NR_002770
2.28	up	DISC1	NM_018662
2.40	up	DISC1	NM_001164544
2.23	up	DKFZP586I1420	NR_002186
3.03	down	DNAJB1	NM_006145
2.87	up	DNMT3A	NM_175630
4.22	up	DOCK10	NM_014689
2.49	up	DOCK11	NM_144658
6.00	up	DOCK2	NM_004946
9.36	up	DOCK2	NM_004946
2.02	down	DOCK7	NM_033407
3.02	up	DOCK8	NM_203447
3.82	up	DOK2	NM_003974
3.05	down	DOK7	AK075037
4.92	up	DPP4	NM_001935
2.76	up	DPYD	NM_000110
2.55	down	DSCR10	NR_027695
3.17	down	DSCR9	NR_026719
7.30	up	DUSP26	NM_024025
5.22	down	DUSP5P	NR_002834
2.45	up	DYNLT1	AK026669
2.93	up	EAF2	NM_018456

3.34	up	EBF3	NM_001005463
3.10	up	EBI3	NM_005755
2.47	up	EDNRB	NM_003991
5.69	down	EGFL6	NM_001167890
2.00	up	EGR1	NM_001964
2.85	up	EGR3	NM_004430
2.30	up	EHD1	NM_006795
2.70	down	EIF4EBP1	NM_004095
2.78	down	ELOVL6	NM_024090
2.01	up	EMP3	NM_001425
4.77	up	EMR3	NM_032571
2.90	down	ENO2	NM_001975
8.05	up	ENO3	NM_001976
5.64	up	ENPP2	NM_006209
6.60	up	ENPP3	NM_005021
2.32	up	ENTPD1	NM_001776
4.29	down	ERBB3	NM_001005915
2.32	down	ERC1	NM_178040
5.79	up	ERLIN2	NM_001003790
3.75	down	ERVMER34-1	NM_024534
4.61	down	ERVMER34-1	NM_024534
5.93	down	ERVMER34-1	NM_024534
3.35	up	ESR1	NM_000125
3.32	up	ETS1	NM_005238
5.28	down	ETV2	NM_014209
3.90	up	EVI2A	NM_001003927
2.08	down	EXOSC4	NM_019037
2.15	down	F11R	NM_016946
5.35	up	F5	NM_000130
2.50	up	FAM105A	NM_019018
2.56	up	FAM106CP	NR_026810
5.75	up	FAM107A	NM_007177
3.70	up	FAM107B	NM_031453
4.96	up	FAM107B	NM_031453
2.55	up	FAM113B	NM_138371
2.48	up	FAM118A	NM_017911
2.41	up	FAM122C	NM_138819
2.18	down	FAM125A	NM_138401
2.90	up	FAM125B	NM_033446
3.87	up	FAM13A-AS1	NR_002806
4.72	up	FAM150B	NM_001002919
2.36	down	FAM162A	NM_014367
2.19	down	FAM166A	NM_001001710
10.51	down	FAM183A	AK309744
2.89	up	FAM189A2	NM_004816
7.82	up	FAM65B	NM_014722
9.54	up	FAM65B	NM_015864
2.93	up	FAM65C	NM_080829
3.42	up	FAM78A	NM_033387

2.08	up	FAM7A3	NR_026859
2.32	up	FAM82A1	NM_144713
2.93	up	FAM95B1	NR_026759
3.91	down	FANK1	
2.43	down	FASN	NM_004104
3.46	up	FAT4	NM_024582
4.00	down	FBLL1	NR_024356
2.37	down	FBXO22-AS1	NR_003136
5.32	up	FCER1A	NM_002001
3.10	up	FCGR2B	NM_004001
2.25	up	FCGRT	NM_004107
8.97	up	FCRL2	NM_030764
30.69	up	FCRL3	AK301257
9.61	up	FCRLA	NM_032738
2.13	up	FES	NM_002005
2.04	down	FGD1	NM_004463
5.84	up	FGL2	NM_006682
3.80	up	FITM1	NM_203402
2.92	up	FLI1	NM_002017
3.33	up	FLJ27354	NR_033981
2.15	up	FLJ31306	NR_029434
2.78	up	FLJ39639	NR_033904
2.11	down	FLJ40039	AK097358
3.84	up	FLJ43663	NR_015431
3.92	up	FLJ43663	NR_015431
4.36	up	FLJ43663	NR_015431
4.65	up	FLJ43663	NR_015431
6.82	up	FLJ43663	NR_015431
4.10	down	FLJ43860	NM_207414
2.03	down	FLJ46906	NR_033896
4.99	up	FLT3	NM_004119
2.35	up	FLVCR1-AS1	NR_027286
2.19	up	FLVCR2	NM_017791
2.21	up	FMOD	NM_002023
2.57	up	FNBP1	AK023681
2.74	up	FNBP1	NM_015033
2.57	up	FOS	NM_005252
4.91	down	FOXD2	NM_004474
2.55	up	FOXP3	NM_014009
2.04	up	FPGT-TNNI3K	BX640903
2.73	up	FPR2	NM_001462
2.70	up	FRY	NM_023037
3.11	up	FRY	BX537670
5.79	down	FSIP2	NM_173651
15.66	down	FTSJD2	NM_015050
3.40	up	FUCA1	NM_000147
2.44	up	FXYD1	NM_005031
6.25	up	FYB	NM_001465
2.70	up	FYN	NM_002037

