

A Computational Approach for Identifying the Impact of Pharmacogenomics in Regulatory Networks to Understand Disease Pathology

Harishchander A*

Department of Bioinformatics, Sathyabama University, Chennai, Tamil Nadu, India

Abstract

In the current era of post genomics, there exist a variety of computational methodologies to understand the nature of disease pathology like RegNetworks, DisgiNet, pharmGkb, pharmacomiR and etc. In most of these computational methodologies either a seed pairing approach or a base pair complement is being followed. Hence there exists a gap in understanding the nature of disease pathology in a holistic view point. In this manuscript we combine the approach of seed pairing and graph theory to illustrate the impact of Pharmacogenomics in Regulatory Networks to understand disease Pathology.

Keywords: Pharmacogenomics; Macromolecules; Phenotypes

Introduction

Events in gene regulation play vital roles in a various developmental and physiological processes in a cell, in which macromolecules such as RNAs, genes and proteins to coordinate and organize responses under various conditions [1]. Therefore, substantial efforts were made to reveal the gene regulatory structures of gene from the transcriptomic datasets generated by microarray [2], ChIP-Seq [3] and RNA-Seq [4]. Although, there were a number of reverse engineering techniques the driven data were previously proposed to identify the regulatory relationships between regulators and their targets (e.g. Transcription Factors and downstream genes) [5]. In order to reduce the low accuracy of these existing methods the dimensionality limits their applications in practice [6]. However, recent studies suggest a promising alternative for identifying the structures of regulatory network by combining the high-throughput data with the prior knowledge on known or predicted regulatory relationships in various databases and literature [7-9]. For instance, the frame work can significantly improve the accuracy of regulatory relationship by incorporating prior knowledge into the transcriptomic profiling in data [10]. Also, the results from several independent studies suggest that the incorporation of prior knowledge can help to identify the context-specific regulatory interactions corresponding to phenotypes [11,12]. Hence, the interest to collect, organize and share such prior information with the related communities is required for future research biomedical science.

Literature Review

Knowledge about the relationships in gene regulation from multiple sources (e.g. conserved co-expression of genes in a high-throughput experiment) was available in various databases and literature. It is vital to develop a unified database and provide the necessary tools to users for retrieving information. However, only limited sources such as RegulonDB for *Escherichia coli* [13] were available previously and the information on the genome-wide regulatory relationships for other species were still lacking. After considering the importance of pharmacogenomics and regulatory networks in biomedical studies, the implementation of genome-wide relationships in regulation was illustrated. It should be clear that, the experimentally observed or discovered regulatory relationships were also curated in public databases such as TRED [14], KEGG [15] and TF binding site (TFBS) information for Transcription Factor-gene regulatory interaction

potentials [16,17]. This information can still be used to predict the new regulatory relationships between TFs and genes by matching the binding motifs in DNA sequences. Hence, these predictions were based on TFBS to integrate into PharmacoReg to provide a more comprehensive landscape in gene regulation. Moreover, to include the post-transcriptional regulatory relationship, consideration of miRNAs (small non-coding RNA molecules with ~22 nucleotides) becomes vital in initiating the gene regulation. Initially the genes associated with Pharmacogenomics of Psoriasis were identified from pharmGkb. Then, the miRNAs associated with Pharmacogenomics of Psoriasis were identified from pharmacomiR. Further, the transcription factors were identified RegNetworks (Figure 1). Finally, a pharmacogenomic based regulatory network was constructed and analyzed in Cytoscape (Table 1).

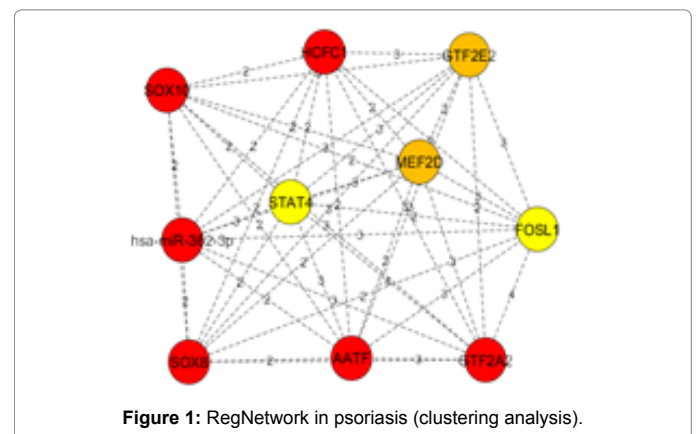


Figure 1: RegNetwork in psoriasis (clustering analysis).

*Corresponding author: Harishchander A, Department of Bioinformatics, Sathyabama University, Chennai, Tamil Nadu, India, Tel: 9940066227; E-mail: harishchander.a@gmail.com

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Genes (pharmGkb)	miRNAs (pharmacomiR)	Transcription Factor (EnrichR)
ABCB1	hsa-miR-222, hsa-miR-338-5p and hsa-miR-451	AR, CEBPA, CEBPB, EGR1, EGR2, ETS1, HAX1, HIF1A, JUN, NFKB1RARARNF2, SP1, TFAP2A, TP53 and WT1
CYP3A4	hsa-miR-221	SP1 and TFAP2A
CTLA4	hsa-miR-200C, hsa-miR-101, hsa-miR-105, hsa-miR-155, hsa-miR-205, hsa-miR-380, hsa-miR-384, hsa-miR-429, hsa-miR-432, hsa-miR-449b, hsa-miR-451, hsa-miR-496, hsa-miR-516a-3p, hsa-miR-517a, hsa-miR-651 and hsa-miR-656	BPTF, STAT5A and STAT5B
TNF	hsa-miR-27a, hsa-miR-130a, hsa-miR-130b, hsa-miR-149, hsa-miR-187, hsa-miR-19a, hsa-miR-296-3p, hsa-miR-409-5p, hsa-miR-454, hsa-miR-516a-5p, hsa-miR-516b, hsa-miR-519b-3p, hsa-miR-542-3p, hsa-miR-581, hsa-miR-592, hsa-miR-599, hsa-miR-654-3p, hsa-miR-770-5p, hsa-miR-875-3p, hsa-miR-875-5p and hsa-miR-939	AHR, ARNT, ATF1, ATF2, CEBPB, CEBPD, CREB1, EBF1, EGR1, EGR4, ELK1, ETS1, ETV4, FOS, IKKKB, IRF5, JUN, NFAT5, NFATC1, NFATC2, NFATC3, NFATC4, NFE2L1, NFKB1, NFKB2, POU2F1, RELA, SMAD6, SMAD7, SP1, SP3, SP11, STAT1, STAT2, STAT3, STAT4, STAT5A, STAT5B, STAT6, TBP, TFAP2A and TP53
MTHFR	hsa-miR-331-5p, hsa-miR-103, hsa-miR-107, hsa-miR-125a-3p, hsa-miR-138, hsa-miR-16, hsa-miR-195, hsa-miR-214, hsa-miR-22, hsa-miR-220b, hsa-miR-24, hsa-miR-424, hsa-miR-486-3p, hsa-miR-497, hsa-miR-516a-5p, hsa-miR-565, hsa-miR-642 and hsa-miR-646	AHR, ARNT, CUX1, E2F1, EP300, JUN, MAX, MXI1::CLEC5A, MYC, REST, SP1, SREBF1, SREBF2, TFAP2A, USF1, XBP1 and YY1
VDR	hsa-miR-451, hsa-miR-124, hsa-miR-125b, hsa-miR-506 and hsa-miR-544	BACH2, CREBBP, CTCF, FOS, FOSB, FOSL1, GTF2B, HMG3, HNF4A, HR, JUN, JUNB, JUND, KDM5A, LMO2, MAX, MED1, NCOA1, NCOA2, NCOA6, NR0B2, NR1H2, NR1P1, RXRA, RXRB, RXRG, SMAD3, SNW1, STAT1 and TRIM24
CREBBP	hsa-miR-27b	AIRE, ALX1, AR, ATF1, ATF4, BCL3, BRCA1, CALCOCO1, CDX2, CEBPA, CEBPB, CEBPD, CITED1, CITED2, CNOT3, CREB1, CREB3, CREB3L1, CREB3L3, CREB3L4 and CREB5
ABCC2	hsa-miR-155, hsa-miR-339-5p	CEBPB, HNF4A, PPARG::RXRA, RXRA and TP53
UGT1A8	hsa-miR-181a	MYB and SRF
UGT1A9	hsa-miR-181c	CUX1, MYB and SRF
NR1I2	hsa-miR-181d, hsa-miR-148a and hsa-miR-148a	NCOA1, NCOA3, NCOR2, POU1F1, PPARGC1A, RXRA, RXRB and RXRG
AKT1	hsa-miR-181b, hsa-miR-125b, hsa-miR-149*, hsa-miR-185, hsa-miR-409-3p, hsa-miR-451 and hsa-miR-625	AR, BRCA1, CREB1, EGR1, EP300, ESR1, ESR2, EZH2, FOXO1, FOXO3, FOXO4, GATA1, GATA2, HIST2, H2BE, HTT, IKKKB, IKKKG, MDM4, NFKB1, NFKBIA, NFKBIB, NKX3-1, NR4A1, PATZ1, PHB2, PPARA, PPARG, PPARGC1B, RELA, SMAD2, SMAD3, SMAD4, SMAD7, SP1, STAT1, STAT5A, TP53, TRIB3, XBP1, YBX1 and YY1
MAP2K1	hsa-miR-19a, hsa-miR-103, hsa-miR-107, hsa-miR-1271, hsa-miR-130a, hsa-miR-130b, hsa-miR-144, hsa-miR-15a, hsa-miR-15b, hsa-miR-16, hsa-miR-181a, hsa-miR-181c, hsa-miR-195, hsa-miR-301a, hsa-miR-335, hsa-miR-34a, hsa-miR-34c, hsa-miR-34c-5p, hsa-miR-411, hsa-miR-424, hsa-miR-449a, hsa-miR-497, hsa-miR-501-5p, hsa-miR-506, hsa-miR-516a-3p, hsa-miR-545, hsa-miR-575, hsa-miR-620, hsa-miR-889 and hsa-miR-96	ATF1, ATF2, ATF3, ATF4, ATF5, ATF6, ATF7, CREB1, ELK1, EP300, MYC, POU3F2 and SP1
PIK3CA	hsa-miR-19b, hsa-miR-10a, hsa-miR-10b, hsa-miR-124, hsa-miR-135a, hsa-miR-135b, hsa-miR-148a, hsa-miR-148b, hsa-miR-152, hsa-miR-155, hsa-miR-193a-5p, hsa-miR-19a, hsa-miR-19b, hsa-miR-203, hsa-miR-302a, hsa-miR-302b, hsa-miR-302c, hsa-miR-302d, hsa-miR-370, hsa-miR-372, hsa-miR-373, hsa-miR-422a, hsa-miR-490-5p, hsa-miR-506, hsa-miR-512-3p, hsa-miR-520a-3p, hsa-miR-520a-5p, hsa-miR-520b, hsa-miR-520d-3p, hsa-miR-520e, hsa-miR-525-5p, hsa-miR-561, hsa-miR-576-5p and hsa-miR-942	CTCF, ESR1, FOX11, FOXO1, FOXO3, FOXO3B, FOXO4, PGR and TP53

