

Introduction

Description

Forkhead box M1, a transcription factor that regulates mitotic cell cycle, organ development, vascular permeability, macrophage and monocyte chemotaxis, promotes protein kinase activity and cell proliferation, upregulated in brain and lung neoplasms

Gene symbol

FOXM1

Synonyms

WIN; Mpm2; (TGT3); (MPP2); INS-1; PIG29; HFH11; FOXM1; HNF-3; MPP-2; FOXM1B; HFH-11; FOXM1A; FOXM1C; FKHL16; HFH-11B; TRIDENT; MPHOSPH2; Hs.198243; forkhead box M1

Gene Ontology [what is this?](#)

Molecular function

DNA binding [E], nucleic acid binding transcription factor activity [E], protein binding [E], protein kinase binding [E]... [details](#)

Biological process

adherens junction assembly [E], angiogenesis [E], cell growth [E], cellular response to DNA damage stimulus [E], MAPK cascade [E]... [details](#)

Cellular component

cytoplasm [E], cytosol [W], nucleolus [W], nucleolus [W], nucleoplasm [W], nucleus [E] [details](#)

Orthologs & Molecular Hierarchy [what is this?](#)

Hierachy of orthologous relationships for this locus

+

 View orthologous relationships

Biomarker Associations [what is this?](#)

Diseases associated with FOXM1 (44 entries)

Show

5

 entries

Search:

	Type of Association	Indication
--	---------------------	------------

geneXplain

Locus Report - Human

FOXM1 (FOXM1)

logout

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Stomach Neoplasms	60 associations	18 associations	37 associations	7 associations		20 associations	5 associations	12 associations
Carcinoma, Non-Small-Cell Lung	47 associations	16 associations	24 associations	7 associations		16 associations	12 associations	12 associations
Carcinoma, Renal Cell	43 associations	19 associations	21 associations	3 associations		19 associations	10 associations	11 associations
Glioma	35 associations	10 associations	20 associations	5 associations		12 associations	7 associations	12 associations
Colorectal Neoplasms	33 associations	18 associations	15 associations			17 associations	11 associations	3 associations

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GENE

Mutations

Inherited FOXM1 mutations

The [Human Gene Mutation Database \(HGMD®\) report](#) provides information on the following inherited FOXM1 mutations (subscription required):

Mutation Type	Count	Mutation Type	Count
Missense/nonsense	2	Small indels	0
Splicing	0	Gross deletions	0
Regulatory	0	Gross insertions	0
Small deletions	0	Complex rearrangements	0
Small insertions	0	Repeat variations	0

Mutant Phenotype [what is this?](#)

Mutant phenotype of closely related homolog(s)

- Mouse **Foxm1** (75.3% identity to Human FOXM1 [0.0])
Viability effects : inviable [details](#)
Anatomical effects : cardiac muscle cells; heart; hepatocytes [details](#)
Physiological effects : cell cycle control [details](#)
- C. elegans **daf-16** (39.8% identity to Human FOXM1 [2e-12])
Viability :

Abnormal lifespan	RNAi
Abnormal lifespan	Null
Abnormal lifespan	Overexpression or ectopic expression
Abnormal lifespan	Recessive
Altered chemical or other sensitivity	Recessive
Showing 1 to 5 of 24 entries	
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S. cerevisiae HCM1 (37.6% identity to Human FOXM1 [3e-15])

Viability :

Null Viable

Show 5 entries

Search:

Phenotypic effect details	Mutation type
Altered sensitivity to divalent cations, heavy metals, or salt	Null
Benomyl sensitive	Null
Chromosome instability	Null
Decreased lifespan	Null
Fluconazole resistant	Null
Showing 1 to 5 of 9 entries	
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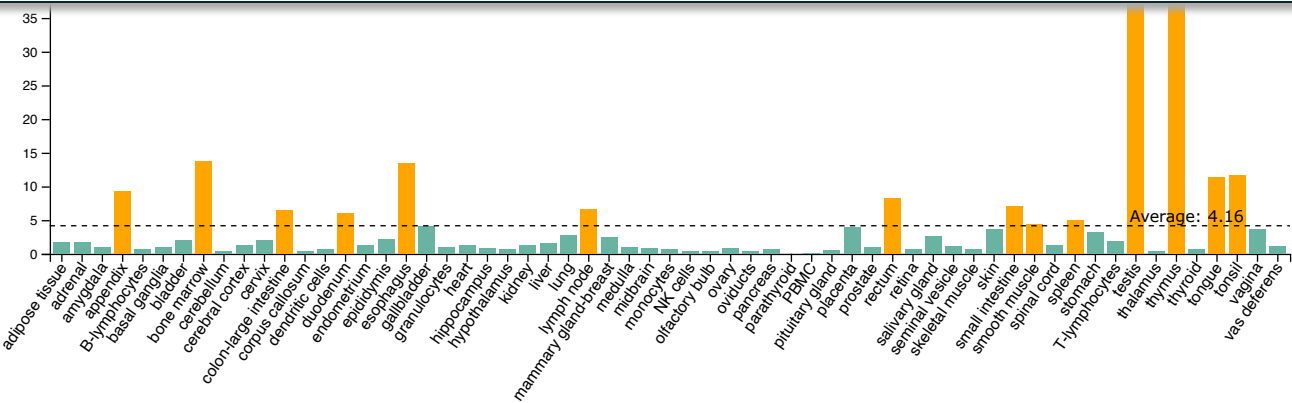
Expression [what is this?](#)

Tissue expression

Consensus normalized transcript expression levels provided by Human Protein Atlas (v20)

Relative tissue specificity: 0.23

Sorting: Alphabetical



+ View organ or tissue, cell type, and tumor type entries in detail

Regulation of FOXM1 expression

Proteins, complexes, or pathways that influence FOXM1 expression (2 entries)

Show 5 entries Search:

Regulator details	Effect
ETV5	Upregulated by
GLI1	Upregulated by

Showing 1 to 2 of 2 entries

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Transcriptional Regulation [what is this?](#)

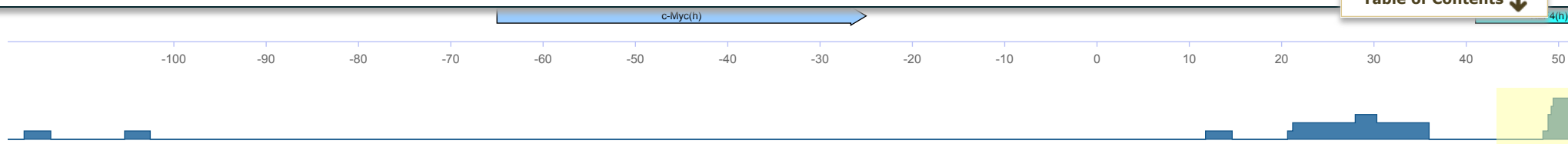
Regulation of FOXM1 gene expression

Analyze FOXM1 with MATCH Suite

Predicted promoter sequences : Match

Best supported : PM000990079

All promoters for the gene : PM000607016, PM000607015, PM000607014, PM000990079

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Viewing nucleotides -118 to 72

* Note: Only binding sites whose location is relative to the TSS are graphically displayed. Binding sites with an asterisk (*) are not included in the graphical display.

Transcription factor binding sites within the FOXM1 gene (17 entries)

Show 5 entries

Search:

Identifier	Relative Location	Genomic Location	Binding Factor(s)	DNA Binding Reaction	Effect
HS\$FOXM1_12	-1792 to -1767	Chr12 2878904 2878929 -	HSF1(h)	HSF1(h) --> FOXM1(h)	DNA binding
HS\$FOXM1_13	-1678 to -1653	Chr12 2878790 2878815 -	HSF1(h)	HSF1(h) --> FOXM1(h)	DNA binding
HS\$FOXM1_03	-450 to -421	Chr12 2877576 2877605 -	STAT3(h)	STAT3(h) --> FOXM1(h)	DNA binding
HS\$FOXM1_14	-357 to -352		Twist-1(h)	Twist-1(h) --> FOXM1(h)	DNA binding
HS\$FOXM1_15	-350 to -198		E2F-1(h)	E2F-1(h) --> FOXM1(h)	DNA binding