5.22	down	FZD9	NM_003508
3.35	up	G0S2	NM_015714
5.53	down	GABRR1	NM_002042
3.37	down	GALNT9	NM_021808
6.90	up	GAPT	NM_152687
5.12	down	GAST	NM_000805
2.13	up	GBP3	NM_018284
3.12	up	GCA	NM_012198
3.33	down	GCAT	NM_014291
4.95	up	GCFC1-AS1	NR_038879
10.63	up	GDF10	NM_004962
2.23	down	GDF11	NM_005811
4.76	up	GFI1	NM_005263
3.61	up	GFRA1	NM_005264
3.69	up	GFRA2	NM_001495
2.21	up	GGA2	NM_015044
2.25	down	GGT3P	NR_003267
3.22	up	GGTA1P	NR_003191
5.23	up	GHRL	NM_016362
2.42	up	GHRLOS	NR_004431
4.89	up	GIMAP2	NM_015660
3.65	up	GIMAP4	NM_018326
5.37	up	GIMAP5	NM_018384
3.76	up	GIMAP6	NM_024711
5.63	up	GIMAP7	NM_153236
2.79	up	GIMAP8	NM_175571
4.50	up	GLCCI1	NM_138426
2.88	up	GLRX	NM_002064
2.60	up	GLT1D1	NM_144669
3.17	up	GLYCTK	NM_145262
4.91	up	GMFG	NM_004877
2.83	up	GNA14	NM_004297
2.10	up	GNAI2	NM_002070
5.39	up	GNAO1	NM_020988
2.84	up	GNG2	NM_053064
6.06	down	GNG4	NM_001098722
2.77	up	GNGT2	NM_031498
2.20	up	GNMT	NM_018960
2.40	down	GNRH2	NM_178332
2.48	down	GP9	NM_000174
5.13	up	GPR183	NM_004951
3.10	up	GPR34	NM_001097579
3.38	down	GPRIN1	NM_052899
5.84	up	GPRIN3	NM_198281
2.01	up	GRASP	NM_181711
2.02	down	GRIN2A	NM_001134408
4.34	down	GRIN2D	NM_000836
4.19	down	GSTT2	NM_000854
4.78	down	GSTT2B	NM_001080843

5.46	up	GUCY2C	NM_004963
2.12	down	GUCY2GP	NR_028134
2.75	up	GUSBP2	NR_003504
2.58	down	H2AFY2	NM_018649
3.23	up	H3F3B	NM_005324
3.33	up	H6PD	NM_004285
2.06	up	HACL1	NM_012260
7.96	down	HAPLN1	NM_001884
6.99	up	HCG26	NR_002812
3.43	up	HCK	NM_002110
4.69	up	HCLS1	NM_005335
4.17	up	HDC	NM_002112
2.10	down	HEATR5A	BC062720
2.37	up	HELQ	NM_133636
2.49	up	HESX1	NM_003865
2.42	up	HEXDC	NM_173620
3.89	up	HHEX	NM_002729
3.76	down	HILS1	NR_024193
3.63	up	HIVEP3	NM_024503
6.93	down	HK2	NM_000189
2.53	up	HLA-A	NM_002116
2.82	up	HLA-A	NM_002116
2.40	up	HLA-B	NM_005514
5.21	up	HLA-DMB	NM_002118
6.01	up	HLA-DOA	NM_002119
5.07	up	HLA-DPA1	NM_033554
5.33	up	HLA-DPA1	NM_001242524
4.87	up	HLA-DPB1	NM_002121
5.21	up	HLA-DPB1	NM_002121
5.31	up	HLA-DPB1	NM_002121
5.65	up	HLA-DPB1	NM_002121
4.19	up	HLA-DPB2	NR_001435
4.65	up	HLA-DQB1	NM_001243962
5.86	up	HLA-DQB1	NM_002123
7.71	up	HLA-DQB1	NM_001243961
10.05	up	HLA-DQB1	NM_001243962
6.73	up	HLA-DQB2	NM_001198858
4.93	up	HLA-DRA	NM_019111
4.55	up	HLA-DRB1	NM_002124
4.50	up	HLA-DRB4	NM_021983
6.00	up	HLA-DRB5	NM_002125
2.57	up	HLA-E	NM_005516
3.48	up	HLA-F	NM_018950
2.96	up	HLA-G	NM_002127
3.07	up	HLA-J	NR_024240
2.21	up	HMBOX1	NM_024567
2.41	up	HMBOX1	NM_024567
3.14	up	HMGA1P4	XR_108949
4.40	up	HMHA1	NM_012292

2.78	down	HOXA4	NM_002141
2.11	down	HOXA6	NM_024014
2.64	down	HOXC8	NM_022658
11.31	up	HPR	NM_020995
5.07	down	HSD17B1	NM_000413
2.06	down	HSP90AA5P	AY956761
5.58	down	HSPA4L	NM_014278
2.99	down	HSPB1	NM_001540
2.13	down	HSPG2	NM_005529
3.13	down	HTR4	NM_001040172
4.15	up	HVCN1	NM_001040107
4.68	up	HVCN1	NM_001040107
2.84	up	ICA1	NM_004968
6.16	up	ICOS	NM_012092
2.14	up	ID2	NM_002166
2.19	up	ID2	NM_002166
6.20	up	IDO2	NM_194294
2.14	up	IFFO1	NM_001039670
2.61	down	IFT81	NM_031473
2.08	up	IFT88	NM_175605
2.00	down	IGF2-AS	NR_028044
31.06	down	IGFL3	NM_207393
6.65	up	IGFN1	NM_001164586
5.78	up	IGJ	NM_144646
4.42	up	IGSF10	NM_178822
6.22	up	IKZF1	NM_006060
2.47	up	IKZF2	NM_001079526
7.26	up	IKZF3	NM_012481
4.87	up	IL10RA	NM_001558
4.87	up	IL16	NM_004513
2.91	up	IL18RAP	NM_003853
7.29	up	IL22RA2	NM_052962
9.07	up	IL22RA2	NM_181310
7.24	up	IL2RB	NM_000878
7.68	up	IL2RG	NM_000206
3.09	up	IL32	NM_001012631
2.03	up	IL4R	NM_000418
2.23	up	IL6R	NM_001206866
2.59	up	IL6ST	NM_002184
3.27	up	IL6ST	NM_001190981
3.42	up	IL6ST	NM_001190981
4.12	up	IL6ST	NM_002184
5.07	up	IL7	NM_000880
3.74	up	IL7R	NM_002185
4.72	up	INPP5D	NM_001017915
2.03	down	INPP5F	NM_001243195
2.50	down	IQGAP3	NM_178229
11.02	up	IRF4	NM_002460
8.65	down	IRF6	NM_006147