BCL2	<p>hsa-miR-301b, hsa-let-7a, hsa-miR-1, hsa-miR-103, hsa-miR-106a, hsa-miR-107, hsa-miR-125a-5p, hsa-miR-125b, hsa-miR-139-5p, hsa-miR-140-3p, hsa-miR-143, hsa-miR-153, hsa-miR-15a, hsa-miR-15b, hsa-miR-16, hsa-miR-17, hsa-miR-181a, hsa-miR-181b, hsa-miR-181c</p> <p>hsa-miR-181d, hsa-miR-182, hsa-miR-192, hsa-miR-195, hsa-miR-204, hsa-miR-20a, hsa-miR-21, hsa-miR-211, hsa-miR-217, hsa-miR-23a, hsa-miR-23b, hsa-miR-296-5p, hsa-miR-29a, hsa-miR-29b</p> <p>hsa-miR-29c, hsa-miR-30a, hsa-miR-30b, hsa-miR-30c, hsa-miR-338-5p, hsa-miR-34a, hsa-miR-34b, hsa-miR-34b*, hsa-miR-34c, hsa-miR-34c-5p, hsa-miR-365, hsa-miR-424, hsa-miR-429, hsa-miR-448, hsa-miR-451, hsa-miR-495, hsa-miR-497, hsa-miR-503, hsa-miR-504, hsa-miR-519a, hsa-miR-519b-3p, hsa-miR-519c-3p, hsa-miR-548b-5p, hsa-miR-548c-3p, hsa-miR-548c-5p, hsa-miR-548d-5p, hsa-miR-587, hsa-miR-630, hsa-miR-641, hsa-miR-646 and hsa-miR-96</p>	<p>AR, ATF1, BCLAF1, BRCA1, CEBPA, CREB1, CTCF, CUX1, DDIT3, EGR1, ETS1, GLI1, GLI2</p> <p>MYB, MYBL1, MYC, NFKB1, NFKB2, NR4A1, PARP1, PMLPPARG, RARA, RARB, RARGRELA, SF1, SP1, STAT3, STAT5A</p> <p>TP53 and WT1</p>
SLC30A8	<p>hsa-miR-454, hsa-miR-143, hsa-miR-183, hsa-miR-186, hsa-miR-194, hsa-miR-205, hsa-miR-25</p> <p>hsa-miR-298, hsa-miR-378, hsa-miR-422a, hsa-miR-501-3p, hsa-miR-502-3p, hsa-miR-543, hsa-miR-563, hsa-miR-577, hsa-miR-874</p> <p>and hsa-miR-9</p>	<p>CEBPB, FOXO3, FOXO3B and HNF1A</p>
CD3G	<p>hsa-miR-301a, hsa-miR-136, hsa-miR-28-5p, hsa-miR-33b and hsa-miR-619</p>	<p>JUN</p>
CD4	<p>hsa-miR-130a, hsa-miR-181c</p> <p>hsa-miR-181d, hsa-miR-221</p> <p>hsa-miR-222 and hsa-miR-765</p>	<p>CREB1, ETS1, ETS2 and MYB</p>
CHN1	<p>hsa-miR-130b, hsa-miR-194, hsa-miR-205, hsa-miR-210, hsa-miR-224, hsa-miR-300, hsa-miR-30a, hsa-miR-30d, hsa-miR-30e, hsa-miR-335, hsa-miR-452, hsa-miR-494, hsa-miR-502-5p, hsa-miR-543, hsa-miR-570 and hsa-miR-802</p>	<p>CUX1, FOXO3, FOXO3B, FOXO4GTF3C1, NKX6-1, POU3F1, POU3F2, SREBF1, SREBF2 SRY and TCF3</p>
ELK1	<p>hsa-miR-24, hsa-miR-135a, hsa-miR-135b, hsa-miR-136, hsa-miR-150, hsa-miR-185, hsa-miR-205, hsa-miR-326, hsa-miR-330-5p, hsa-miR-34b, hsa-miR-34c-3p</p> <p>hsa-miR-361-3p, hsa-miR-495</p> <p>hsa-miR-498, hsa-miR-539, hsa-miR-542-5p, hsa-miR-626, hsa-miR-660 and hsa-miR-873</p>	<p>AR, ARNT, BRCA1, BRCA1, CEBPA, CEBPB, CREBBP, CUX1, EGR1, EP300, FOS, ID1, ID2, ID3, KLF4, MAX, MXI1::CLEC5A, MYB, MYC, NFKB1, NFYA, PIAS2, SP1, SRF, STAT1, STAT2, TFAP2A, TFAP2C and USF1</p>
FYN	<p>hsa-miR-15b, hsa-miR-125a-3p, hsa-miR-1271, hsa-miR-183, hsa-miR-326, hsa-miR-330-5p, hsa-miR-369-3p, hsa-miR-370, hsa-miR-376a</p> <p>hsa-miR-376b, hsa-miR-380, hsa-miR-452, hsa-miR-486-3p, hsa-miR-489, hsa-miR-569, hsa-miR-583</p> <p>hsa-miR-586, hsa-miR-604, hsa-miR-624, hsa-miR-639, hsa-miR-646, hsa-miR-889, hsa-miR-921</p> <p>hsa-miR-939, hsa-miR-944 and hsa-miR-96</p>	<p>ALX1, BCL3, CREB1, CTNNB1</p> <p>EGR1, HLF, HNRNPK, KHDRBS1</p> <p>NFIL3, NFKB1, NKX2-2, NR3C1</p> <p>PAX5, RFX1, RREB1, SP1, STAT1</p> <p>VSX2 and YTHDC1</p>
LAT	<p>hsa-miR-497, hsa-miR-216b, hsa-miR-296-3p, hsa-miR-376c, hsa-miR-574-3p, hsa-miR-602, hsa-miR-604, hsa-miR-608, hsa-miR-631 and hsa-miR-941</p>	<p>CTCF, PAX2, PPARG, TFAP4 and YY1</p>
LCK	<p>hsa-miR-424 and hsa-miR-202</p>	<p>ARNT, CTCF, EBF1, ELK1</p> <p>ESR1, ESR2, ETS1, HNF4A</p> <p>KHDRBS1, MIF, MYB, NFKBIA</p> <p>NR3C1, RXRA, SP1, STAT1, STAT3, STAT5A, TAL1, TCF3 and USF1</p>
MAP2K4	<p>hsa-miR-16, hsa-miR-124, hsa-miR-128, hsa-miR-128a, hsa-miR-128b</p> <p>hsa-miR-136, hsa-miR-137, hsa-miR-141, hsa-miR-15b, hsa-miR-16</p> <p>hsa-miR-195, hsa-miR-200a, hsa-miR-218, hsa-miR-22, hsa-miR-24</p> <p>hsa-miR-25, hsa-miR-27a, hsa-miR-27b, hsa-miR-29a, hsa-miR-29b, hsa-miR-29c, hsa-miR-30b, hsa-miR-30d, hsa-miR-30e, hsa-miR-32</p> <p>hsa-miR-363, hsa-miR-367, hsa-miR-374a, hsa-miR-424, hsa-miR-487b, hsa-miR-497, hsa-miR-503, hsa-miR-505, hsa-miR-506, hsa-miR-580, hsa-miR-892a, hsa-miR-92, hsa-miR-92a, hsa-miR-92b and hsa-miR-938</p>	<p>AHR, ARID5B, ARNT, PAX5 and YY1</p>