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In vivo fragments within the promoter(s) of the FOXM1 gene that are bound by transcription factors (1174 entries)

Show 5 entries

Search:

Promoter	Transcription Factor	Genomic Location	Cell Source	Matrix	Relative Location	CSS	MSS	Sequence	Reference
PM000990079	FOXA3(h)	12:2887080..2887439	HepG2	V\$HNF3G_Q4	-10407	0.868	0.850	AAAAAATA	ENCODE Data ↗ 22955616 ↗
PM000607015	NANOG(h)	12:2878376..2878876	ESC + H1 + 3IL	V\$NANOG_01	-10332	0.966	0.928	GGGAATGATCGT	ArrayExpress Data ↗ 29126285 ↗ 25361974 ↗
PM000990079	EAR2(h)	12:2887077..2887416	HepG2	V\$EAR2_Q4	-10332	0.967	0.821	GTGAGCAGAGA	ENCODE Data ↗ 22955616 ↗
PM000607015	Sp1(h)	12:2878194..2878828	HL60	V\$SP1_05	-10313	1.000	0.908	ACGGGCGGGGG	
PM000607015	ATF-4(h)	12:2878530..2878766	K562	V\$ATF4_Q5	-10248	0.962	0.910	ACTGAAGGAATA	ENCODE Data ↗ 22955616 ↗

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Predicted enhancers / silencers for FOXM1 regulation (1 entry)

Show 5 entries

Search:

Translational Regulation [what is this?](#)

Regulation of FOXM1 mRNA expression

miRNA binding sites within FOXM1 mRNA (16 entries)

Show 5 entries

Search:

Identifier	Region	Location	Location Reference Point	Binding Factor(s)
HS\$FOXM1_04	3' UTR	3129 to 3149	start of reference sequence	hsa-miR-31-5p(h)
HS\$FOXM1_05	3' UTR	68 to 90	stop codon (end of coding sequence (CDS))	hsa-miR-370-3p(h)
HS\$FOXM1_06	3' UTR	3583 to 3605	start of reference sequence	hsa-miR-149-5p(h)
HS\$FOXM1_11	3' UTR	130 to 152	stop codon (end of coding sequence (CDS))	hsa-miR-134-5p(h)
HS\$FOXM1_17	3' UTR	890 to 912	stop codon (end of coding sequence (CDS))	hsa-miR-342-3p(h)

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RNA Features [what is this?](#)

Overview of RNA sequence

Nucleotide Sequence : TTTCAAA...AAAAAAA (1..3506; 3506 nt) [details](#)

Sequence source : REFSEQ#NM_001243088

FASTA

PROTEIN

Drug Interactions [what is this?](#)

Drug(s) targeting FOXM1 (5 entries)

Show 5 entries

Search:

Drug(s)	Status	Interaction Data Source	Reference(s)
Curcumin	small molecule, approved, experimental, investigational	DrugBank	24165291

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Nitroxoline	small molecule,approved	DrugBank	25897210
Proellex	small molecule,investigational	DrugBank	27215412
Tauroursodeoxycholic acid	small molecule,approved,investigational	DrugBank	30998645

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Pathways & Interactions

Pathways

Pathways from Reactome (6 entries)

Provided by the [Reactome](#) database, release 78 ([ReactomePathways.gmt](#)).

Show 5 entries

Search:

Name	Reactome pathway report link	Reactome pathway browser link
Cell Cycle	R-HSA-1640170	Open in Reactome Browser
Cell Cycle, Mitotic	R-HSA-69278	Open in Reactome Browser
Cyclin A/B1/B2 associated events during G2/M transition	R-HSA-69273	Open in Reactome Browser
G2/M Transition	R-HSA-69275	Open in Reactome Browser
Mitotic G2-G2/M phases	R-HSA-453274	Open in Reactome Browser

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Pathways from WikiPathways (5 entries)

Provided by the [WikiPathways](#) database.

