Table 5. List of hypermethylated and hypomethylated genes and their reported associations with colorectal cancer (CRC) or other cancer types.

Gene	Role	Linked to CRC or other cancers	Reference
Baiap2l2	BAIAP2L2 is a BAR domain-containing protein that promotes formation of planar membrane sheets	BAIAP2L2 is highly expressed in human gastric cancer tissues and promotes proliferation and metastasis of gastric cancer cells	doi: 10.1016/j.biopha.2020.110414. Epub 2020 Jun 20. PMID: 32570120.
Septin9	This gene is a member of the septin family involved in cytokinesis and cell cycle control.	*Septin9* is a well-established biomarker for CRC and its methylation status is used in colorectal cancer screening.	https://doi.org/10.1158/2767-9764.CRC-21-0142
Espn	This gene encodes an actin-bundling protein that is essential for organizing and regulating microvillus structures involved in sensory transduction in mechanosensory and chemosensory cells.	ESPN promotes osteosarcoma metastasis by activating ZEB1-driven epithelial–mesenchymal transition (EMT) via the PI3K/AKT/mTOR signaling pathway.	doi: 10.1186/s12967-025-06500-8
Casz1	CASZ1 is a zinc finger transcription factor that is predicted to have a role in controlling cell fate	Loss of the tumor suppressor CASZ1 is associated with oncogenic disruption of the core regulatory circuitry in neuroblastoma.	doi: 10.1038/s41419-022-05314-6.
Tacc2	TACC2 encodes a protein involved in cell cycle regulation and may contribute to cancer development.	TACC2 is not a cancer related gene.	• DOI: 10.1128/MCB.24.14.6403-6409.2004
Mxra7	Mxra7 is involved in various cellular processes, including cell differentiation, tissue repair, and inflammation.	Mxra7 has been shown to be associated with the prognosis of CRC patients.	doi: 10.3389/fonc.2023.1109181
Crmp1	The Crmp1 gene encodes Collapsin Response Mediator Protein 1, a member of the CRMP family	CRMP1 functions as a suppressor of tumor growth and metastasis in prostate cancer cells.	doi: 10.1038/onc.2016.227
Ephb2	Ephb2 encodes a receptor tyrosine kinase called Ephrin type-B receptor 2	EPHB2 is overexpressed in a subset of colorectal cancers and serves as a significant prognostic indicator.	doi: 10.4132/jptm.2018.06.29
Gse1	GSE1 encodes a coiled-coil protein that is part of the CoREST complex, which regulates histone and DNA methylation.	GSE1 enhances oncogenic traits and recurrence in castration-resistant prostate cancer by targeting the tumor-associated calcium signal transducer TACSTD2.	doi: 10.3390/cancers13163959
Nfatc2	Nfatc2 encodes a DNA-binding protein from the NFAT family, featuring REL- and NFAT-homology regions.	NFATC2 is essential for sustaining colorectal cancer stem cells (CRC-SCs).	doi: 10.2147/OTT.S169129