MAP3K1	hsa-miR-195, hsa-let-7a, hsa-let-7b, hsa-let-7c, hsa-let-7d, hsa-let-7e, hsa-let-7f, hsa-let-7g, hsa-let-7i, hsa-miR-1, hsa-miR-106a, hsa-miR-106b, hsa-miR-124, hsa-miR-129-3p, hsa-miR-129-5p, hsa-miR-136, hsa-miR-137, hsa-miR-17, hsa-miR-18a, hsa-miR-18b, hsa-miR-190, hsa-miR-192, hsa-miR-193a-3p, hsa-miR-193b, hsa-miR-19a, hsa-miR-19b, hsa-miR-200b, hsa-miR-200c, hsa-miR-203, hsa-miR-206, hsa-miR-20a, hsa-miR-20b, hsa-miR-21, hsa-miR-23a, hsa-miR-23b, hsa-miR-30a, hsa-miR-31, hsa-miR-340, hsa-miR-371-5p, hsa-miR-372, hsa-miR-411, hsa-miR-429, hsa-miR-433, hsa-miR-488, hsa-miR-495, hsa-miR-499-3p, hsa-miR-506, hsa-miR-517b, hsa-miR-519d, hsa-miR-520d-5p, hsa-miR-524-5p, hsa-miR-544, hsa-miR-548c-3p, hsa-miR-557, hsa-miR-582-5p, hsa-miR-590-5p, hsa-miR-607, hsa-miR-613, hsa-miR-643, hsa-miR-892b, hsa-miR-9, hsa-miR-93 and hsa-miR-98	CEBPB, EGR1, IKKKB, IKKKG, NFKB1, RELA and SPI1
PTPN7	hsa-miR-15a and hsa-miR-126	E2F1, EGR1, GATA1 and MXI1::CLEC5A
RAC1	hsa-miR-214, hsa-miR-101, hsa-miR-122, hsa-miR-137, hsa-miR-142-3p, hsa-miR-144, hsa-miR-155, hsa-miR-182, hsa-miR-194, hsa-miR-200c, hsa-miR-217, hsa-miR-299-5p, hsa-miR-300, hsa-miR-320, hsa-miR-361-5p, hsa-miR-369-3p, hsa-miR-374, hsa-miR-429, hsa-miR-485-3p, hsa-miR-518f, hsa-miR-655 and hsa-miR-96	ABL1, E2F1, EIF2AK2, ELK1, GABPA, NFKB1, RELA, STAT1, STAT3 and YY1
RAF1	hsa-miR-22, hsa-miR-125b, hsa-miR-135a, hsa-miR-135b, hsa-miR-15a, hsa-miR-15b, hsa-miR-16, hsa-miR-195, hsa-miR-19a, hsa-miR-19b, hsa-miR-424, hsa-miR-497, hsa-miR-516a-3p, hsa-miR-516b, hsa-miR-634, hsa-miR-646, hsa-miR-649 and hsa-miR-7	AR, MYC, NR3C1, RB1, RBL2, RFXANK, TSC22D3 and YY1
RELA	hsa-miR-544, hsa-miR-124, hsa-miR-138, hsa-miR-22, hsa-miR-302a, hsa-miR-302b, hsa-miR-302c, hsa-miR-302d, hsa-miR-329, hsa-miR-362-3p, hsa-miR-371-5p, hsa-miR-373, hsa-miR-506, hsa-miR-512-3p, hsa-miR-520f, hsa-miR-569, hsa-miR-596, hsa-miR-7, hsa-miR-769-5p and hsa-miR-891b	AATF, AES, AHR, AR, BRCA1, CEBPB, CEPBD, CREBBP, EGR1, EGR1, EP300, ESR1, FOS, FUS, GTF2B, HDAC1, HDAC2, HDAC3, HEXIM1, HMGA2, IKKKB, IKKKG, ING4, IRF1, IRF2, IRF3, JUN, KAT2B, MEN1, MYC, NCOA3, NCOR2, NFKB1, NFKB2, NFKB2, NFKBIA, NFKBIB, NKRF, NKX2-1, NR3C1, PARP1, PAX6, PDCD11, PGR, PIAS1, PIAS3, PML, POU2F1, PPARA, PPARG, REL, RELB, RFC1, RXRA, SIN3A, SIRT1, SNIP1, SP1, SRF, STAT1, STAT3, STAT6, TAF1, TAF11, TAF4B, TAF6, TBP, TP53, TP53BP1, TRIB3, TRIP4, TSC22D3 and TWIST1
CLAR	hsa-miR-302e, hsa-miR-324-3p, hsa-miR-361-3p, hsa-miR-450b-3p, hsa-miR-516a-5p, hsa-miR-627, hsa-miR-660 and hsa-miR-768-5p	AR, E2F1, E2F4, GABPA, MYCNFYA, NKX2-1, NR3C1, RREB1, SP1, TFAP2A, TFAP2C, USF1, VSX2 and YY1
CAMK4	hsa-miR-302d, hsa-miR-106a, hsa-miR-129-5p, hsa-miR-17, hsa-miR-187, hsa-miR-191, hsa-miR-20a, hsa-miR-299-3p, hsa-miR-30a, hsa-miR-30b, hsa-miR-30c, hsa-miR-33a and hsa-miR-33b, hsa-miR-34b, hsa-miR-34c-3p, hsa-miR-455-5p, hsa-miR-507, hsa-miR-511, hsa-miR-567, hsa-miR-586, hsa-miR-885-5p and hsa-miR-96	ATF4, BACH1, BACH2, CREBBP, EP300, HDAC4, MAX, MEF2AMYC, PPARG and RELA
CA1KK1	hsa-miR-302b, hsa-miR-103, hsa-miR-107, hsa-miR-145, hsa-miR-221, hsa-miR-222, hsa-miR-361-3p, hsa-miR-515-5p, hsa-miR-574-5p, hsa-miR-596, hsa-miR-619, hsa-miR-631, hsa-miR-634, hsa-miR-671-5p, hsa-miR-769-5p, hsa-miR-921 and hsa-miR-943	ARNT, BACH1, BACH2, E2F1, MAX, MXI1::CLEC5A, MYC, NFYA, PAX6, PPARG, TFAP2A, TFAP2C and USF1
EDN1	hsa-miR-302a, hsa-let-7b, hsa-let-7c, hsa-miR-1, hsa-miR-147, hsa-miR-155, hsa-miR-185, hsa-miR-199a-5p, hsa-miR-203, hsa-miR-206, hsa-miR-220c, hsa-miR-454, hsa-miR-517b, hsa-miR-574-5p, hsa-miR-613, hsa-miR-648, hsa-miR-892a and hsa-miR-935	AR, CEBPA, CREB1, E2F1, FOXJ2, FOXO1, HIF1A, HLF, JUN, MEF2A, NFIC, NFKB1, PPARA, PPARG, SMAD1, SMAD3, SMAD4, TCF3 and ZEB1
GATA4	hsa-miR-302c, hsa-miR-1, hsa-miR-200b, hsa-miR-200c, hsa-miR-208b and hsa-miR-429	ATF1, ATF2, ATF3, ATF4, ATF5, ATF6, ATF7, CEBPA, CREB1, CUX1, EP300, FOS, FOSB, HAND2, JARID2, JUN, JUNB, JUND, MED1, MEF2C, NFATC4, NFKB1, NFKB2, NKX2-5, NR5A1, PIAS1, RELA, SRF, TBX5, USF1 and ZFPM2
GSK3B	hsa-miR-181d, hsa-miR-199a-5p, hsa-miR-199b-5p, hsa-miR-224, hsa-miR-26a, hsa-miR-26b, hsa-miR-548a-5p, hsa-miR-548b-5p, hsa-miR-548c-5p, hsa-miR-548d-5p, hsa-miR-582-3p, hsa-miR-647 and hsa-miR-876-3p	APC, AR, ARNT, ATF4, BCL3, CDX2, CEBPA, CEBPA, CREB1, CREB3, CREB3L1, CREB3L3, CREB3L4, CREB5, CREM, CSDA, CTNNB1, CUX1, E2F1, E2F1, FOXO1, GLI1, GLI2, GLI3, HNRNP, HOXA9, IKKKB, MEIS1, MITF, MYC, MYOCD, NFAT5, NFATC1, NFATC2, NFATC3, NFATC4, NFKB1, NFYA, NFYB, NFYC, NFYD, NOTCH2, PAX5, POU2F1, PPARG, SNAI1, SOX9, SPI1, STAT5A, TP53 and YBX1

HAND1	hsa-miR-520a-3p, hsa-let-7a, hsa-let-7b, hsa-let-7c, hsa-let-7d, hsa-let-7e, hsa-let-7f, hsa-let-7g, hsa-let-7i, hsa-miR-196a, hsa-miR-196b, hsa-miR-25, hsa-miR-32, hsa-miR-335, hsa-miR-363, hsa-miR-367, hsa-miR-92, hsa-miR-92a, hsa-miR-98	FHL2, FOXD1, FOXF2, HEY2, HEYL, HOXA9, MEIS1, MYOD1, POU3F1, RORA, TCF12 and TCF3
HAND2	hsa-miR-520e, hsa-miR-1, hsa-miR-128, hsa-miR-135b, hsa-miR-140-5p, hsa-miR-181a, hsa-miR-181b, hsa-miR-181c, hsa-miR-181d, hsa-miR-202, hsa-miR-206, hsa-miR-25, hsa-miR-296-5p, hsa-miR-32, hsa-miR-363, hsa-miR-367, hsa-miR-519a, hsa-miR-519b-3p, hsa-miR-519c-3p, hsa-miR-543, hsa-miR-566, hsa-miR-615-5p, hsa-miR-661, hsa-miR-767-3p, hsa-miR-876-3p, hsa-miR-92, hsa-miR-92a and hsa-miR-92b	AHR, ARNT, BPTF, CENPB, COPS5, EP300, FOXD3, GATA4, HEY2, HEYL, NPM1, PHOX2ASRY, TCF3 and VSX2
HDAC5	hsa-miR-373, hsa-miR-124, hsa-miR-128, hsa-miR-134, hsa-miR-30a, hsa-miR-30b, hsa-miR-506, hsa-miR-589, hsa-miR-629, hsa-miR-653, hsa-miR-765, hsa-miR-768-3p and hsa-miR-9	ANKRA2, BCL6, BCOR, CIITA, HR, KLF4, MAX, MEF2A, MEF2C, MEF2D, NCOR1, NCOR2, NFKB2, NR1P1, PHB2, RFXANK, RUNX3, USF1 and ZBTB16
HDAC9	hsa-miR-520c-3p, hsa-miR-124, hsa-miR-147, hsa-miR-182, hsa-miR-190b, hsa-miR-199b-5p, hsa-miR-19a, hsa-miR-26a, hsa-miR-26b, hsa-miR-27a, hsa-miR-27b, hsa-miR-299-5p, hsa-miR-302b, hsa-miR-302c, hsa-miR-30a, hsa-miR-30a-5p, hsa-miR-30b, hsa-miR-30c, hsa-miR-30d, hsa-miR-30e, hsa-miR-32, hsa-miR-338-5p, hsa-miR-365, hsa-miR-377, hsa-miR-383, hsa-miR-409-5p, hsa-miR-452, hsa-miR-506, hsa-miR-514, hsa-miR-515-5p, hsa-miR-542-5p, hsa-miR-558, hsa-miR-768-3p, hsa-miR-891a and hsa-miR-96	KLF12, MEF2A, MEF2B, NCOR1, REST, SIN3A, SIN3B, USF1, ZBTB16 and ZEB1
LIF	hsa-miR-520b, hsa-miR-125a-5p, hsa-miR-125b, hsa-miR-1297, hsa-miR-181b, hsa-miR-181d, hsa-miR-199a, hsa-miR-199a-5p, hsa-miR-26a, hsa-miR-28-5p, hsa-miR-29a, hsa-miR-29b, hsa-miR-29c, hsa-miR-328, hsa-miR-331-3p, hsa-miR-346, hsa-miR-494, hsa-miR-504, hsa-miR-654-5p, hsa-miR-874 and hsa-miR-93	CTCF, EGR3, ETS1, ETS2, MZF1, NFKB1, PBX1, RREB1, STAT1, STAT2 and TBP
MEF2C	hsa-miR-520d-3p, hsa-miR-135a, hsa-miR-135b, hsa-miR-137, hsa-miR-153, hsa-miR-182, hsa-miR-183, hsa-miR-18a, hsa-miR-18b, hsa-miR-190, hsa-miR-190b, hsa-miR-194, hsa-miR-19a, hsa-miR-19b, hsa-miR-203, hsa-miR-21, hsa-miR-223, hsa-miR-23a, hsa-miR-23b, hsa-miR-27b, hsa-miR-302a, hsa-miR-302b, hsa-miR-302c, hsa-miR-302d, hsa-miR-330-3p, hsa-miR-331-5p, hsa-miR-33a, hsa-miR-340, hsa-miR-372, hsa-miR-421, hsa-miR-448, hsa-miR-450b-5p, hsa-miR-520a-3p, hsa-miR-520b, hsa-miR-520c-3p, hsa-miR-520d-3p, hsa-miR-520d-5p, hsa-miR-520e, hsa-miR-520f, hsa-miR-524-5p, hsa-miR-556-3p, hsa-miR-603, hsa-miR-621 and hsa-miR-656	ATF2, BPTF, CDC5L, CREB1, CUX1, EP300, ESR1, FOXD3, FOXI1, FOXJ2, GATA4, HDAC4, HDAC5, HLF, IRF1, KLF12, MEF2A, MEF2D, NCOA2, NKX2-2, NKX3-1, PAX6, PBX1, POU2F1, POU2F2, POU3F1, POU3F2, POU3F3, POU5F1, SMAD2, SP1, SP1, SPI1, STAT5A, STAT5B, TCF3, TEAD1, TFAP4, TGIF1, TWIST2 and VGLL2
MYL2	hsa-miR-124, hsa-miR-490-5p, hsa-miR-593 and hsa-miR-876-5p	HNF1A and MEF2A
ACTA1	hsa-miR-506, hsa-let-7a, hsa-let-7b, hsa-let-7c, hsa-let-7d, hsa-let-7e, hsa-let-7f, hsa-let-7g, hsa-let-7i, hsa-miR-122, hsa-miR-155, hsa-miR-21, hsa-miR-220c, hsa-miR-569, hsa-miR-574-5p and hsa-miR-98	ABL1, E2F4, ELK1, HCLS1, MEF2A, NR3C2, REST, SRF, TBPTP53 and ZEB1
PDPK1	hsa-miR-23a, hsa-miR-147, hsa-miR-181a, hsa-miR-181c, hsa-miR-214, hsa-miR-27a, hsa-miR-27b, hsa-miR-323-5p, hsa-miR-374b, hsa-miR-375, hsa-miR-382, hsa-miR-410, hsa-miR-486-3p, hsa-miR-499-3p, hsa-miR-504, hsa-miR-885-3p and hsa-miR-944	EGR1, EGR3, GABPA, PPARG, RXRA, RXRB, RXRG and SP1
RPS6KB1	hsa-miR-23b, hsa-miR-103, hsa-miR-107, hsa-miR-124, hsa-miR-128, hsa-miR-129-5p, hsa-miR-130, hsa-miR-130b, hsa-miR-135a, hsa-miR-135b, hsa-miR-137, hsa-miR-142-5p, hsa-miR-145, hsa-miR-153, hsa-miR-155, hsa-miR-181a, hsa-miR-181b, hsa-miR-181c, hsa-miR-181d, hsa-miR-186, hsa-miR-200b, hsa-miR-200c, hsa-miR-218, hsa-miR-223, hsa-miR-27a, hsa-miR-27b, hsa-miR-301a, hsa-miR-301b, hsa-miR-340, hsa-miR-369-3p, hsa-miR-377, hsa-miR-429, hsa-miR-506, hsa-miR-507, hsa-miR-548c-3p, hsa-miR-557, hsa-miR-561, hsa-miR-568, hsa-miR-579, hsa-miR-590-3p, hsa-miR-605, hsa-miR-607, hsa-miR-641, hsa-miR-655, hsa-miR-7 and hsa-miR-944	E2F1, E2F2 and LMO2