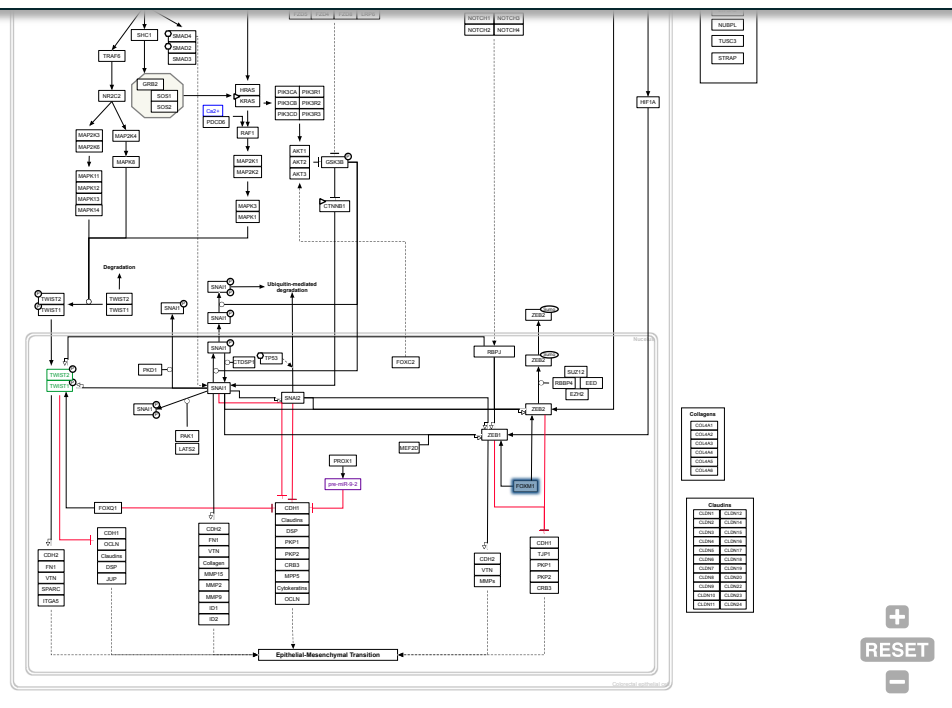
Show 5 entries

Search:

Name	Display below	WikiPathways external link
DNA IR-damage and cellular response via ATR	View	WikiPathways
Epithelial to mesenchymal transition in colorectal cancer	View	WikiPathways
Hippo-Merlin signaling dysregulation	View	WikiPathways
Malignant pleural mesothelioma	View	WikiPathways
Sudden infant death syndrome (SIDS) susceptibility pathways	View	WikiPathways

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Protein-protein interactions

+ Proteins bound by FOXM1 (87 partners)

Events acting on FOXM1

+ Proteins or complexes that phosphorylate FOXM1 (6 partners)

+ Proteins or complexes that affect FOXM1 in other ways (82 partners)

Events triggered by FOXM1

+ Proteins or complexes affected by FOXM1 in other ways (112 partners)

Transcription Factor Activity what is this?

Regulation of gene expression by FOXM1

Transcription factor classification :

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Search:

Gene	Location within Gene	Binding Site Identifier	DNA Binding Reaction	Effect	Quality Score
ANXA1(h)	-1620 to -1605	HS\$ANXA1_07	FOXM1(h) --> ANXA1(h)	transactivation	1
CDC25A(h)	-1019 to -1012	HS\$CDC25A_12	FOXM1(h) --> CDC25A(h)	DNA binding	3
CDC25A(h)	-891 to -884	HS\$CDC25A_13	FOXM1(h) --> CDC25A(h)	DNA binding	3
CDC25A(h)	-875 to -868	HS\$CDC25A_14	FOXM1(h) --> CDC25A(h)	DNA binding	3
CDC6(h)	-1011 to -1004	HS\$CDC6_08	FOXM1(h) --> CDC6(h)	DNA binding	3