7.95	up	IRF8	NM_002163
4.14	down	IRX5	NM_005853
2.02	up	ISCU	NM_014301
3.57	up	ITGA4	NM_000885
4.36	up	ITGA4	NM_000885
2.33	up	ITGB1BP2	NM_012278
6.92	up	ITIH4	NM_002218
2.40	up	ITIH5	NM_001001851
20.88	up	ITK	NM_005546
5.97	up	ITM2A	NM_004867
3.36	up	ITPR1	NM_002222
2.15	up	ITPR2	NM_002223
2.08	up	JAK3	NM_000215
5.60	up	JAK3	NM_000215
2.11	up	JPH3	AB593088
2.50	down	JPH3	NM_020655
3.27	up	JPH4	NM_032452
66.39	up	KBTBD10	NM_006063
3.53	up	KBTBD11	NM_014867
4.77	up	KBTBD8	NM_032505
2.18	down	KCNA10	NM_005549
5.60	up	KCNN4	NM_002250
4.28	down	KDM4B	NM_015015
5.43	up	KIAA0226L	NM_025113
2.17	up	KIAA1147	NM_001080392
2.15	down	KIAA1671	NM_001145206
3.39	down	KIAA1671	NM_001145206
2.67	up	KIF19	NM_153209
2.90	up	KIT	NM_000222
3.53	up	KIT	NM_001093772
2.42	up	KL	NM_004795
2.79	up	KLF2	NM_016270
2.45	up	KLF9	NM_001206
4.81	up	KLHDC1	NM_172193
4.93	up	KLHL3	NM_017415
3.38	up	KLHL6	NM_130446
12.83	up	KLRB1	NM_002258
5.65	up	KLRC4	NM_013431
5.58	up	KLRF1	NM_016523
10.48	up	KLRF1	NM_016523
5.56	down	KLRG2	NM_198508
5.96	up	KLRK1	NM_007360
3.14	up	KMO	NM_003679
2.42	down	KREMEN1	NM_001039570
3.98	up	KRT222	NM_152349
2.94	down	KRT8	NM_002273
3.11	down	KRT9	NM_000226
2.80	down	KRTAP1-3	NM_030966
4.97	up	KRTAP19-2	NM_181608

2.36	down	KRTAP19-7	NM_181614
2.35	down	KRTAP20-2	NM_181616
2.57	down	KRTAP6-1	NM_181602
3.38	down	KRTCAP3	NM_173853
2.94	up	L3MBTL3	NM_032438
2.73	up	LAIR1	NM_002287
4.67	up	LAPTM5	NM_006762
3.49	up	LAT2	NM_032464
3.55	up	LCP2	NM_005565
3.41	down	LCTL	NM_207338
7.35	up	LDLRAD2	NM_001013693
9.42	up	LEPR	NM_001003679
5.85	up	LIMS3L	NM_001205288
2.06	up	LINC00277	NR_026949
3.50	down	LINC00319	NR_026960
2.99	up	LINC00339	NR_023918
8.60	up	LINC00426	NR_024464
2.60	up	LINC00476	NR_023389
2.84	up	LMO2	NM_005574
6.91	up	LOC100128420	NR_038461
6.57	up	LOC100128531	NR_038941
2.66	down	LOC100128703	AK128830
6.34	down	LOC100128881	NR_036480
5.05	up	LOC100129973	AF007131
2.32	down	LOC100130009	XM_001718914
2.24	down	LOC100130015	NR_027335
3.63	down	LOC100130238	NR_024563
2.93	down	LOC100130522	NR_028340
2.85	down	LOC100130673	NR_038454
2.31	down	LOC100130776	NR_027032
2.44	up	LOC100131089	NR_040059
3.20	up	LOC100131089	NR_040062
3.52	up	LOC100131089	NR_040059
4.20	up	LOC100131089	NR_040059
2.89	up	LOC100132111	NR_024237
2.78	down	LOC100132354	NR_024478
4.53	up	LOC100132707	BC050402
2.35	up	LOC100133445	NR_037844
2.46	down	LOC100190939	NR_024458
2.01	up	LOC100216545	NR_024586
3.30	up	LOC100270804	NR_026885
3.35	up	LOC100270804	NR_026885
4.15	up	LOC100287188	XM_003119104
2.60	down	LOC100287765	NR_038988
2.00	down	LOC100499194	NR_034130
2.25	up	LOC100505495	NR_040109
2.44	up	LOC100505495	NR_040109
2.97	up	LOC100505495	NR_040109
73.11	up	LOC100505495	NR_040109

2.78	up	LOC100505500	XR_108722
2.18	down	LOC100505504	XR_110921
6.80	up	LOC100505576	NR_038847
3.55	up	LOC100505648	NR_040058
2.25	down	LOC100505657	XM_003118895
3.06	up	LOC100505687	NR_038301
6.52	up	LOC100505746	NR_038311
2.25	up	LOC100505894	CR625773
2.14	down	LOC100505903	XR_110201
3.29	up	LOC100506036	XR_109916
4.68	up	LOC100506178	NR_038393
2.64	up	LOC100506342	XR_108862
2.90	down	LOC100506374	XR_109498
3.77	down	LOC100506374	XR_109498
2.10	up	LOC100506516	XR_108763
3.60	up	LOC100506553	XR_109636
10.46	up	LOC100506582	XR_109454
6.44	up	LOC100506779	NR_038410
4.56	up	LOC100506802	XR_132718
2.29	up	LOC100506860	XR_108813
2.32	up	LOC100506922	XR_109888
2.72	up	LOC100506990	NR_040092
2.75	up	LOC100506990	NR_040092
7.43	down	LOC100507003	NM_001195256
7.01	up	LOC100507042	XR_108778
2.44	down	LOC100507055	BX379759
2.64	up	LOC100507062	NR_038286
2.16	down	LOC100507077	XR_110527
2.41	up	LOC100507204	XR_108902
3.89	up	LOC100507254	NR_038981
5.83	up	LOC100507254	NR_038981
3.00	up	LOC100507280	XR_110418
10.01	up	LOC100507307	XR_109952
5.71	up	LOC100507309	XR_109012
5.07	up	LOC100507347	XR_109013
3.09	up	LOC100507360	XR_109953
2.27	up	LOC100507373	
2.36	down	LOC100507420	XR_110876
2.13	down	LOC100507520	XR_109439
3.78	down	LOC100507588	NM_001195259
2.59	down	LOC100507591	XR_109528
3.52	up	LOC100507602	XR_110081
8.42	up	LOC100507616	XR_110328
17.35	up	LOC100507616	XR_110328
4.42	up	LOC100507632	NR_038236
2.05	down	LOC100509196	XM_003119833
2.18	up	LOC100527964	NR_037642
2.12	down	LOC100652807	XM_003403510
2.16	down	LOC100652869	XM_003403453