YWHAH	hsa-miR-125b, hsa-miR-103, hsa-miR-107, hsa-miR-137, hsa-miR-15a, hsa-miR-15b, hsa-miR-16, hsa-miR-195, hsa-miR-25, hsa-miR-28-3p, hsa-miR-33, hsa-miR-33a, hsa-miR-33b, hsa-miR-361-5p, hsa-miR-365, hsa-miR-381, hsa-miR-421, hsa-miR-424, hsa-miR-490-5p, hsa-miR-497, hsa-miR-519d, hsa-miR-521, hsa-miR-523, hsa-miR-563, hsa-miR-576-5p, hsa-miR-583, hsa-miR-584, hsa-miR-586, hsa-miR-598, hsa-miR-652, hsa-miR-660, hsa-miR-708, hsa-miR-885-5p, hsa-miR-888, hsa-miR-95 and hsa-miR-96	ABL1, ATF2, CREB1, CREBBP, E2F4, EGR3, ESR1, ESR2, ING1, JUN, MDM4, MED1, MEF2A, MYC, NCOA1, NCOA2, NCOA3, NR3C1, NR1P1, TFAP2A, THRA, TLX2, TNFAIP3, YY1 and ZFP36
ADSS	hsa-miR-125a-5p, hsa-miR-1, hsa-miR-16, hsa-miR-182, hsa-miR-19a, hsa-miR-19b, hsa-miR-206, hsa-miR-28-3p, hsa-miR-383, hsa-miR-503, hsa-miR-514, hsa-miR-548a-3p, hsa-miR-548a-5p, hsa-miR-548b-5p, hsa-miR-548c-5p, hsa-miR-548d-5p, hsa-miR-561, hsa-miR-609, hsa-miR-642, hsa-miR-922, hsa-miR-923 and hsa-miR-96	CTCF, EGR1, EGR2, EGR3, KLF12, SP1, TFAP2A and TFAP2C
CDKN1A	hsa-miR-590-3p, hsa-miR-449a, hsa-miR-449b, hsa-let-7a, hsa-let-7e, hsa-let-7f, hsa-miR-106a, hsa-miR-106b, hsa-miR-125a-5p, hsa-miR-130a, hsa-miR-130b, hsa-miR-132, hsa-miR-145, hsa-miR-146a, hsa-miR-146b-5p, hsa-miR-17, hsa-miR-17-5p, hsa-miR-182, hsa-miR-193a-5p, hsa-miR-20, hsa-miR-208, hsa-miR-208b, hsa-miR-20a, hsa-miR-20b, hsa-miR-21, hsa-miR-212, hsa-miR-22, hsa-miR-224, hsa-miR-28-5p, hsa-miR-298, hsa-miR-299-5p, hsa-miR-301a, hsa-miR-301b, hsa-miR-302a, hsa-miR-345, hsa-miR-363, hsa-miR-370, hsa-miR-372, hsa-miR-423-3p, hsa-miR-454, hsa-miR-503, hsa-miR-509-3-5p, hsa-miR-515-3p, hsa-miR-516a-3p, hsa-miR-519a, hsa-miR-519b-3p, hsa-miR-519c-3p, hsa-miR-519d, hsa-miR-519e, hsa-miR-520a-3p, hsa-miR-520b, hsa-miR-520g, hsa-miR-520h, hsa-miR-572, hsa-miR-608, hsa-miR-639, hsa-miR-641, hsa-miR-654-3p, hsa-miR-657, hsa-miR-93, hsa-miR-939, hsa-miR-942 and hsa-miR-96	AR, ATF2, CDC5L, CEBPA, CEBPB, ESR1, ESR2, ETS1, FLI1, FOS, FOXO1, FOXO2, FOXO3, HDAC11, HIF1A, HNF4A, JUN, PARP1, PPARG, RARA, RB1, RELB, SMAD1, SMAD2, SMAD3, SMAD4, SP1, SP3, SP4, SRF, STAT1, STAT3, TFAP2A, TP53, TP63, TP73, TSG101, WT1 and XRCC6
GNAQ	hsa-miR-381, hsa-miR-142-3p, hsa-miR-182, hsa-miR-423-5p, hsa-miR-491-3p, hsa-miR-574-3p, hsa-miR-581, hsa-miR-587, hsa-miR-642, hsa-miR-886-3p and hsa-miR-96	CTCF, CUX1, EGR1, MEF2A and PPARG
MARCKS	hsa-miR-300, hsa-miR-1, hsa-miR-128a, hsa-miR-128b, hsa-miR-138, hsa-miR-142-3p, hsa-miR-143, hsa-miR-144, hsa-miR-182, hsa-miR-200b, hsa-miR-200c, hsa-miR-205, hsa-miR-206, hsa-miR-21, hsa-miR-216a, hsa-miR-218, hsa-miR-222, hsa-miR-23a, hsa-miR-25, hsa-miR-27a, hsa-miR-27b, hsa-miR-300, hsa-miR-30a, hsa-miR-30a-5p, hsa-miR-30b, hsa-miR-30c, hsa-miR-30d, hsa-miR-30e, hsa-miR-370, hsa-miR-429, hsa-miR-491-5p, hsa-miR-495, hsa-miR-499-5p, hsa-miR-561, hsa-miR-655, hsa-miR-770-5p and hsa-miR-876-3p	AHR, ALX1, ARNT, HNF1A, MZF1, NFKB1, PAX6, POU2F1, TOB1 and YY1
SP1	hsa-miR-153, hsa-miR-1, hsa-miR-105, hsa-miR-124, hsa-miR-128, hsa-miR-128a, hsa-miR-128b, hsa-miR-135a, hsa-miR-135b, hsa-miR-137, hsa-miR-138, hsa-miR-149, hsa-miR-150, hsa-miR-155, hsa-miR-203, hsa-miR-204, hsa-miR-206, hsa-miR-211, hsa-miR-216a, hsa-miR-218, hsa-miR-22, hsa-miR-223, hsa-miR-24, hsa-miR-27a, hsa-miR-27b, hsa-miR-29a, hsa-miR-29b, hsa-miR-29c, hsa-miR-300, hsa-miR-32, hsa-miR-320, hsa-miR-324-5p, hsa-miR-335, hsa-miR-361-5p, hsa-miR-362-3p, hsa-miR-374b, hsa-miR-375, hsa-miR-377, hsa-miR-381, hsa-miR-384, hsa-miR-410, hsa-miR-429, hsa-miR-487a, hsa-miR-488, hsa-miR-495, hsa-miR-506, hsa-miR-539, hsa-miR-548a-5p, hsa-miR-548b-3p, hsa-miR-548b-5p, hsa-miR-548c-5p, hsa-miR-548d-5p, hsa-miR-570, hsa-miR-590-3p, hsa-miR-603, hsa-miR-607, hsa-miR-613, hsa-miR-625 and hsa-miR-7	AATF, AHR, AR, ARNT, ATF7IP, BCL6, BCOR, BRCA1, CEBPA, CEBPB, E2F1, E2F2, E2F3, E2F4, EGR1, EGR2, EGR3, ELF1, EP300, ESR1, ESR2, ETS1, GABPA, GATA1, HCF1, HDAC1, HDAC2, HIF1A, HMG1, HNF4A, HTT, JUN, KLF10, KLF4, KLF6, MEF2A, MEF2C, MEF2D, MIS18BP1, MSX1, MYB, MYC, MYOD1, MYOG, NCOR1, NCOR2, NFYA, NFYB, NR2F1, NR5A1, PAX6, PER3, PML, POU2F1, POU2F1, PURA, RARA, RB1, RBBP4, RBL1, REL, RELB, RREB1, RXRA, SMAD2, SMAD3, SMAD4, SOX10 and SOX8
SP3	hsa-miR-361-5p, hsa-miR-105, hsa-miR-124, hsa-miR-133a, hsa-miR-133b, hsa-miR-135a, hsa-miR-135b, hsa-miR-145, hsa-miR-153, hsa-miR-155, hsa-miR-182, hsa-miR-223, hsa-miR-27a, hsa-miR-338-5p, hsa-miR-369-3p, hsa-miR-374a, hsa-miR-374b, hsa-miR-410, hsa-miR-421, hsa-miR-448, hsa-miR-487a, hsa-miR-487b, hsa-miR-506, hsa-miR-507, hsa-miR-520d-5p, hsa-miR-522, hsa-miR-524-5p, hsa-miR-548a-5p, hsa-miR-548b-5p, hsa-miR-548c-5p, hsa-miR-548d-5p, hsa-miR-568, hsa-miR-580, hsa-miR-590-3p, hsa-miR-634, hsa-miR-655, hsa-miR-889 and hsa-miR-96	E2F1, E2F2, E2F3, E2F4, E2F5, E2F6, E2F7, EGR1, EP300, ESR1, GABPA, HDAC1, HDAC2, MEF2A, NFYA, PAX6, PBX1, PIAS1, RB1, RBBP4 and SP1