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ChIP-seq or similar experiments for FOXM1 (13 entries)

Show 5 entries

Search:

ChIP Experiment Report	Chromosome	Binding Fragments	Cell	Reference
View Report	Human Genome	22821	GM12878	ENCODE Data 22955616
View Report	Human: 1,2,3,4,5,6,7,8,9,10,11,12,13,14,15,16,17,18,19,20,21,22	17633	K562	ENCODE Data 22955616
View Report	Human: 1,2,3,4,5,6,7,8,9,10,11,12,13,14,15,16,17,18,19,20,21,22	5347	HEK293T	ENCODE Data 22955616
View Report	Human Genome	2625	HEK293	GEO Data 29126285 26100407 23193258
View Report	Human Genome	8390	HeLa	GEO Data 29126285 24109597 23193258

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Positional weight matrices for FOXM1 (5 entries)

Show 5 entries

Search:

Sequence logo	PWM ID	Matrix type	Matrix category
	V\$FOXM1_01	factor-specific	matrix compiled from individual genomic sites
	V\$FOXM1_Q3	factor-specific	matrix compiled from individual genomic sites

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Transcription factors which interact with FOXM1

Search:

Protein Features what is this?

Overview of protein sequence and structure

Isoforms : FOXM1-isoform1 , FOXM1-isoform2 , FOXM1-isoform4

[+ View related proteins](#)

Post-translational modifications of FOXM1 protein



- + Ubiquitinated forms (1 entry)

Known types of modification : serine phosphorylation [details](#)

View complexes containing FOXM1 protein

[+ View complexes \(77 entry\)](#)

- Forkhead box M1, a transcription factor that regulates mitotic cell cycle, organ development, vascular permeability, macrophage and monocyte chemotaxis, promotes protein kinase activity and cell proliferation, upregulated in brain and lung neoplasms [10567581](#) [16585184](#) [18206647](#) [12183437](#) [16489016](#) [17804744](#)

Function

- Broadly expressed in actively dividing cells and is crucial for cell cycle-dependent gene expression in the G2 phase of the cell cycle [17014965](#)

Disease related

- Expression of the corresponding gene and protein is upregulated in glioblastomas and is associated with glioma tumorigenicity [16585184](#)
- Expression of the corresponding gene is upregulated in basal cell carcinomas [12183437](#)
- Expression of the corresponding gene is upregulated in non small cell lung cancers [16489016](#)
- FoxM1 activity may contribute to the increase in mitotic errors seen in human diseases such as cancer and early onset of ageing diseases [17014965](#)
- MRNA is overexpressed in acute myeloid leukemia [20823107](#)

more

Identifiers [what is this?](#)

Accessions mapped to this record

BIOBASE gene accession : GN000003858, G004005, MO000030791

BIOBASE protein accession : PR000007731, MO000088314, MO000178534, MO000178546, MO000329116, MO000332716, MO000332751, MO000480856, MO000481216, MO000482209, MO000482359, MO000482606, MO000483460, MO000484248, MO000485012, MO000572653, MO000572654, T09368

