Supplementary Materials and Methods

Plasmids

The pcDNA3.1-CCNE2 (plasmid 19935) was purchased from Addgene (Addgene, Cambridge, MA). The pcDNA3.1-CCNA2 construct was generated by subcloning the full-length CCNA2 from Rc/CMV-CCNA2 (plasmid 8959, Addgene) into the pcDNA3.1 vector (Invitrogen).

Establishment of LNCaP stable cell lines

LNCaP cells were transfected with the pcDNA3.1-CCNE2 and the pcDNA3.1-CCNA2 constructs. Two days after transfection, cells were selected by G418 for 2 weeks. G418 resistant colonies were picked up and identified by Western Blots analysis.

Correlation of FoxA1 cistrome in LNCaP and abl cells with clinical ADPC and CRPC microarray data.

abl-specific binding sites (3,862) were defined as those regions with significant FoxA1 binding in abl (MAT-score ≥ 3.72 , equivalent to p-value $\leq 1 \times 10^{-4}$) while the corresponding binding in LNCaP was insignificant (MAT-score ≤ 1.28 , p-value ≥ 0.1), whereas LNCaP-specific binding sites (717) were defined the other way around. Common binding sites (14,248) are those regions with significant FoxA1 binding (MAT-score ≥ 3.72) in both abl and LNCaP. In order to improve signal-to-noise ratio, all the remaining binding sites (grey points in Supplementary Fig. S3A) were not considered in this comparison. As a control, we randomized FoxA1 binding sites by keeping the chromosome and size unchanged while shuffled the genome coordinates using BEDTools

(1). Consequently, each group of binding sites has its matched random control, which was used to estimate the background distribution of number of genes associated with FoxA1 binding sites.

To determine the differential expressed genes in clinical CRPC compared with ADPC, we compared 94 ADPC cases with 39 CRPC cases from three clinical ADPC/CRPC gene expression datasets. We selected top 200 over-expressed and under-expressed genes in CRPC versus ADPC. As a control, we also randomly picked 200 genes from Refseq database (2).

We associated each of the overexpressed, underexpressed and random gene lists with each of the FoxA1 binding site lists (i.e. abl-specific, LNCaP-specific, and common binding sites), respectively. Genes having FoxA1 binding sites within 20 kb of the transcription start site (TSS) were defined as FoxA1 associated genes. Those genes having both cell line-specific and common binding sites will be regarded as cell line-specific FoxA1 associated genes. Genes having both abl-specific and LNCaP-specific binding sites were not identified. To determine the statistical significance of the association, we estimated the background distribution of "number of genes with abl-specific FoxA1 binding sites" by shuffling the binding sites 1000 times. Because the distributions were approximately normal (Supplementary Fig. S3C), we calculated the p-values of abl FoxA1 binding association according to a normal distribution. However, in the case of "number of genes with LNCaP-specific binding sites", the actual distribution is only part of the bell curve (Supplementary Fig. S3C). We thus determine those p-values of LNCaP FoxA1 binding association in a non-parametric manner (i.e. area under

the curve with the number of genes equal to or greater than the one that was actually observed).