MAPK3	hsa-miR-429, hsa-miR-132, hsa-miR-212, hsa-miR-497 and hsa-miR-613	AR, BCL3, CEBPB, ELK1, ELK4, ESR1,ETS1,ETS2,ETV6, ETV7, FOS, GATA1, GATA4, GTF2I, HDAC4, HIF1A, HSF1, HSF4, JUN, JUND, MAX, MITF, MYC, NR3C1, PPARA, SMAD1, SMAD2, SMAD3, SMAD4, SMAD5, SMAD9, SNAI2, SP1, SPIB, SREBF1, SREBF2, STAT3, STAT5A, TAL1, TAL2, TCF3, TGIF1, TOP2B, TP53, UBTX, USF1, YY1 and ZNF7
PRKCA	hsa-miR-200b, hsa-miR-147, hsa-miR-183, hsa-miR-186, hsa-miR-200c, hsa-miR-203, hsa-miR-205, hsa-miR-25, hsa-miR-340, hsa-miR-362-5p, hsa-miR-495, hsa-miR-522,hsa-miR-545, hsa-miR-548a-5p, hsa-miR-548b-5p, hsa-miR-548c-5p,hsa-miR-548d-5p, hsa-miR-590-3p hsa-miR-603, hsa-miR-9 and hsa-miR-15a	AR, BTG2, CREM, DDX5, DLX3, EDF1, EWSR1, HABP4, HAND1HAND2, HES1, HMGN1, HMGN2MAX, MXI1::CLEC5A, MYOD1NFATC1, NFKB1, PA2G4, PPARARARA, RARA, SP1, TFAP2ATP53, TRIM29 and USF1
FOS	hsa-miR-340, hsa-miR-345-3p, hsa-miR-4771, hsa-miR-4765, hsa-miR-4749-5p, hsa-miR-4749-3p, hsa-miR-4742-5p, hsa-miR-4742-3p, hsa-miR-4732-5p, hsa-miR-4732-3p hsa-miR-4692, hsa-miR-4659b-5p hsa-miR-4659b-3p, hsa-miR-4657 hsa-miR-4645-5p, hsa-miR-4645-3p, hsa-miR-4534, hsa-miR-4533, hsa-miR-4522, hsa-miR-4521, hsa-miR-451a, hsa-miR-4519, hsa-miR-4518, hsa-miR-449c-5p, hsa-miR-449c-3p, hsa-miR-449b-5p, hsa-miR-449b-3p hsa-miR-449a, hsa-miR-4484, hsa-miR-4479, hsa-miR-4457, hsa-miR-4425, hsa-miR-4419a, hsa-miR-4317, hsa-miR-4310, hsa-miR-4292 hsa-miR-4288, hsa-miR-4282, hsa-miR-4274, hsa-miR-4258, hsa-miR-4256, hsa-miR-383, hsa-miR-3690, hsa-miR-3676-5p, hsa-miR-3676-3p, hsa-miR-3670, hsa-miR-3616-5p, hsa-miR-3616-3p, hsa-miR-3179, hsa-miR-3117-5p, hsa-miR-3117-3p, hsa-miR-30a-5p, hsa-miR-30a-3p, hsa-miR-301b, hsa-miR-29b-3p, hsa-miR-22-5p, hsa-miR-22-3p, hsa-miR-212-5p, hsa-miR-212-3p, hsa-miR-2116-5p, hsa-miR-2116-3p, hsa-miR-1827, hsa-miR-1470, hsa-miR-144-5p, hsa-miR-144-3p, hsa-miR-139-5p, hsa-miR-139-3p, hsa-miR-132-5p, hsa-miR-132-3p, hsa-miR-130b-5p, hsa-miR-130b-3p, hsa-miR-130a-5p, hsa-miR-130a-3p, hsa-miR-1302, hsa-miR-1283, hsa-miR-1269a, hsa-miR-125b-5p, hsa-miR-1255b-5p hsa-miR-1252, hsa-miR-1249 hsa-miR-1227 and hsa-let-7a-5p	ATF1, ATF2, ATF7, BACH2, BATF, BCL3, CEBPB, CEBPG, COBRA1, CREB1, DDIT3, EGR1 EGR2, ELK1, ELK3, ELK4, ESR1 ESR2, ETS1, ETS2, ETV4 and FL1
JUN	hsa-miR-324-3p, hsa-miR-139-5p, hsa-miR-141, hsa-miR-15a, hsa-miR-16, hsa-miR-200a, hsa-miR-200b, hsa-miR-200c, hsa-miR-216b, hsa-miR-297, hsa-miR-30a, hsa-miR-340, hsa-miR-429, hsa-miR-495, hsa-miR-496, hsa-miR-517c, hsa-miR-520d-5p, hsa-miR-522, hsa-miR-524-5p, hsa-miR-612, hsa-miR-642, hsa-miR-758, hsa-miR-890, hsa-miR-889, hsa-miR-802, hsa-miR-766-5p, hsa-miR-766-3p, hsa-miR-661, hsa-miR-645, hsa-miR-614, hsa-miR-5706, hsa-miR-5684, hsa-miR-5587-5p, hsa-miR-5587-3p, hsa-miR-5586-5p, hsa-miR-5586-3p, hsa-miR-553, hsa-miR-548z, hsa-miR-548ao-3p, hsa-miR-548aj-3p, hsa-miR-544a, hsa-miR-539-3p, hsa-miR-520b, hsa-miR-519a-3p, hsa-miR-518e-5p, hsa-miR-518e-3p, hsa-miR-518a-5p, hsa-miR-518a-3p, hsa-miR-516a-5p, hsa-miR-516a-3p, hsa-miR-5008-5p, hsa-miR-5008-3p, hsa-miR-5000-5p, hsa-miR-5000-3p, hsa-miR-487b, hsa-miR-487a, hsa-miR-4792, hsa-miR-4784, hsa-miR-4771, hsa-miR-4763-5p, hsa-miR-4763-3p, hsa-miR-4732-5p, hsa-miR-4732-3p hsa-miR-4716-5p, hsa-miR-4716-3p hsa-miR-4696, hsa-miR-4692 hsa-miR-4687-5p, hsa-miR-4687-3p hsa-miR-4683, hsa-miR-4665-5p hsa-miR-4665-3p, hsa-miR-4659b-5p, hsa-miR-4659b-3p, hsa-miR-4640-5p, hsa-miR-4640-3p, hsa-miR-4534, hsa-miR-4521, hsa-miR-451a, hsa-miR-4519, hsa-miR-449c-5p, hsa-miR-449c-3p, hsa-miR-449b-5p, hsa-miR-449b-3p, hsa-miR-449a, hsa-miR-4457, hsa-miR-4434 and hsa-miR-4425	ABL1, AR, ATF1, ATF2, ATF3, ATF4, BATF, BCL3, BCL6, BRCA1, COBRA1, COPS5, CREB1, CREB5CREBBP, DDIT3, E2F1, E2F4, EGR1, ELF3, EN1, EP300, ERG, ESR1, ESR2, ETS1, ETS2, FOSFOSL1, FOSL2, GATA1, GATA2GATA3, GTF2B, GTF2F2, HCFC1HDAC3, HHEX, HIF1A, HMGA1 HOXA9, HOXC8, LEF1, MAF MAFB, MEF2A, MYBBP1A MYC, MYOD1, NCOA1, NCOA2 NCOA3, NFE2L1, NFE2L2, NFIC NFYA, NR3C1, NR5A1, NRIP1 PGR, PIAS1, POU1F1, RARA, RARB, RARG, RB1, RBM39 REL, RELA, RUNX1, RUNX2 SKI, SMAD2, SMAD3, SMAD4 SMARCD1, SMARCD3, SNAPC5 SOX10, SOX8, SP1, SPI1, SPIB SREBF1, SREBF2, STAT1, STAT2 STAT3, STAT4, STAT5A, STAT6 TAF1, TBP, TCF20, TCF4, TCF7 TCF7L1, TCF7L2, TGIF1, TRIP4 TSC22D3, VDR, HSF2 and JDP2
MAPK8	hsa-miR-26a, hsa-miR-103, hsa-miR-107, hsa-miR-196b, hsa-miR-214, hsa-miR-548c-3p and hsa-miR-641	ATF2, COPS2, ELK1, ELK3, FOS HSF1, HSF4, JDP2, JUN, JUNB, JUND, IL8, MECOM, MYC, NFATC2, NFATC4, NR3C1, PAX2 PGR, PPARG, REL, SMAD2, SMAD3, SPIB, STAT3, TP53, TP73 and XRCC6
SRC	hsa-miR-1297, hsa-miR-137, hsa-miR-141, hsa-miR-144, hsa-miR-149, hsa-miR-153, hsa-miR-200a, hsa-miR-203, hsa-miR-220c, hsa-miR-31, hsa-miR-34a, hsa-miR-34c-5p, hsa-miR-449a, hsa-miR-449b, hsa-miR-9, hsa-miR-940, hsa-miR-145 and hsa-miR-143	ABL1,AR, ARHGAP35,CTNBN1, DAB2, ESR1, ESR2, ETS1, ETS2, FOXO1, GTF2I, HCLS1, HNF1A, HNRNPK, IKKBK, KHDRBS1, MAX, MXI1::CLEC5A, MYC, NFKBIA, NR1I2, PAX5, PGR, PPARD, RXRA, SMARCB1, SMARCE1, SP1, SRF, STAT1, STAT3, STAT5A, STAT5B, STAT6, TFAP2A, THRA, TRIP6 WBP11 and YTHDC1