4.02	up	LOC100652951	XR_132888
2.11	down	LOC100652993	XR_132786
5.28	up	LOC100653030	XR_132913
2.33	up	LOC100653033	XR_132874
3.55	up	LOC100653060	XM_003403393
2.17	down	LOC100653323	XM_003403859
2.76	up	LOC115110	NR_026927
4.36	up	LOC115110	NR_026927
3.26	up	LOC145820	NR_027132
4.72	up	LOC145820	NR_027133
2.20	down	LOC151171	NR_037809
2.08	down	LOC154860	NR_036484
2.73	up	LOC155060	NR_036573
4.51	down	LOC201651	NR_026915
3.84	down	LOC283553	NR_038358
3.89	up	LOC283624	NR_038970
7.58	up	LOC283663	NR_024433
2.17	down	LOC284889	NR_038911
5.40	up	LOC285419	NR_027105
2.34	down	LOC285577	NR_033898
3.76	up	LOC285957	AK097526
5.46	up	LOC339290	NR_015389
3.49	down	LOC387647	NR_003930
2.37	up	LOC388242	NR_002556
2.62	down	LOC388796	NR_015366
2.83	down	LOC388796	NR_027241
2.86	down	LOC388796	NR_027241
2.89	down	LOC388796	NR_027241
2.90	down	LOC388796	NR_027241
3.77	up	LOC389634	NR_024420
5.14	up	LOC400456	NR_034095
2.14	down	LOC400662	AK055411
2.02	down	LOC401074	NR_040005
4.02	up	LOC439949	NR_036502
5.19	up	LOC440900	NR_034128
6.15	up	LOC440900	NR_034128
2.06	up	LOC440993	XR_110395
4.33	up	LOC441179	XR_112948
2.27	down	LOC441204	NR_015364
2.12	down	LOC554207	BC031469
2.22	down	LOC643529	NR_038382
3.30	up	LOC643733	NR_034079
3.96	up	LOC643733	NR_034079
2.78	down	LOC644242	NR_036540
4.04	up	LOC645431	NR_024334
4.83	up	LOC645586	AK057937
2.93	up	LOC646329	NR_034120
2.01	down	LOC649201	XM_001127211
3.94	up	LOC728802	XM_001713923

2.23	up	LOC728875	NR_024584
2.11	up	LOC728903	AK093722
8.47	down	LOC729080	NR_033244
4.98	up	LOC729468	BU567215
3.18	down	LOC729995	XR_110198
2.15	down	LOC92659	NR_015454
6.68	up	LONRF3	
2.40	up	LPIN2	NM_014646
3.08	up	LPXN	NM_004811
6.15	up	LRMP	NM_006152
2.22	down	LRRC1	NM_018214
2.27	down	LRRC23	NM_006992
2.27	up	LRRC25	NM_145256
2.34	up	LRRC33	NM_198565
8.05	up	LRRC39	NM_144620
3.18	up	LRRC70	NM_181506
3.39	down	LRRC72	NM_001195280
6.26	down	LRRC8E	NM_025061
3.69	up	LRRK2	AK127729
3.78	up	LRRK2	NM_198578
2.19	down	LSR	NM_205834
4.24	up	LST1	NM_007161
15.42	up	LTB	NM_002341
2.04	down	LTBR	NM_002342
18.39	up	LTF	NM_002343
15.19	up	LY75	NM_002349
7.54	up	LYVE1	NM_006691
2.64	up	LZTFL1	NM_020347
3.44	down	LZTS2	AK097997
4.09	up	MAB21L2	NM_006439
2.10	down	MAGED4B	NM_030801
2.13	up	MALAT1	NR_002819
2.23	up	MALAT1	NR_002819
2.32	up	MALAT1	NR_002819
5.21	down	MAML3	NM_018717
4.26	up	MAN1B1	CR749534
3.64	up	MAN1C1	NM_020379
2.94	up	MAOB	NM_000898
2.70	up	MAP3K8	NM_005204
6.02	up	MAP4K1	NM_001042600
4.65	down	MAP7	NM_003980
2.30	up	MAP7D3	NM_001173517
2.36	up	MAPRE2	NM_014268
2.29	down	MARVELD3	NM_001017967
2.43	down	MAST1	NM_014975
2.25	up	MAST3	NM_015016
2.20	up	MBLAC2	NM_203406
2.04	up	MBP	NM_001025100
2.09	up	ME3	NM_001014811

2.11	up	ME3	NM_001014811
2.04	down	MEA1	NM_014623
2.62	up	MED23	NM_015979
6.01	up	MEF2C	NM_002397
5.49	up	MEOX1	NM_004527
6.64	up	MEOX2	NM_005924
3.48	up	MGAT4A	NM_012214
2.04	up	MGC21881	NR_015363
2.19	up	MGC21881	NR_015363
2.26	up	MGC21881	NR_015363
2.99	up	MIA3	NM_198551
6.00	up	MIAT	NR_003491
2.05	down	MIB2	NM_080875
2.03	up	MICAL1	NM_022765
2.94	up	MILR1	NM_001085423
2.58	up	MIPEPP3	AK093279
2.06	down	MLXIP	NM_014938
20.13	up	MMRN1	NM_007351
3.42	up	MNDA	NM_002432
2.05	up	MOB3B	NM_024761
3.92	down	MORN4	BC022054
2.14	down	MPDU1	AK027742
3.67	up	MPEG1	NM_001039396
5.66	up	MPEG1	NM_001039396
2.04	down	MPND	NM_032868
2.45	up	MRPL19	
2.17	up	MRPL42P5	NR_002208
2.25	down	MRPS18A	NM_018135
2.96	up	MS4A14	NM_032597
3.23	up	MS4A2	NM_000139
2.28	up	MS4A6A	NM_152852
3.50	up	MS4A6A	NM_022349
2.29	up	MS4A7	NM_021201
4.63	down	MTMR11	NM_181873
9.55	up	MUSTN1	NM_205853
28.90	up	MYBPC1	NM_206819
128.51	up	MYBPC2	NM_004533
39.03	up	MYBPH	NM_004997
2.08	up	MYCBP2	NM_015057
2.44	up	MYCBP2	NM_015057
9.49	up	MYH3	NM_002470
103.19	up	MYL1	NM_079420
2.41	down	MYO19	NM_001033580
2.98	up	MYO1F	NM_012335
3.86	up	MYO1G	NM_033054
3.18	down	MZT2A	
3.76	up	N4BP2L1	NM_052818
2.09	up	N4BP2L2	NM_014887
3.07	up	N4BP2L2	NM_033111