Gene

Affymetrix	11725441_a_at, 11725442_a_at, 11734028_a_at, 16760048, 202580_x_at, 3440599, 3440600, 3440601, 3440602, 3440603, 3440604, 3440605, 3440606, 3440607, 3440608, 3440609, 3440610, 3440612, 3440614, 3440615, 3440616, 3440617, 3440618, 3440619, 3440620, 3440621, 3440622, 3440623, 3440627, 3440628, 3440629, 3440630, 3440631, 3440632, 3440633, 3440634, 3440635, 34715_at, 70225_r_at, 7960340, g11386144_3p_s_at, TC12001106.hg, U74612_at,
Agilent	A_23_P151150
Ensembl	ENSG00000111206 , ENST00000342628 , ENST00000359843 , ENST00000361953 , ENST00000366362 , ENST00000535350 , ENST00000536066 , ENST00000537018 , ENST00000538564 , ENST00000545049 , ENST00000627656
EntrezGene	2305
Genbank	11386144 , 13623192 , 15277518 , 158255847 , 16306807 , 1842252 , 1842254 , 30582810 , 340545542 , 340545544 , 3738267 , 42544160 , 42544164 , 42544166 , 452438 , 46982410 , 63021435 , 77625206 , AK291206 , AY542306 , BC006192 , BC006529 , BC012863 , BT006986 , CS174342 , DQ022289 , L16783 , NM_001243088 , NM_001243089 , NM_021953 , NM_202002 , NM_202003 , U74612 , U74613 , U83113
HGMD	FOXM1
HumanProteinAtlas	ENSG00000111206
Illumina	0003840594, 0005390044, ILMN_1716400

RefSeq	NP_973732.1 , XM_005253676.4 , XM_011520930.3 , XM_011520931.3 , XM_011520932.1 , XM_011520933.1 , XM_011520934.3 , XM_011520935.1 , XP_005253733.1 , XP_011519232.1 , XP_011519233.1 , XP_011519234.1 , XP_011519235.1 , XP_011519236.1 , XP_011519237.1 , XR_931507.1
UniGene	Hs&239
WikiPathways	WP4016 , WP4239 , WP4541 , WP5087 , WP706

Protein

Genbank	11386145 , 13623193 , 15277519 , 158255848 , 16306808 , 1778838 , 1842253 , 1842255 , 292331 , 30582811 , 340545543 , 340545545 , 42544161 , 42544165 , 42544167 , 46982411 , 63021436 , 77625207 , AAC37541.1 , AAC51128.1 , AAC51129.1 , AAC63595.1 , AAH06192.1 , AAH06529.1 , AAH12863.1 , AAP35632.1 , AAT08175.1 , AAY26401.1 , BAF83895.1 , CAJ34550.1 , NP_001230017.1 , NP_001230018.1 , NP_068772.1 , NP_068772.2 , NP_973731.1 , NP_973732.1
UniProt	Q08050

References (209 entries)

Show 5 entries

Search:

Sl.No	PMID	Citation
1	33961781	Dual Proteome-scale Networks Reveal Cell-specific Remodeling of the Human Interactome Cell 184 3022-3040 (2021) Show abstract
2	31783819	Liang, J, Liu, Z, Wei, X, Zhou, L, Tang, Y, Zhou, C, Wu, K, Zhang, F, Zhang, F, Lu, Y, Zhu, Y, Expression of FSCN1 and FOXM1 are associated with poor prognosis of adrenocortical carcinoma patients. BMC cancer 19 (1) 1165-1165 (2019) Show abstract
3	31364741	Tang, C, Liu, T, Wang, K, Wang, X, Xu, S, He, D, Zeng, J, Transcriptional regulation of FoxM1 by HIF?1? mediates hypoxia?induced EMT in prostate cancer. Oncol Rep 42 (4) 1307-1318 (2019) Show abstract
4	31225930	Mazzu, YZ, Yoshikawa, Y, Nandakumar, S, Chakraborty, G, Armenia, J, Jehane, LE, Lee, GM, Kantoff, PW, Methylation-associated miR-193b silencing activates master drivers of aggressive prostate cancer. Mol Oncol - (2019) Show abstract
5	31208440	Cao, X, Liu, L, Yuan, Q, Li, X, Cui, Y, Ren, K, Zou, C, Chen, A, Xu, C, Qiu, Y, Quan, M, Zhang, J, Cao, J, Chen, X, Isovitexin reduces carcinogenicity and stemness in hepatic carcinoma stem-like cells by modulating MnSOD and FoxM1. J Exp Clin Cancer Res 38 (1) 264-264 (2019) Show abstract

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