GRB2	hsa-miR-26b, hsa-miR-124, hsa-miR-128a, hsa-miR-128b, hsa-miR-141, hsa-miR-153, hsa-miR-15a, hsa-miR-15b, hsa-miR-16, hsa-miR-182, hsa-miR-195, hsa-miR-200a, hsa-miR-208b, hsa-miR-220c, hsa-miR-27a, hsa-miR-27b, hsa-miR-320, hsa-miR-329, hsa-miR-376c, hsa-miR-424, hsa-miR-433, hsa-miR-497, hsa-miR-506, hsa-miR-520g, hsa-miR-520h, hsa-miR-532-3p, hsa-miR-941 and hsa-miR-96	ABL1, DAB2, DTX1, EGR1, ELK1, ESR1, FOXA2, FOXO1, FOXO3, FOXO3B, GABPA, HTT, KHDRBS1, KHDRBS2, MTA1, MTA3, NPM1, PAX5 and TP63
PIK3R1	hsa-miR-376c, hsa-miR-103, hsa-miR-107, hsa-miR-128, hsa-miR-132, hsa-miR-136, hsa-miR-150, hsa-miR-153, hsa-miR-155, hsa-miR-15a, hsa-miR-15b, hsa-miR-16, hsa-miR-186, hsa-miR-195, hsa-miR-21, hsa-miR-212, hsa-miR-218, hsa-miR-221, hsa-miR-222, hsa-miR-29a, hsa-miR-29b, hsa-miR-29c, hsa-miR-361-5p, hsa-miR-424, hsa-miR-448, hsa-miR-455-3p, hsa-miR-486-5p, hsa-miR-488, hsa-miR-495, hsa-miR-497, hsa-miR-503, hsa-miR-520a-5p, hsa-miR-525-5p, hsa-miR-532-3p, hsa-miR-542-3p, hsa-miR-545, hsa-miR-548a-3p, hsa-miR-548c-3p, hsa-miR-579, hsa-miR-590-5p, hsa-miR-603, hsa-miR-630, hsa-miR-655, hsa-miR-656, hsa-miR-767-5p, hsa-miR-891b, hsa-miR-93 and hsa-miR-96	ABL1, CTCF, CTNNB1, EBF1, EGR1, EGR2, EGR3, ELK1, ESR1, GABPA, GATA3, GTF2H1, HNF1A, HOXA9, IRF1, KHDRBS1, KLF12, MEF2A, MEIS1, NFE2L1, NFIL3, NFKBIA, NFYA, NFYB, NFYC, NR2F2, PBX1, PGR, POU3F1, POU3F2, RB1, SP1, USF1 and WBP11
ABCG2	hsa-miR-496, hsa-miR-192, hsa-miR-328, hsa-miR-328, hsa-miR-519c-3p, hsa-miR-519d, hsa-miR-520a-3p, hsa-miR-520b, hsa-miR-520c-3p, hsa-miR-520d-3p, hsa-miR-520e, hsa-miR-520f, hsa-miR-520g and hsa-miR-520h	FOS, JUN, MAX and USF1
SHC1	hsa-miR-186, hsa-miR-124, hsa-miR-1271, hsa-miR-127-5p, hsa-miR-140-3p, hsa-miR-140-5p, hsa-miR-198, hsa-miR-204, hsa-miR-211, hsa-miR-219, hsa-miR-219-5p, hsa-miR-330-5p, hsa-miR-452, hsa-miR-506, hsa-miR-518e, hsa-miR-568, hsa-miR-572, hsa-miR-650, hsa-miR-9 and hsa-miR-96	ABL1, BCL3, ELK1, EP300, ESR1, ESR1, FOS, GABPA, JUN, NPM1, POU2F1, REL, RELA, SP1, STAT5A, STAT5B, TOPORS and TP53
SOS1	hsa-miR-495, hsa-miR-124, hsa-miR-132, hsa-miR-148b, hsa-miR-152, hsa-miR-155, hsa-miR-181a, hsa-miR-181b, hsa-miR-181d, hsa-miR-204, hsa-miR-211, hsa-miR-212, hsa-miR-217, hsa-miR-302c, hsa-miR-30a, hsa-miR-30b, hsa-miR-30d, hsa-miR-30e, hsa-miR-506, hsa-miR-519a, hsa-miR-519b-3p, hsa-miR-519c-3p, hsa-miR-520a-3p, hsa-miR-520b, hsa-miR-520c-3p, hsa-miR-520d-3p, hsa-miR-520e, hsa-miR-520f, hsa-miR-9 and hsa-miR-96	AR, BIN1, CTCF, EGR1, ESR1, NFIC, RARA, SP1, STAT3, TFAP2A, USF1, NFIC, RARA, SPRY1, SPRY2, CCND1, SPRY4, SPRY3, BCL2L1, CCND2, CCND3, MYC, SPRED1 and SPRED2
CREB1	hsa-miR-653, hsa-miR-103, hsa-miR-124, hsa-miR-128a, hsa-miR-128b, hsa-miR-141, hsa-miR-181a, hsa-miR-181b, hsa-miR-181c, hsa-miR-181d, hsa-miR-182, hsa-miR-200a, hsa-miR-223, hsa-miR-25, hsa-miR-27a, hsa-miR-27b, hsa-miR-32, hsa-miR-34b*, hsa-miR-363, hsa-miR-367, hsa-miR-433, hsa-miR-519b-3p, hsa-miR-526b, hsa-miR-543, hsa-miR-552, hsa-miR-576-5p, hsa-miR-92a, hsa-miR-92b, hsa-miR-944 and hsa-miR-96	ABL1, AHR, ARNT, ATF1, ATM, CEBPA, CEBPB, CIITA, CREBBP, CREM, EDF1, EGR1, EP300, FHL5, GLI2, GTF2F2, KAT5, KCNIP3, MYC, NFKB1, NFKB2, NR3C1, PDX1, REL, RELA, RELB, SMARCA4, SMARCA5, SOX9, SRF, STAT3, THRA and TLX2
PLCG1	hsa-miR-543, hsa-miR-101, hsa-miR-129, hsa-miR-129-5p, hsa-miR-149, hsa-miR-182, hsa-miR-200b, hsa-miR-218, hsa-miR-221, hsa-miR-30a, hsa-miR-30a-5p, hsa-miR-30b, hsa-miR-30c, hsa-miR-30d, hsa-miR-30e, hsa-miR-34a, hsa-miR-429, hsa-miR-455-5p, hsa-miR-874 and hsa-miR-96	ABL1, ATF2, CREB1, CTCF, E2F4, EEF1A1, EGR1, ESR1, GTF2H1, KHDRBS1, NFYA, SREBF1, SREBF2, TOPORS, USF1 and YY1
CD247	hsa-miR-410, hsa-miR-214 and hsa-miR-346	EP300, FOS, JUN, SLA2, STAT5A, STAT5B and YY1
ZAP70	hsa-miR-297, hsa-miR-331-3p, hsa-miR-34a, hsa-miR-34b, hsa-miR-34c-5p, hsa-miR-484, hsa-miR-629, hsa-miR-885-3p and hsa-miR-939	ABL1, ATF6, CTCF, HNF4A, NFYA, NR2F1, NR2F2, SLA2, USF1 and XBP1
CSNK2A1	hsa-miR-520h, hsa-miR-125b, hsa-miR-141, hsa-miR-186, hsa-miR-200a, hsa-miR-216b and hsa-miR-221	AIP, APEX1, ARNT, ATF1, ATF2, BDP1, BRCA1, BRF1, CREBBP, CREM, CTD1P1, CTNNB1, CUX2, DDIT3, EGR1, ETS1, FOS, GTF2A1, GTF2A1L, HCLS1, HDAC1, HDAC2, HDAC3, HES6, HIF1A, HMGA1, HMGA2, HOXB7, HSF1, IFI16, IRF2, JUN, KLF1, MAX, MAZ, MEF2C, MYB, MYC, MYCN, MYF5, NAP1L4, NFIC, NFKB1, NFKBIA, NKX2-5, PGR, PML, RELA, SHOX, SP1, SPIB, SRF, SSRP1, SUB1, TCF7L2, TOPORS, TP53, UBTF, VDR, YY1 and ZHX1

PTK2B	hsa-miR-519c-3p, hsa-miR-19a, hsa-miR-205, hsa-miR-23a, hsa-miR-23b, hsa-miR-345, hsa-miR-515-5p, hsa-miR-647, hsa-miR-892b and hsa-miR-940	CTCF, EGR1, EWSR1, GABPA, HNF4A, MYC, NFKB1, REST, SP1, SPI1, SRF, STAT3, TGFB111 and TP53
CAMK2B	hsa-miR-544	AHR, ARNT, ATF4, CTCF, E2F1, E2F2, E2F3, E2F4, E2F5, E2F6, E2F7, EGR1, EGR2, EGR3, ETS1, MEF2A, NFE2L1, PAX5, RORA, RREB1, RXRG, SP1, THRB, USF1 and XBP1
HBXIP	hsa-miR-192, hsa-miR-106a, hsa-miR-106b, hsa-miR-140-5p, hsa-miR-145, hsa-miR-16, hsa-miR-17, hsa-miR-18a, hsa-miR-18b, hsa-miR-20a, hsa-miR-20b, hsa-miR-370, hsa-miR-378, hsa-miR-492, hsa-miR-496, hsa-miR-515-3p, hsa-miR-519d, hsa-miR-519e, hsa-miR-520d-5p, hsa-miR-520g, hsa-miR-520h, hsa-miR-524-5p, hsa-miR-545, hsa-miR-590-3p, hsa-miR-606, hsa-miR-619, hsa-miR-631, hsa-miR-876-3p and hsa-miR-93	EEF1A1, GABPA, HNF1A, HNF4A, MAF1, MAX, POU2F1, USF1 and ZBTB16
PPP3CA	hsa-miR-328, hsa-let-7a, hsa-let-7b, hsa-let-7c, hsa-let-7e, hsa-let-7f, hsa-let-7g, hsa-let-7i, hsa-miR-100, hsa-miR-106a, hsa-miR-106b, hsa-miR-142-3p, hsa-miR-145, hsa-miR-153, hsa-miR-17, hsa-miR-182, hsa-miR-20b, hsa-miR-21, hsa-miR-300, hsa-miR-30a, hsa-miR-30a-5p, hsa-miR-30b, hsa-miR-30c, hsa-miR-30d, hsa-miR-30e, hsa-miR-31, hsa-miR-340, hsa-miR-34b, hsa-miR-372, hsa-miR-381, hsa-miR-410, hsa-miR-495, hsa-miR-499-5p, hsa-miR-501-3p, hsa-miR-502-3p, hsa-miR-519a, hsa-miR-519b-3p, hsa-miR-519c-3p, hsa-miR-520d-3p, hsa-miR-520d-5p, hsa-miR-520e, hsa-miR-520g, hsa-miR-520h, hsa-miR-524-5p, hsa-miR-590-5p, hsa-miR-635, hsa-miR-93, hsa-miR-96, hsa-miR-98 and hsa-miR-99a	AHR, ARNT, CEBPB, CUX1, E2F1, E2F2, E2F3, E2F4, E2F5, E2F6, E2F7, EGR1, FOXC1, FOXJ2, NFAT5, NFATC1, NFATC2, NFATC3, NFATC4, NFYA, PPARG and ZBTB6
NFATC1	hsa-miR-519c, hsa-miR-122, hsa-miR-124, hsa-miR-137, hsa-miR-143, hsa-miR-155, hsa-miR-506 and hsa-miR-611	AHR, ARNT, ATF2, CDC5L, EP300, FOXC1, FOXF2, FOXI1, FOXO1, FOXO3, FOXO3B, FOXO4, NFKB1, PAX5, REL, RELA, SPI1, SRF and USF1
PPP3CB	hsa-miR-371-5p, hsa-miR-101, hsa-miR-103, hsa-miR-107, hsa-miR-1297, hsa-miR-137, hsa-miR-140-3p, hsa-miR-15a, hsa-miR-15b, hsa-miR-16, hsa-miR-192, hsa-miR-195, hsa-miR-196b, hsa-miR-19b, hsa-miR-215, hsa-miR-222, hsa-miR-26a, hsa-miR-26b, hsa-miR-30a, hsa-miR-30a-5p, hsa-miR-30b, hsa-miR-30e, hsa-miR-326, hsa-miR-424, hsa-miR-506, hsa-miR-559, hsa-miR-613, hsa-miR-645, hsa-miR-646, hsa-miR-660, hsa-miR-768-3p and hsa-miR-802	CEBPA, CEBPB, DDIT3, EGR1, EP300, NFAT5, NFATC1, NFATC2, NFATC3, NFATC4, NR3C1 and PAX2
RCAN1	hsa-miR-148a, hsa-let-7b, hsa-miR-103, hsa-miR-107, hsa-miR-124, hsa-miR-323-3p, hsa-miR-34a, hsa-miR-34c-5p and hsa-miR-506	ALX1, CREB1, EBF1, EGR1, IRF1, JUN, MAX, POU3F1, SP1, SPI1, STAT5A, TGIF1, USF1 and VSX2
PPARG	hsa-miR-196a, hsa-miR-128a, hsa-miR-130a, hsa-miR-130b, hsa-miR-138, hsa-miR-144, hsa-miR-20b, hsa-miR-27a, hsa-miR-27b, hsa-miR-301, hsa-miR-338-5p, hsa-miR-34a, hsa-miR-409-3p, hsa-miR-449a, hsa-miR-520b, hsa-miR-520c-3p, hsa-miR-520d-3p, hsa-miR-548a-5p, hsa-miR-548b-5p, hsa-miR-548c-5p, hsa-miR-548d-5p and hsa-miR-559	AR, BRD8, CEBPA, CEBPB, COPS5, CREB1, EDF1, EGR1, ESR1, ESR2, FOXO1, GATA1, HDAC3, HMGA1, MED1, NCOA1, NCOA2, NCOA3, NCOA4, NCOA6, NCOR1, NCOR2, NFE2L1, NFE2L2, NR0B1 and NR0B2
NOS3	hsa-miR-10b	BACH1, CTCF, EPAS1, ERG, ESR1, ESR2, ETS1, ETV4, GABPA, GATA1, GATA2, GATA3, JUN, NR2F2, RORA, SP1, SP1, SP3, SPI1, TAL1::GATA1, TFAP2A and TP53
ADRB2	hsa-miR-142-3p, hsa-let-7a, hsa-let-7b, hsa-let-7c, hsa-let-7d, hsa-let-7e, hsa-let-7f, hsa-let-7g, hsa-let-7i, hsa-miR-155, hsa-miR-15a, hsa-miR-15b, hsa-miR-16, hsa-miR-195, hsa-miR-216b, hsa-miR-27a, hsa-miR-30a, hsa-miR-30a-5p, hsa-miR-30b, hsa-miR-30d, hsa-miR-30e, hsa-miR-424, hsa-miR-497, hsa-miR-556-3p, hsa-miR-605, hsa-miR-607, hsa-miR-625, hsa-miR-634, hsa-miR-7, hsa-miR-888 and hsa-miR-98	CEBPA, CEBPB, CREB1, CUX1, ELK1, GATA1, HLF, NFIC, NFIL3, PBX1, RORA, STAT5A and TBP