2.16	up	NAAA	NM_001042402
2.80	up	NAALADL1	NM_005468
2.65	up	NAIP	NM_004536
2.98	up	NAIP	NM_004536
3.77	up	NAIP	NM_004536
3.26	up	NAPSA	NM_004851
9.44	up	NCR3	NM_147130
2.71	down	NEDD4L	NM_015277
3.47	down	NEDD4L	NM_001144967
2.07	up	NEK3	NM_002498
4.00	up	NEK8	NM_178170
4.42	up	NEURL	NM_004210
3.05	up	NFAM1	NM_145912
2.26	down	NHLRC1	NM_198586
2.13	up	NINJ1	NM_004148
2.09	up	NKTR	NM_005385
8.71	up	NLRC3	NM_178844
2.22	up	NLRP1	NM_033004
2.43	up	NLRP1	NM_001033053
9.42	up	NLRP2	NM_017852
3.27	up	NLRP3	NM_001243133
3.85	up	NLRP3	NM_001079821
2.71	down	NMB	NM_021077
2.02	down	NME4	NM_005009
3.21	up	NMT2	NM_004808
2.95	up	NOTCH2NL	NM_203458
2.39	down	NQO2	NM_000904
2.35	up	NR2F2	NM_021005
2.47	down	NR2F6	NM_005234
7.08	up	NR3C2	NM_000901
2.34	up	NR5A2	NM_205860
72.87	up	NRAP	NM_198060
2.02	down	NSDHL	NM_001129765
3.53	down	NUDT8	NM_001243750
2.27	up	NXPH3	NM_007225
2.06	down	OBP2B	NM_014581
2.66	up	OGT	NM_181672
2.11	down	OR10G8	NM_001004464
2.02	down	OR13H1	NM_001004486
2.08	down	OR7E14P	NR_045002
3.37	up	ORMDL1	AK126336
3.03	up	OXNAD1	NM_138381
2.84	down	OXT	NM_000915
3.05	up	P2RX5	NM_175080
5.44	up	P2RY10	NM_014499
6.19	up	P2RY12	NM_022788
6.35	up	P2RY13	NM_176894
12.42	up	P2RY14	NM_014879
3.57	up	P2RY8	NM_178129

2.05	up	P4HTM	NM_177938
2.43	up	PAG1	NM_018440
2.82	up	PAG1	NM_018440
2.29	down	PALM3	NM_001145028
2.20	up	PAN3	NM_175854
3.41	up	PAPLN	NM_173462
2.61	up	PARP8	NM_024615
2.34	up	PARP9	NM_031458
2.01	down	PARS2	NM_152268
2.42	down	PC	NM_001040716
2.43	down	PCDHB9	NM_019119
2.21	down	PCDHGA12	NM_032094
2.03	down	PCDHGC4	NM_032406
3.88	up	PDE4B	NM_001037341
3.72	up	PDE4DIP	NM_001198834
5.46	up	PDE4DIP	NM_001198834
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5.48	up	PDE4DIP	NM_001198834
5.85	up	PDE4DIP	NM_014644
6.57	up	PDE4DIP	NM_001198832
2.46	down	PDLIM7	NM_005451
2.49	up	PEAR1	NM_001080471
2.44	up	PECAM1	NM_000442
2.58	up	PECAM1	NM_000442
3.49	up	PER3	NM_016831
4.87	up	PER3	NM_016831
2.85	up	PGLYRP1	NM_005091
3.75	up	PGM5	NM_021965
9.87	up	PGM5	NM_021965
3.33	up	PGPEP1L	NM_001167902
4.68	up	PHACTR1	AB051520
5.19	down	PHLDB2	BC038806
2.57	up	PIK3CD	NM_005026
3.08	up	PIK3CD	NM_005026
4.13	up	PIK3CG	NM_002649
2.32	up	PIK3IP1	NM_052880
2.31	up	PIK3R6	NM_001010855
2.70	up	PIKFYVE	NM_015040
3.13	up	PIP4K2A	NM_005028
7.06	up	PIP5K1B	NM_003558
3.71	up	PITPNC1	NM_181671
3.59	up	PKIA	NM_006823
3.08	up	PKIG	NM_181805
2.97	up	PKNOX2	NM_022062
7.84	up	PLA1A	NM_015900
3.31	up	PLA2G7	NM_005084
3.54	up	PLCB2	NM_004573
3.00	up	PLCL2	NM_015184
3.34	up	PLCL2	NM_015184

3.91	up	PLD4	NM_138790
5.51	up	PLEKHA6	NM_014935
2.14	down	PLEKHG4B	NM_052909
2.12	up	PLEKHM1	NM_014798
6.15	up	PLGLB1	NM_001032392
3.22	up	PNPLA7	NM_001098537
2.57	down	POLB	NM_002690
4.29	down	POLR1A	NM_015425
2.28	down	POLR2J4	NR_003655
2.86	down	POU6F2	NM_007252
4.43	down	PPAP2C	NM_177543
2.37	up	PPM1M	NM_144641
3.35	up	PPP1R12B	NM_002481
2.17	down	PPP1R14B	NM_138689
2.00	up	PPP3CC	NM_005605
2.61	up	PRCP	NM_199418
4.27	up	PRDM8	NM_020226
2.57	up	PREX1	NM_020820
3.54	up	PRG2	NM_002728
12.58	up	PRKCB	NM_002738
13.52	up	PRKCB	NM_002738
2.23	up	PRKD3	NM_005813
2.74	up	PRORSD1P	NR_027258
2.77	up	PROS1	NM_000313
3.21	down	PRPH	NM_006262
3.76	up	PRR18	NM_175922
2.62	down	PRR21	NM_001080835
3.87	down	PRRG4	NM_024081
3.01	up	PRSS30P	NR_026864
3.74	up	PRSS36	NM_173502
7.47	up	PRUNE2	NM_015225
9.33	up	PRUNE2	NM_015225
2.20	down	PSMC3IP	NM_013290
5.87	down	PSPH	NM_004577
47.40	down	PSPHP1	BC065228
4.24	up	PTGFR	NM_000959
6.40	up	PTGFR	NM_001039585
8.79	up	PTGFR	NM_001039585
7.81	down	PTH2	NM_178449
6.33	down	PTH2R	NM_005048
2.04	up	PTP4A2	NM_080391
3.52	up	PTPN22	NM_015967
5.58	up	PTPRC	NM_002838
5.88	up	PTPRC	NM_002838
6.46	up	PTPRC	NM_080923
6.58	up	PTPRC	NM_002838
5.58	up	PTPRO	NM_030667
3.05	up	PVALB	NM_002854
3.93	down	PVRL1	NM_203286