Plch2	PLCH2 is a member of the PLC-eta family of the phosphoinositide-specific phospholipase C (PLC) superfamily of enzymes	Phospholipase C Isozymes Are Deregulated in Colorectal Cancer	doi: 10.1371/journal.pone.0024419
Cdh23	Cdh23 is one of the calcium-dependent cell adhesion proteins	Epigenetic silencing of CDH23 by methylation is associated with poor prognosis in diffuse large B-cell lymphoma.	doi: 10.18632/aging.203268
Cilp2	CILP2 encodes a protein present in articular and meniscal cartilage.	CILP2 may serve as a biomarker and therapeutic target for peritoneal metastases in colorectal cancer.	doi: 10.1038/s41598-024-63366-4.
Crtac1	Crtac1 is a glycosylated extracellular matrix protein that is found in the interterritorial matrix of articular deep zone cartilage.	Crtac1 has been identified as a protective factor in certain kinds of cancer, such as gastric adenocarcinoma and bladder cancer.	doi: 10.1038/s41598-024-61804-x.
Il12rb1	The IL12RB1 gene encodes the interleukin-12 receptor beta 1 subunit	Disruptive variants in IL12RB1 are significantly more frequent in familial and early-onset colorectal cancer cases than in controls.	doi: 10.1002/humu.24057.
Nav2	NAV2 encodes a protein involved in tumor development and cell migration.	NAV2 overexpression predicts poor prognosis in colorectal cancer and promotes invasion via the SSH1L/cofilin-1 pathway.	doi: 10.1186/s13046-015-0237-3
Rbpms	Rbpms is one of RNA binding protein that mediates the regulation of pre-mRNA alternative splicing (AS)	Elevated expression of RBPMS splice variants suppresses cell proliferation in ovarian cancer cells.	doi: 10.3390/ijms232314742
Tbxa2r	TBXA2R is the gene symbol for the thromboxane A2 receptor.	knockdown of TBXA2R or TBXAS1 in human colorectal cancer cells resulted in reduceing the malignant potential of colon cancer cells.	doi: 10.1016/j.ebiom.2014.12.004.
Trim2	Trim2 is a member of the tripartite motif (TRIM) family.	TRIM2 is a novel promoter of human colorectal cancer	doi: 10.1080/00365521.2019.1575463.
Afap1	Afap1 is a potential modulator of actin filament integrity in response to cellular signals.	Overexpression of lncRNA AFAP1-AS1 correlates with poor prognosis and promotes tumorigenesis in colorectal cancer.	https://doi.org/10.1016/j.biopha.2016.04.009
Bex6	Bex6 is a Brain Expressed X-linked gene 6.	Bex6 is not associated with CRC.	doi: 10.1016/j.gene.2005.05.012.
Ccr4	CCR4 encodes a G-protein coupled receptor known as C-C chemokine receptor type 4.	In colorectal cancer, CCR4 promotes metastasis through the ERK/NF-κB/MMP13 pathway and functions downstream of TNF-α.	doi: 10.18632/oncotarget.10256
Dlgap3	Dlgap3 is involved in modification of postsynaptic structure and modulation of chemical synaptic transmission.	The DLGAP3 gene, also known as SAP97, is occasionally found to have frameshift mutations in colorectal cancer (CRC) with high microsatellite instability (MSI-H).	DOI 10.1007/s12253-017-0297-0

Epha2	EphA2 is a receptor tyrosine kinase involved in normal development and disease processes.	EphA2 plays a significant role in colorectal cancer (CRC) development and progression.	doi: 10.1002/cmdc.202300420
Ipcef1	Interaction Protein for Cytohesin Exchange Factors 1 involved in Signal transduction	Ipcef1 is involved in papillary thyroid carcinoma.	doi: 10.7150/jca.98470
Kank1	KANK1 contributes to the regulation of actin polymerization and inhibits cell migration.	KANK1 is related to breast cancer.	doi: 10.1038/s41467-024-54645-9.
Pitx1	PITX1 interacts with p53 and controls cellular processes	PITX1 plays essential functions in cancer	doi: 10.3389/fonc.2023.1253238
Prag1	Prag1 is a kind of tyrosine protein kinase family	Patients with CRC showing high *PRAG1* expression have shorter free recurrence survival (FRS).	https://doi.org/10.3390/cancers14122981
Rufy3	RUFY3 is an ARL8 (616597) effector involved in regulation of endolysosomal trafficking	RUFY3 promotes colorectal cancer invasion and metastasis through its interaction with FOXK1.	doi: 10.1038/s41598-017-04011-1.
Sh3pxd2a	Predicted to enable superoxide-generating NADPH oxidase activator activity.	SH3PXD2A-AS1 is upregulated in 70% CRC tissues and is associated with poor survival.	doi: 10.7150/ijbs.58422
Vav3	Vav3 is a guanine nucleotide exchange factor (GEF)	VAV3 overexpression could be a useful marker for predicting the outcomes of CRC patients.	https://doi.org/10.1038/srep09360
Vps8	Vps8 regulates endosomal trafficking and membrane fusion.	Vps8 is not directly related to CRC.	https://doi.org/10.1038/s41467-018-03226-8
Anks1	Anks1 enables ephrin receptor binding activity	Emerging evidence links ANKS1 to cancer development and progression.	DOI: 10.1371/journal.pone.0064817
Anxa2	Anxa2 is involved in various cellular processes like cell growth, signal transduction, and membrane fusion.	USP10/XAB2/ANXA2 axis promotes DNA damage repair to enhance chemoresistance to oxaliplatin in colorectal cancer	https://doi.org/10.1186/s13046-025-03357-z
Arid3a	Arid3a encodes a member of the ARID (AT-rich interaction domain) family of DNA binding proteins.	ARID3A suppresses colorectal cancer stemness, drug resistance, and tumor growth.	https://doi.org/10.1016/j.lfs.2025.123642
Asxl3	Asxl3 encodes a chromatin-associated protein involved in epigenetic regulation of gene expression	Mutations in ASXL genes and disruptions in the MLL4-ASXL-BAP1 axis alter gene regulation and may contribute to colon cancer development.	doi: 10.1016/j.jbc.2025.108333