CORIN	hsa-miR-873, hsa-miR-106a, hsa-miR-106b, hsa-miR-138, hsa-miR-148a, hsa-miR-152, hsa-miR-17, hsa-miR-20a, hsa-miR-20b, hsa-miR-302a, hsa-miR-302b, hsa-miR-302c, hsa-miR-302d, hsa-miR-373, hsa-miR-495, hsa-miR-520a-3p, hsa-miR-520b, hsa-miR-520c-3p, hsa-miR-520d-3p, hsa-miR-520e, hsa-miR-520f, hsa-miR-548a-3p, hsa-miR-561, hsa-miR-582-3p and hsa-miR-93	CTCF
GNAS	hsa-miR-139-5p, hsa-let-7i, hsa-miR-105, hsa-miR-136, hsa-miR-138, hsa-miR-143, hsa-miR-155, hsa-miR-15b, hsa-miR-18a, hsa-miR-205, hsa-miR-218, hsa-miR-219-2-3p, hsa-miR-219-5p, hsa-miR-221, hsa-miR-223, hsa-miR-338-3p, hsa-miR-34b, hsa-miR-361-3p, hsa-miR-361-5p, hsa-miR-362-5p, hsa-miR-452, hsa-miR-453, hsa-miR-489, hsa-miR-494, hsa-miR-502-5p, hsa-miR-512-3p, hsa-miR-532-5p, hsa-miR-582-3p, hsa-miR-588, hsa-miR-596, hsa-miR-624, hsa-miR-625, hsa-miR-629, hsa-miR-630, hsa-miR-660, hsa-miR-876-3p and hsa-miR-943	CEBPA, CTCF, CUX1, E2F2, E2F4 HSF1, NFIL3, REST, TFAP2A, TFAP2C, USF1, VXSX2 and YY1
HSP90AA1	hsa-miR-133b	AHR, AIP, AR, ARNT, ARNTL, CREB1, CTCF, EGR1, EIF2AK2, ESR1, HIF1A, HSF1, HSF2, IKKBK, IKKKG, MAX, MXI1::CLEC5A, MYC, MYOD1, NPAS2, NR2C2, NR3C1, NR3C2, PPARA, REST, RUNX1T1, SRF, STAT1, STAT3, TFAP2A, TFAP2C, TP53, USF1 and YY1
GTF2A1	hsa-miR-9, hsa-miR-142-3p, hsa-miR-196a, hsa-miR-196b, hsa-miR-25, hsa-miR-32, hsa-miR-493 and hsa-miR-92a	ARNT, BACH2, BCL3, ELK1, EP300, ESR1, GTF2A2, GTF2E1, GTF2E2, GTF2F1, MAX, MXI1::CLEC5A, MYC, TAF1, TAF4, TBP, TBPL1, TRIP4 and USF1
GTF2E1	hsa-miR-145, hsa-miR-124, hsa-miR-155, hsa-miR-200b, hsa-miR-200c, hsa-miR-221, hsa-miR-222, hsa-miR-300, hsa-miR-361-5p, hsa-miR-381, hsa-miR-429, hsa-miR-494, hsa-miR-506, hsa-miR-654-5p and hsa-miR-944	AES, E2F2, ERCC3, GTF2A1, GTF2A2, GTF2B, GTF2E2, GTF2F2, GTF2H1, GTF2H4, NFYA SND1, SP1, TAF6, TBP, TCEA1, TRIM24, YY1 and ZEB1
NR3C1	hsa-miR-384, hsa-miR-1, hsa-miR-124, hsa-miR-137, hsa-miR-141, hsa-miR-142-3p, hsa-miR-144, hsa-miR-181a, hsa-miR-181b, hsa-miR-181c, hsa-miR-181d, hsa-miR-182, hsa-miR-183, hsa-miR-18a, hsa-miR-18b, hsa-miR-200a, hsa-miR-200b, hsa-miR-200c, hsa-miR-204, hsa-miR-206, hsa-miR-211, hsa-miR-22, hsa-miR-29a, hsa-miR-29b, hsa-miR-29c, hsa-miR-300, hsa-miR-30a, hsa-miR-30b, hsa-miR-320, hsa-miR-328, hsa-miR-340, hsa-miR-377, hsa-miR-381, hsa-miR-410, hsa-miR-429, hsa-miR-506, hsa-miR-515-5p, hsa-miR-518d-5p, hsa-miR-543, hsa-miR-548c-3p, hsa-miR-582-5p, hsa-miR-603 and hsa-miR-889	AHR, AR, ARNT, ATF1, ATF2, ATF3, ATF4, ATF5, ATF6, ATF7, CEBPA, CEBPB, CREB1, CREBBP, CTCF, DDX54, E2F1, ECD, EGR1, EGR2, EGR3, ETS1, ETS2, HIF1A, JUN, KDM5A, MED14, NCOA1, NCOA2, NCOA6, NCOR1, NCOR2, NFIA, NFIC, NFKB1, NFKB2, NR2F2 and NR2F6
POLR2A	hsa-miR-28-5p, hsa-miR-214, hsa-miR-542-5p and hsa-miR-873	ABL1, ALX1, ATF2, BARD1, BRCA1, CREB1, CREBBP, CTCF, CTDTP1, ELL, ERCC6, FUS, GTF2B, HTATSF1, KLF12, MCM3 MED21, NFIL3, NONO, NR3C1, POLR2C, POLR2D, POLR2E, POLR2F, POLR2G, POLR2H, POLR2L, POU2F1, PQBP1, SAFB, SND1, SP1, STAT1, STAT3, SUPT5H, TAF10, TBP, TCEA1, TCERG1, TFAP2A, UPF1, USF1 XAB2, XRCC5, YY1 and ZNF74
GNB1	hsa-let-7g, hsa-miR-101, hsa-miR-139-5p, hsa-miR-218, hsa-miR-570 and hsa-miR-598	CREB1, EGR1, EGR2, EP300, HDAC5, MZF1, NFKB1, PATZ1 RELA, SP1 and VSX2
RXRA	hsa-miR-98, hsa-miR-124, hsa-miR-219-5p, hsa-miR-27a, hsa-miR-27b, hsa-miR-506, hsa-miR-626, hsa-miR-876-5p and hsa-miR-9	BCL3, BRD8, COPS2, CTNNB1, EDF1, EGR1, ESR1, FOXO1, FUS, GATA2, HMGA1, JMJD1C, MED1, MYC, MYOD1, NCOA1, NCOA2, NCOA3, NCOA4, NCOA6, NCOR2, NFKB1, NFKBIB, NPAS2, NR0B2, NR1H2, NR1H3, NR1H4, NR1I2, NR1I3, NR2F1, NR4A2, NRBF2, NRIP1, NSD1, PARP1, PAX8, POU2F1, PPARA, PPARG, PPARGC1A, RARA, RARB, RARG and RELA
SMARCD1	hsa-let-7c, hsa-miR-101, hsa-miR-127-5p, hsa-miR-133a, hsa-miR-133b, hsa-miR-141, hsa-miR-148a, hsa-miR-148b, hsa-miR-150, hsa-miR-152, hsa-miR-191, hsa-miR-200a, hsa-miR-21, hsa-miR-223, hsa-miR-324-5p, hsa-miR-325, hsa-miR-369-5p, hsa-miR-370, hsa-miR-421, hsa-miR-490-3p, hsa-miR-515-5p, hsa-miR-552, hsa-miR-556-3p, hsa-miR-590-5p, hsa-miR-624, hsa-miR-7 and hsa-miR-940	ATF1, ATF2, ATF3, ATF4, ATF5 ATF6, ATF7, CREB1, FOS, GATA1, JUN, MAX, MEIS1, MXI1::CLEC5A, MYC, NR3C1 and REL
SMARCE1	hsa-let-7a, hsa-miR-103, hsa-miR-107, hsa-miR-134, hsa-miR-135a, hsa-miR-135b, hsa-miR-22, hsa-miR-485-3p, hsa-miR-494, hsa-miR-512-5p, hsa-miR-520a-5p, hsa-miR-548a-5p, hsa-miR-548b-5p, hsa-miR-548c-3p, hsa-miR-548c-5p, hsa-miR-548d-5p, hsa-miR-555, hsa-miR-603, hsa-miR-609, hsa-miR-760 and hsa-miR-9	BAZ1B, E2F1, E2F2, E2F3, E2F4, E2F5, E2F6, E2F7, ESR1, ESR2, IRF7, NCOA1, NCOA2, NCOA3, NR3C1, PAX5, RELB and SMAD1