2.19	up	PXN	NM_001243756
12.21	up	PYGM	NM_005609
6.74	up	PYHIN1	NM_198930
3.41	down	Q6P4E4	
2.91	up	Q6TXI9	
2.01	down	Q7VPR2	
2.62	up	Q8WNA4	AK090765
3.82	up	Q96G65	AK090765
4.91	up	Q9UJ41	BC017910
5.06	up	Q9UJ41	BC017910
3.08	up	RAB17	NM_022449
2.04	up	RAB27A	NM_004580
2.10	up	RAB30	NM_014488
3.30	up	RAB33A	NM_004794
6.77	up	RAB37	NM_175738
2.60	up	RABGAP1L	NM_014857
2.23	up	RAD17	NM_002873
2.75	up	RAPGEF3	NM_006105
3.25	up	RAPGEF6	NM_016340
2.40	up	RASA3	NM_007368
5.00	up	RASAL3	NM_022904
3.10	up	RASGRF1	NM_002891
4.03	up	RASGRP2	NM_153819
4.04	up	RASGRP2	NM_153819
7.85	up	RASGRP2	NM_153819
2.84	up	RASGRP3	NM_170672
2.29	up	RASL10A	NM_001007279
5.02	up	RASSF2	NM_014737
3.79	up	RASSF4	NM_032023
2.31	up	RASSF5	NM_182663
2.13	up	RB1	NM_000321
3.03	up	RBM26-AS1	NR_038991
2.14	up	RBM5	NM_005778
2.05	up	RBPMS	AK057533
5.26	down	RCOR2	NM_173587
5.42	up	RCSD1	NM_052862
3.31	up	REPS2	NM_004726
3.86	up	RET	NM_020975
2.10	down	RFX8	NM_001145664
2.29	up	RFXAP	NM_000538
3.29	up	RGS1	NM_002922
13.48	up	RGS13	NM_002927
3.91	up	RGS18	NM_130782
3.73	up	RGS3	NM_017790
6.24	up	RHOH	NM_004310
2.26	up	RHOJ	NM_020663
2.13	up	RHOQ	NM_012249
2.18	up	RILPL2	NM_145058
5.17	up	RLN1	NM_006911

2.06	up	RN18S1	NR_003286
2.92	up	RNASE6	NM_005615
2.00	down	RNASEH2A	NM_006397
2.28	up	RNF103	NM_001198952
5.36	up	RNF125	NM_017831
2.03	up	RNF150	NM_020724
4.35	up	RNU2-2	NR_002761
4.47	up	RORC	NM_005060
2.46	up	RPA1	NM_002945
2.33	up	RPGR	NM_000328
2.81	up	RPGR	NM_000328
4.27	up	RPGR	NM_001034853
2.11	down	RPP40	NM_006638
2.35	up	RPRD1A	AK056810
17.77	up	RRAD	NM_004165
2.14	up	RRP15	NM_016052
2.59	down	RTKN	NM_033046
3.87	up	RUNX3	NM_001031680
3.93	up	RUNX3	NM_001031680
2.41	down	RUSC1-AS1	NM_001039517
3.39	down	S100A11	NM_005620
4.72	up	S100Z	NM_130772
3.57	up	S1PR1	NM_001400
4.99	up	S1PR4	NM_003775
5.17	up	SAA2	NM_001127380
2.17	up	SACM1L	NM_014016
2.72	down	SACS-AS1	XR_110106
4.21	up	SAMD3	NM_001017373
4.37	up	SAMSN1	NM_022136
5.92	up	SASH3	NM_018990
2.89	up	SCARNA16	NR_003013
2.96	up	SCARNA16	NR_003013
3.44	up	SCARNA17	NR_003003
3.55	up	SCARNA9	NR_002569
10.53	up	SCML4	NM_198081
2.67	up	SCN4B	NM_174934
2.48	up	SDPR	NM_004657
2.64	up	SEC31B	NM_015490
2.04	up	SEC62	NM_003262
2.33	up	SECISBP2L	NM_014701
2.38	up	SEL1L	NM_005065
4.74	up	SELE	NM_000450
4.84	up	SELE	NM_000450
11.09	up	SELL	NM_000655
4.95	up	SELP	NM_003005
8.22	up	SELP	NM_003005
3.62	up	SELPLG	NM_003006
3.87	up	SEMA4D	NM_006378
2.25	down	SEMA6C	NM_001178061