Auts2	The AUTS2 gene encodes a nuclear protein involved in neurodevelopment.	Studies suggest that AUTS2 plays a role in mediating colorectal tumorigenesis.	doi: 10.1186/s40164-023-00440-z
Axin2	Axin2 is a gene that plays a crucial role in the Wnt signaling pathway.	Variations in *AXIN2* predict risk and prognosis of colorectal cancer.	https://doi.org/10.1038/s41405-019-0022-z
Cct7	CCT7 is a molecular chaperone that plays significant roles in cancer biology	Elevated expression of chaperonin containing TCP1 subunit 7 (CCT7) serves as a diagnostic and prognostic marker for hepatocellular carcinoma.	doi: 10.18632/aging.203809
Cntn2	Cntn2 is a member of the immunoglobulin superfamily of cell adhesion molecules	Cntn2 is overexpressed in glioblastoma	doi: 10.2147/OTT.S113390
Cntn3	Cntn3 is a member of the immunoglobulin superfamily of cell adhesion molecules	CNTN3 expression is significantly reduced in hepatocellular carcinoma (HCC).	doi: 10.3892/ol.2019.10482
Col23a1	COL23A1 encodes a transmembrane collagen that plays roles in cell adhesion, migration, and tumor progression.	High COL23A1 expression is associated with recurrent non-small cell lung cancer.	https://doi.org/10.1038/s41598-017-10134-2
Crabp1	The CRABP1 gene encodes cellular retinoic acid-binding protein 1	CRABP1 is identified as epigenetically deregulated genes in colorectal tumorigenesis	• DOI: 10.1155/2006/949506
Cul9	CUL9 (*Cullin 9*, also known as PARC) is a member of the Cullin-RING E3 ubiquitin ligase family	CUL9 is a significant prognostic biomarkers in colorectal cancer.	doi: 10.62347/CHIB8915
Dennd3	Dennd3 enables guanyl-nucleotide exchange factor activity.	Expression of DNM3 is associated with good outcome in colorectal cancer	doi: 10.1515/med-2022-0420
Dgkh	The DGKH gene encodes the protein diacylglycerol kinase eta (DGKH).	DGKH-driven phosphatidic acid metabolism promotes self-renewal and therapy resistance in hepatocellular carcinoma (HCC).	doi: 10.1097/HEP.0000000000000001158.
Dnai2	Dnai2 belongs to the dynein intermediate chain family.	Dnai2 has not been associated with CRC.	
Dnm3	DNM3 (*Dynamin 3*) is a member of the dynamin family of GTPases	Expression of DNM3 is associated with good outcome in colorectal cancer	doi: 10.1515/med-2022-0420
Exoc7	EXOC7 is a gene encoding a critical subunit of the exocyst complex	High EXOC7 expression is linked to advanced stage, metastasis, and poor prognosis in colorectal cancer patients.	DOI:10.1038/s41598-017-05308-x
Fjx1	Fjx1 plays a role in cell signaling and development,	Fjx1 is a prognostic factor with a significant role in tumor immunity.	doi: 10.3389/fonc.2023.1170482