ANXA1	hsa-let-7i , hsa-miR-196a, hsa-miR-221, hsa-miR-222, hsa-miR-376c, hsa-miR-598 and hsa-miR-758	FOS, FOXL1, POU3F1 and TBP
CAV1	hsa-let-7b, hsa-miR-106b, hsa-miR-124, hsa-miR-125a-3p, hsa-miR-203, hsa-miR-34b*, hsa-miR-34c-5p, hsa-miR-377, hsa-miR-409-3p, hsa-miR-494, hsa-miR-506, hsa-miR-548c-3p, hsa-miR-628-5p, hsa-miR-768-3p and hsa-miR-96	ABL1, AR, ATF6, E2F1, E2F4, EGR1, ESR1, NFIC, PAX2, RFX1SP1, TFDP1, TP53 and XBP1
LPL	hsa-let-7e, hsa-miR-138, hsa-miR-155, hsa-miR-27a, hsa-miR-27b, hsa-miR-29a, hsa-miR-29b, hsa-miR-29c, hsa-miR-452, hsa-miR-588, hsa-miR-590-3p and hsa-miR-768-5p	AR, ARNT, ASCC2, E2F1, E2F2, E2F3, E2F4, E2F5, E2F6, E2F7, ESR1, POU2F1, POU2F2, POU3F1, POU3F2, POU3F3, POU5F1, PPARA, PPARG, RXRA, RXRB and RXRG
ACTB	hsa-let-7d, hsa-miR-145, hsa-miR-216a, hsa-miR-221, hsa-miR-412, hsa-miR-582-3p, hsa-miR-647 and hsa-miR-648	ATF7IP, EEF1A1, EGR1, EGR3, ELK1, EP300, GABPA, HNF4A, HNRNPAB, NFKB1, NFKB2, NFYA, NFYB, NFYC, POLR2A, POU3F2, PPARG, REL, RELA, SMAD3, SMAD9, SMARCA4, SP1, SRF, STAT1, STAT3, TBP, TFAP2A and USF1
ARID1A	hsa-let-7f, hsa-miR-1, hsa-miR-101, hsa-miR-132, hsa-miR-144, hsa-miR-153, hsa-miR-185, hsa-miR-19a, hsa-miR-19b, hsa-miR-203, hsa-miR-212, hsa-miR-216, hsa-miR-216a, hsa-miR-221, hsa-miR-222, hsa-miR-223, hsa-miR-30a, hsa-miR-30b, hsa-miR-30c, hsa-miR-30d, hsa-miR-30e, hsa-miR-31, hsa-miR-324-5p, hsa-miR-340, hsa-miR-377, hsa-miR-485-3p, hsa-miR-486-5p, hsa-miR-548c-3p, hsa-miR-555, hsa-miR-568, hsa-miR-576-5p, hsa-miR-583, hsa-miR-625, hsa-miR-765, hsa-miR-876-3p, hsa-miR-885-3p and hsa-miR-9	ARNT, CREB1, E2F1, E2F2, E2F3, E2F4, E2F5, E2F6, E2F7, FOXD3, FOXI1, GATA2, HNF4A, MAX, MLLT1, MXI1::CLEC5A, MYC, MZF1, PAX5, POU2F1, POU3F1, PPARG, SMARCA4, SOX9, SP1, SRF, TFAP2A, TFAP2C, TP53, USF1 and YY1
GTF2B	hsa-miR-202, hsa-miR-1, hsa-miR-103, hsa-miR-107, hsa-miR-122, hsa-miR-187, hsa-miR-190, hsa-miR-190b, hsa-miR-199a-3p, hsa-miR-206, hsa-miR-214, hsa-miR-22, hsa-miR-24, hsa-miR-26a, hsa-miR-26b, hsa-miR-338-3p, hsa-miR-384, hsa-miR-488, hsa-miR-511, hsa-miR-520d-5p, hsa-miR-524-5p, hsa-miR-561, hsa-miR-582-5p, hsa-miR-607 and hsa-miR-633	BCL3, CREBBP, EGR1, EP300, ESR1, ESRRA, FOXF2, GTF2E1, GTF2E2, GTF2F1, GTF2F2, HSF1, IKZF1, JUN, MAX, MCM2, MXI1::CLEC5A, MYC, NCOA1, NCOA3, NCOA4, NR2F1, NR5A1, POLR2A, POU2F1, POU2F2, POU3F2, REL, RELA, TAF9, TBP, TBPL1, TCEA2, THRA, USF1 and VDR
NF1	hsa-miR-30e , hsa-miR-103, hsa-miR-107, hsa-miR-10b, hsa-miR-125a-3p, hsa-miR-128, hsa-miR-135a, hsa-miR-135b, hsa-miR-137, hsa-miR-144, hsa-miR-153, hsa-miR-15a, hsa-miR-15b, hsa-miR-16, hsa-miR-182, hsa-miR-195, hsa-miR-19a, hsa-miR-19b, hsa-miR-200b, hsa-miR-200c, hsa-miR-217, hsa-miR-219-1-3p, hsa-miR-25, hsa-miR-27a, hsa-miR-27b, hsa-miR-30a, hsa-miR-30b, hsa-miR-30c, hsa-miR-30d, hsa-miR-30e, hsa-miR-338-5p, hsa-miR-340, hsa-miR-363, hsa-miR-369-3p, hsa-miR-370, hsa-miR-374a, hsa-miR-374b, hsa-miR-424, hsa-miR-448, hsa-miR-497, hsa-miR-519b-3p, hsa-miR-519c-3p, hsa-miR-543, hsa-miR-548d-3p, hsa-miR-552, hsa-miR-561, hsa-miR-571, hsa-miR-582-5p, hsa-miR-590-3p, hsa-miR-617, hsa-miR-625, hsa-miR-655, hsa-miR-876-5p, hsa-miR-944 and hsa-miR-96	ATF2, CREB1, CTCF, JUN, PATZ1, PAX5, SP1, TBPL1 and TFAP2A
SMARCA4	hsa-miR-30c, hsa-miR-1, hsa-miR-101, hsa-miR-132, hsa-miR-139-5p, hsa-miR-144, hsa-miR-155, hsa-miR-191, hsa-miR-206, hsa-miR-212, hsa-miR-221, hsa-miR-222, hsa-miR-296-5p, hsa-miR-301a, hsa-miR-30c, hsa-miR-452, hsa-miR-489, hsa-miR-495, hsa-miR-503, hsa-miR-508-5p, hsa-miR-512-3p, hsa-miR-517b, hsa-miR-568, hsa-miR-569, hsa-miR-574-3p, hsa-miR-582-5p, hsa-miR-613, hsa-miR-765 and hsa-miR-942	AHR, ARID1A, ARID1B, BRCA1, BRWD1, CEBPB, CHD4, CREB1, CTNNB1, E2F1, E2F4, EGR1, ESR1, ETS2, GABPA, HSF1, IKZF1, MYC, MZF1, NR3C1, PAX6, PBRM1, RB1, RELB, RFXAP, SMARCB1, SMARCC1, SMARCE1, STAT2, TMF1, TP53, YY1 and ZMYND11
SMARCB1	hsa-miR-30d, hsa-miR-1, hsa-miR-192, hsa-miR-206 and hsa-miR-300	CEBPB, E2F4, FOS, FOSB, FOSL1, HNF4A, JUN, JUNB, JUND, KLF1, MECP2, MYC, NR3C1, RB1, RELB, SMARCA4, TCF3, TFAP2A, TP53 and YEATS4
SMARCC1	hsa-miR-30a, hsa-let-7a, hsa-let-7b, hsa-let-7c, hsa-let-7d, hsa-let-7e, hsa-let-7f, hsa-let-7g, hsa-let-7i, hsa-miR-1, hsa-miR-124, hsa-miR-129-5p, hsa-miR-144, hsa-miR-153, hsa-miR-196a, hsa-miR-196b, hsa-miR-202, hsa-miR-206, hsa-miR-208b, hsa-miR-214, hsa-miR-23a, hsa-miR-23b, hsa-miR-29b, hsa-miR-29c, hsa-miR-330-3p, hsa-miR-339-3p, hsa-miR-488, hsa-miR-506, hsa-miR-548d-3p, hsa-miR-567, hsa-miR-610, hsa-miR-641 and hsa-miR-98	CEBPB, FOXO1, GABPA, HOXA9, KLF1, MEIS1, NR3C1, RELB, SIN3A and SMARCA4

SMARCC2	hsa-miR-30b, hsa-miR-28-5p, hsa-miR-30a, hsa-miR-30b, hsa-miR-30c, hsa-miR-30e, hsa-miR-519a, hsa-miR-519b-3p, hsa-miR-519c-3p, hsa-miR-519d, hsa-miR-568, hsa-miR-608, hsa-miR-708 and hsa-miR-938	BAZ1B, CTCF, ESR1, GABPA POLR2C and RELB
HRH1	hsa-miR-196b, hsa-miR-192, hsa-miR-324-5p, hsa-miR-518a-5p, hsa-miR-527, hsa-miR-583	FOS, HNF4A, JUN, MAX, NR2F1, NR3C1, POU2F1, POU2F2, POU3F1, POU3F2, POU3F3, POU5F1 and TFAP2A

Table 1: Pharmacoreg of psoriasis.

Discussion

Based on Clustering Analysis of Target (Gene) and interactors (miRNA and Transcription factors), it is clear that hsa-miR-362-3p, SOX 10, SOX8, AATF and GTF2A2 regulates most of the vital process in disease pathology and this result will have a vital impact in the research areas of Biomarker and Personalised medicine for disorders in auto immunity.

Conclusion

The approach in this manuscript is to have a different view point to approach the disease pathology of Psoriasis and hence an ensemble of associated gene. miRNAs and transcription factors from available sources were retrieved and analyzed on the basis of Network Biology (An emerging field with prominent significance). In this manuscript Pharmacoreg is implemented for Psoriasis but in future it will be implemented to understand the pathology of other diseases.

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