2.13	up	SENP7	NM_020654
2.62	up	SEPP1	NM_001093726
2.85	up	SEPP1	NM_005410
3.32	up	SEPT6	NM_145802
3.92	up	SEPT7P2	NR_024271
2.62	up	SERP2	NM_001010897
4.29	up	SERPINB9	NM_004155
2.13	up	SETDB2	NM_031915
2.16	up	SFMBT2	NM_001029880
2.70	up	SFMBT2	NM_001029880
2.42	up	SH2B3	NM_005475
6.08	up	SH2D1A	NM_002351
2.11	up	SH3BGRL2	NM_031469
2.92	up	SH3KBP1	NM_001024666
2.50	up	SH3TC1	NM_018986
2.60	up	SHE	NM_001010846
3.46	down	SHH	NM_000193
2.42	down	SHOX	NM_006883
3.46	down	SHOX2	NM_003030
6.72	up	SIGLEC10	NM_033130
4.56	up	SIGLECP3	NR_002804
2.20	up	SIRPB1	NM_006065
2.86	up	SIRPB1	NM_001135844
6.52	up	SIT1	NM_014450
3.47	up	SLA	NM_001045556
6.87	up	SLAMF1	NM_003037
2.62	down	SLAMF9	NM_033438
2.09	up	SLC1A1	NM_004170
2.51	up	SLC24A4	NM_153646
2.02	down	SLC25A1	NM_005984
3.52	up	SLC25A27	NM_004277
2.87	up	SLC25A34	NM_207348
2.37	up	SLC2A14	BC060766
3.73	up	SLC2A3	NM_006931
2.02	up	SLC35E2	NM_182838
2.12	up	SLC35E2	NM_182838
2.36	up	SLC39A8	NM_022154
2.57	up	SLC39A8	NM_001135147
4.68	up	SLC40A1	NM_014585
6.28	down	SLC6A10P	NR_003083
4.05	down	SLC6A8	U17986
5.86	down	SLC6A8	NM_005629
4.91	up	SLC8A3	NM_183002
2.07	up	SLC9A8	NM_015266
2.40	up	SLC9B1	NM_139173
2.66	up	SLCO2B1	NM_007256
2.21	up	SMA4	NR_029426
2.06	up	SMAD9	NM_005905
2.23	up	SMAP2	NM_022733

10.25	up	SMPD3	NM_018667
2.40	down	SNAR-C4	BF570948
2.60	down	SNAR-I	NR_024343
2.25	up	SNHG5	NR_003038
2.35	up	SNHG5	NR_003038
2.71	down	SNORA51	NR_002981
2.07	down	SNORA55	NR_002983
2.36	up	SNORD11	NR_003031
2.38	up	SNRK	NM_017719
7.59	up	SNX22	NM_024798
2.23	up	SNX29	NM_032167
2.34	up	SNX29	BC029857
4.53	up	SNX29	BC029857
3.66	up	SOD3	NM_003102
2.95	up	SORBS2	NM_021069
5.46	up	SORCS1	NM_052918
50.05	down	SOST	NM_025237
2.06	down	SOX4	NM_003107
10.73	down	SP9	
3.46	up	SPARCL1	NM_004684
2.11	down	SPHK1	NM_182965
11.24	up	SPIB	NM_003121
5.37	up	SPIN3	NM_001010862
2.27	up	SPN	NM_001030288
6.99	up	SPOCK2	NM_014767
2.32	down	SRD5A1	NM_001047
3.69	up	SRGN	NM_002727
2.27	up	SRSF6	NM_006275
4.41	up	ST6GAL1	NM_173216
4.20	up	ST6GALNAC3	NM_001160011
2.84	up	ST8SIA4	NM_005668
2.17	up	STAB1	NM_015136
4.10	up	STAB2	NM_017564
5.36	up	STAC3	NM_145064
4.52	up	STAMBPL1	NM_020799
4.25	down	STAP2	NM_001013841
2.70	up	STARD9	NM_020759
4.37	up	STAT4	NM_003151
2.66	up	STAT5A	NM_003152
5.37	down	STC1	NM_003155
2.03	down	STIP1	NM_006819
4.02	up	STK10	NM_005990
2.57	up	STK17B	NM_004226
2.70	up	STK17B	NM_004226
2.58	up	STK4	NM_006282
3.97	up	STMN1	NM_001145454
2.94	up	STS	NM_000351
2.46	up	SUFU	NM_016169
2.23	up	SUN2	NM_015374

2.89	down	SUPT3H	NM_003599
5.33	up	SUSD3	NM_145006
8.61	up	SV2B	NM_014848
3.05	up	SVEP1	NM_153366
2.53	up	SYBU	NM_001099744
4.63	up	SYPL2	NM_001040709
2.00	up	TADA2B	NM_152293
3.72	up	TAGAP	NM_138810
6.01	up	TAGAP	NM_054114
2.34	down	TAT	NM_000353
8.28	up	TBC1D10C	NM_198517
2.54	up	TBC1D22A	AK125705
3.40	up	TBC1D4	NM_014832
5.92	up	TCF7	NM_003202
2.22	up	TDRD10	NM_182499
7.73	up	TFEC	NM_012252
6.62	up	TFF3	NM_003226
18.70	up	TFF3	NM_003226
25.41	up	TFF3	NM_003226
3.82	up	TFPI	NM_001032281
4.24	up	TFPI	AB209866
4.51	up	TFPI	NM_006287
2.35	down	TFR2	NM_003227
3.66	up	TGFBR2	NM_001024847
6.49	up	TGFBR3	NM_003243
7.14	up	TIGIT	NM_173799
2.03	down	TIMM44	NM_006351
21.49	up	TLR10	NM_030956
3.76	up	TLR4	NM_138554
5.07	up	TLR7	NM_016562
2.44	up	TM6SF1	NM_023003
3.29	up	TMEM100	NM_018286
4.24	up	TMEM106A	NM_145041
2.06	down	TMEM145	NM_173633
2.84	up	TMEM170B	NM_001100829
3.05	up	TMEM176B	NM_014020
2.46	up	TMEM192	NM_001100389
2.51	down	TMEM200B	NM_001003682
2.47	up	TMEM55A	NM_018710
2.01	up	TMEM62	NM_024956
2.18	down	TMEM63B	NM_018426
3.92	up	TMOD1	NM_003275
14.21	up	TMOD4	NM_013353
2.71	up	TNFAIP8	NM_014350
4.24	up	TNFAIP8L2	NM_024575
2.84	up	TNFRSF10C	NM_003841
12.08	up	TNFRSF11B	NM_002546
3.54	up	TNFRSF1B	NM_001066
3.00	up	TNFRSF8	NM_001243