Foxp1	FOXP1 is a transcription factor belonging to the FOXP subfamily of the forkhead box (FOX) proteins.	Foxp1 associated with reduced survival rates in CRC tissue	doi: 10.1309/LM7IHV2NJI1PHMXC.
Has3	The HAS3 gene encodes the protein Hyaluronan Synthase 3	HAS3 inhibition decreases subcutaneous tumor growth by colon cancer cells	doi: 10.2174/1871520117968176 55
Il1r1	Il1r1 encodes a cytokine receptor that belongs to the interleukin-1 receptor family	IL1R1-positive cancer-associated fibroblasts promote tumor progression and contribute to immunosuppression in colorectal cancer.	https://doi.org/10.1038/s41467-023-39953-w
Itsn1	ITSN1 acts as a guanine nucleotide exchange factor	Itsn1 is involved in breast cancer.	https://doi.org/10.1038/s41419-021-04218-1
Klhdc4	KLHDC4 encodes a kelch repeat-containing protein involved in cytoskeletal organization, cell proliferation, and apoptosis regulation.	Upregulation of KLHDC4 Predicts a Poor Prognosis in Human Nasopharyngeal Carcinoma	doi: 10.1371/journal.pone.0152820
Meak7	MEAK7 is a regulatory protein implicated in mTOR signaling	Meak7 can be target for cancer therapy.	https://doi.org/10.3389/fonc.2024.1375498
Myo18a	Myosin 18A is a protein that belongs to the unconventional myosin family	Intratumor heterogeneity of MYO18A impact the clinical outcome of stage III Colorectal Cancer.	doi: 10.3389/fonc.2020.588557.
Olig3	OLIG3 is a member of the basic helix-loop-helix (bHLH) transcription factor family	OLIG3 is involved in brain cancers.	doi: 10.3389/fnins.2023.1129434
Pax1	Pax1 regulates mesodermal development and skeletal patterning.	Methylation of *PAX1*/*SOX1*, which may be new biomarkers for CRC screening.	doi: 10.2147/OTT.S143389
Prdm16	PRDM16 (*PR domain containing 16*) is a transcriptional regulator that plays key roles in cell fate determination, metabolic regulation, and stem cell maintenance.	PRDM16 is suppressed in colorectal cancer due to DNA methylation.	https://doi.org/10.1016/j.cellsig.2025.111634
Pxn	Pxn encodes a cytoskeletal protein involved in actin-membrane attachment	paxillin increases metastasis and epithelial–mesenchymal transition in colorectal cancer	doi: 10.3892/or.2020.7687
Rack1	RACK1 is an insulin-like growth factor 1 (IGF-1) receptor-interacting protein	RACK1 acts as a potential tumor promoter in Colorectal Cancer.	doi: 10.1155/2019/5625026
Rxra	RXRA is a protein that plays a crucial role in regulating gene expression.	RXRA is a nuclear receptor with tumor-suppressive functions in colorectal cancer.	doi: 10.1136/gut.2007.129858
Slc37a1	The SLC37A1 gene encodes a protein that acts as a glucose-	SLC37A1 is involved in the hematogenous metastasis of CRC.	doi: 10.3892/ol.2017.7559

	6-phosphate/phosphate antiporter.		
Sstr2	The SSTR2 gene encodes the somatostatin receptor type 2, a protein involved in various physiological processes	SSTR2 is a potential therapeutic target for cancer	https://doi.org/10.3389/pore.2022.1610196
Tafa5	Tafa5 is a chemokine-like family member.	TAFA5 promotes proliferation and migration in gastric cancer	doi: 10.3892/mmr.2019.10724
Tmem72	TMEM72 is predicted as a multi-pass transmembrane protein.	TMEM72 is involved in normal kidney development and tumorigenesis in renal cell carcinoma.	https://doi.org/10.1111/febs.16697
Tnrc18	TNRC18 is a poorly characterized gene.	TNRC18 is not associated with cancer.	
Trak1	TRAK1 gene encodes a kinesin adaptor protein that plays an important role in mitochondrial axonal transport,	MGb2-Ag/TRAK1 may play an important role in the development of CRC and may be a valuable prognostic indicator of CRC.	doi: 10.1007/s00384-011-1237-1.
Unc119	UNC119 is a lipid-binding adaptor protein involved in intracellular trafficking, signal transduction, and immune cell function.	UNC119 promotes hepatocellular carcinoma cell proliferation through Wnt/β-catenin signaling and predicts a poor prognosis.	doi: 10.1111/cas.13706
Wasf3	WASF3 is a key regulator of actin cytoskeleton remodeling and plays a significant role in cell migration, invasion, and metastasis	Wasf3 increases the CRC metastasis.	https://doi.org/10.32604/biocell.2022.018847
Gm12830	Predicted gene	Undefined.	
Gm14216	Predicted gene	Undefined.	
Gm19183	Predicted gene	Undefined.	
Gm22645	Predicted gene	Undefined.	
Gm23326	Predicted gene	Undefined.	
Gm26815	Predicted gene	Undefined.	
Gm29441	Predicted gene	Undefined.	
Gm37516	Predicted gene	Undefined.	
Gm56103	Predicted gene	Undefined.	
Gm47071	Predicted gene	Undefined.	
Gm56573	Predicted gene	Undefined.	
Gm33321	Predicted gene	Undefined.	
Gm55248	Predicted gene	Undefined.	
Gm37191	Predicted gene	Undefined.	
Gm37491	Predicted gene	Undefined.	
Gm38414	Predicted gene	Undefined.	
Gm43784	Predicted gene	Undefined.	
Gm55346	Predicted gene	Undefined.	
Gm55867	Predicted gene	Undefined.	
Gm57154	Predicted gene	Undefined.	
Gm26971	Predicted gene	Undefined.	

Gm55121	Predicted gene	Undefined.
9230111E07Rik	lincRNA gene	Undefined.
5830428M24Rik	lincRNA gene	Undefined.
9430087B13Rik	lincRNA gene	Undefined.
CJ186046Rik	lincRNA gene	Undefined.