8.26	up	TNIK	NM_015028
41.48	up	TNNC1	NM_003280
28.60	up	TNNC2	NM_003279
40.32	up	TNNT3	NM_001042780
106.65	up	TNNT3	NM_006757
2.25	down	TNP2	NM_005425
2.08	down	TOP1MT	NM_052963
5.76	up	TOX	NM_014729
2.70	up	TPK1	NM_022445
8.23	up	TPM3	NM_152263
2.39	up	TPP1	NM_000391
3.64	down	TPRG1	NM_198485
2.74	up	TPSAB1	NM_003294
2.64	up	TPSD1	NM_012217
8.26	up	TRAF1	NM_005658
8.62	up	TRAF3IP3	NM_025228
8.68	up	TRAF3IP3	NM_025228
9.84	up	TRAF3IP3	AK126139
2.01	up	TRAK2	NM_015049
12.44	up	TRAT1	NM_016388
2.12	up	TRDMT1	NM_004412
2.02	up	TRIB1	NM_025195
3.06	up	TRIB2	
36.34	up	TRIM63	NM_032588
3.02	up	TRPV2	NM_016113
3.58	up	TSGA10	NM_025244
2.85	down	TSHB	NM_000549
2.26	up	TTC21A	NM_145755
2.16	up	TTC32	NM_001008237
11.35	up	TTN	NM_133379
21.88	up	TTN	NM_133379
28.69	up	TTN	AF321609
68.23	up	TTN	NM_133378
9.68	up	TXK	NM_003328
8.15	up	TXLNB	NM_153235
2.85	up	TXNIP	NM_006472
2.14	up	U2AF1L4	NM_144987
7.33	up	UBASH3A	NM_018961
2.06	up	UBE2D3	
2.44	up	UBE2J1	NM_016021
2.43	down	UBE3B	NM_183415
2.34	down	UHRF1	NM_013282
2.04	up	UPRT	NM_145052
2.15	up	UQCRB	NM_001199975
2.69	up	USP25	NM_013396
2.48	up	USP47	NM_017944
2.08	up	USP53	NM_019050
2.16	up	USPL1	NM_005800
2.46	up	VAPA	NM_003574

3.79	up	VAV1	NM_005428
4.71	down	VAX1	NM_001112704
5.08	up	VHLL	NM_001004319
3.14	up	VNN1	NM_004666
8.41	up	VNN2	NM_004665
2.38	up	VOPP1	NM_030796
4.67	up	VPRBP	NM_014703
2.93	up	VPS13C	NM_020821
2.91	down	VSTM2A	NM_182546
2.20	down	VWCE	NM_152718
2.49	up	VWF	NM_000552
2.09	down	WASF1	NM_003931
3.20	down	WBSCR27	NM_152559
6.14	up	WDFY4	NM_020945
6.27	up	WDFY4	NM_020945
2.59	up	WDPCP	NM_015910
2.07	up	WDR19	NM_025132
2.25	up	WDR19	NM_025132
4.02	up	WDR63	NM_145172
2.50	up	WDR74	AK292330
4.22	up	WIPF1	BC110288
2.91	up	WNT6	NM_006522
2.62	down	WWTR1	NM_015472
3.08	up	XLOC_000044	BU566406
4.87	up	XLOC_000292	
3.85	down	XLOC_000379	
2.70	down	XLOC_000511	
2.93	down	XLOC_000778	
11.75	down	XLOC_000855	AF279783
2.95	up	XLOC_001035	
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2.30	down	XLOC_001452	
2.14	down	XLOC_001453	
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2.73	down	XLOC_001856	
3.91	down	XLOC_001856	
2.63	up	XLOC_002221	
2.00	down	XLOC_002323	
2.61	down	XLOC_002560	
9.77	down	XLOC_002603	
11.18	down	XLOC_002603	
11.66	down	XLOC_002603	
2.74	up	XLOC_002643	XR_110001
2.73	up	XLOC_002675	
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2.47	down	XLOC_002948	
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2.97	up	XLOC_002997	XR_110395
13.38	up	XLOC_003176	
2.48	down	XLOC_003225	
2.12	up	XLOC_003479	
2.06	down	XLOC_003546	AL833514
6.90	down	XLOC_003629	
2.00	down	XLOC_004308	
3.99	up	XLOC_004350	BG207267
3.51	up	XLOC_004456	
4.77	up	XLOC_004577	
4.84	down	XLOC_004929	XR_110563
2.43	down	XLOC_005056	
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2.45	down	XLOC_005297	AL157439
2.18	down	XLOC_005327	
2.46	down	XLOC_005343	BX101229
2.95	up	XLOC_005405	
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2.20	down	XLOC_006091	BC042120
2.37	up	XLOC_006178	CD693121
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3.86	up	XLOC_006699	
4.51	up	XLOC_006846	
6.42	up	XLOC_007038	
2.62	up	XLOC_007052	BX500531
3.66	down	XLOC_007290	AL832443
2.28	down	XLOC_007408	BC021182
2.05	down	XLOC_007684	
2.16	down	XLOC_007696	
5.00	up	XLOC_007710	CR627148
2.00	down	XLOC_007745	BC042427
2.25	up	XLOC_007775	XR_108974
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2.09	down	XLOC_007868	
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2.41	down	XLOC_008254	
2.28	down	XLOC_008311	
5.48	down	XLOC_008323	
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2.19	down	XLOC_012826	AK309717
2.14	down	XLOC_012857	
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2.25	up	XLOC_013921	
2.31	down	XLOC_014020	BU933671
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3.17	down	YTHDF1	NM_017798
6.07	up	ZAP70	NM_001079
2.18	up	ZBTB20	NM_015642
2.27	up	ZBTB25	NM_006977
2.05	up	ZDHHC17	NM_015336
2.97	down	ZDHHC20	NM_153251
2.78	up	ZEB2	NR_033258
4.28	up	ZFP82	NM_133466
2.74	up	ZFYVE28	NM_020972
5.36	up	ZIK1	NM_001010879
2.65	up	ZMYM2	AL136621
2.06	up	ZMYM6NB	NM_001195156
2.38	up	ZNF331	
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3.34	up	ZNF366	NM_152625
2.02	up	ZNF37A	NM_001007094
2.94	up	ZNF385D	NM_024697
2.06	up	ZNF41	NM_153380
2.30	up	ZNF445	NM_181489
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2.26	down		BC032956
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2.46	up		CN285977
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2.73	down		BC058012
2.79	down		BX109507
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