Supplementary Table S1: Primers and siRNA sequences

RT-PCR primers	Sequence (5'-3')	
CCNE2 mRNA+	ACCTCATTATTCATTGCTTCCAA	
CCNE2 mRNA-		
	TCTTCACTGCAAGCACCATC	
CCNA2 mRNA+	CAGAAAACCATTGGTCCCTC	
CCNA2 mRNA-	CACTCACTGGCTTTTCATCTTC	
CCNE1 mRNA+	GAAATGGCCAAAATCGACAG	
CCNE1 mRNA-	TCTTTGTCAGGTGTGGGGA	
CDK2 mRNA+	CTGAAATCCTCCTGGGCTG	
CDK2 mRNA-	GAATCTCCAGGGAATAGGGC	
CDK4 mRNA+	TGCAGTCCACATATGCAACA	
CDK4 mRNA-	GTCGGCTTCAGAGTTTCCAC	
CDK6 mRNA+	ATGCCGCTCTCCACCAT	
CDK6 mRNA-	TGTCTGTTCGTGACACTGTGC	
CCND1 mRNA+	TCCTCTCCAAAATGCCAGAG	
CCND1 mRNA-	GGCGGATTGGAAATGAACTT	
CCND2 mRNA+ (3)	AAGAATTCCTCCTCAATAGCCTGCAGCAGTA	
CCND2 mRNA- (3)	GCGGGATATCGACCTGTGAGAATTCGAT	
CCND3 mRNA+	TGACCATCGAAAAACTGTGC	
CCND3 mRNA-	TTGAGCTTCCCTAGGACCAG	
CDKN1A mRNA+	AGTCAGTTCCTTGTGGAGCC	
CDKN1A mRNA-	CATGGGTTCTGACGGACAT	
CDKN1B mRNA+	AAGAAGCCTGGCCTCAGAAG	
CDKN1B mRNA-	TTCATCAAGCAGTGATGTATCTGA	
RB mRNA+	TGTGAACATCGAATCATGGAA	
RB mRNA-	TCAGTTGGTCCTTCTCGGTC	
E2F1 mRNA+ (4)	CATCCAGCTCATTGCCAAGAAG	
E2F1 mRNA- (4)	GATCCCACCTACGGTCTCCTCA	
siRNA sequences		
siFoxA1-1 (5)	GGACUUCAAGGCAUACGAA	
siFoxA1-2 (6)	GAGAGAAAAAUCAACAGC	
siMYBL2	AAACGAGCCUGCCUUACAA	
(ON-TARGETplus SMARTpool siRNA)	GAGCACCUGUUAAGACC	
	GUAACAGCCUCACGCCCAA	
	GAACAGGAGCCCAUCGGUA	
siCREB1	GAGAGAGGUCCGUCUAAUG	
(ON-TARGETplus SMARTpool siRNA)	UAGUACAGCUGCCCAAUGG	
	CAACUCCAAUUUACCAAAC	
	GCCCAGCCAUCAGUUAUUC	
siE2F1	UCGGAGAACUUUCAGAUCU	
(ON-TARGETplus SMARTpool siRNA)	GAGAAGUCACGCUAUGAGA	
	GAGCAGAUGGUUAUGGUGA	
	GAACAGGCCACUGACUCU	
siCCNE2	GCAGAUAUGUUCAUGACAA	
(siGenome SMARTpool siRNA)	CAUAAUAUCCAGACACAUA	

siCCNA2

(siGenome SMARTpool siRNA)

UAAGAAAGCCUCAGGUUUG AAGACGAAGUAGCCGUUUA GCUGUGAACUACAUUGAUA GAUGAUACCUACACCAAGA AAGCUGGCCUGAAUCAUUA GGAAAUGGAGGUUAAAUGU Sequence (5'-3')

ChIP real-time PCR and FAIRE primers

UBE2C Enhancer 1+ (7) UBE2C Enhancer 1- (7) UBE2C Enhancer 2+ (7) UBE2C Enhancer 2- (7) CDK1 Enhancer + (7) CDK1 Enhancer - (7) CCNA2 Promoter + CCNA2 Promoter -CCNE2 Enhancer 1+ CCNE2 Enhancer 1-CCNE2 Enhancer 2+ CCNE2 Enhancer 2-CCNE2 Promoter+ CCNE2 Promoter-CCNE2 Enhancer 3+ CCNE2 Enhancer 3-CCNE2 Enhancer 4+ CCNE2 Enhancer 4-E2F1 Promoter + E2F1 Promoter -E2F1 Enhancer 1+ E2F1 Enhancer 1-E2F1 Enhancer 2+ E2F1 Enhancer 2-LNCaP specific binding site 1+ LNCaP specific binding site 1-LNCaP specific binding site 2+ LNCaP specific binding site 2-LNCaP specific binding site 3+ LNCaP specific binding site 3-LNCaP specific binding site 4+ LNCaP specific binding site 4-LNCaP specific binding site 5+ LNCaP specific binding site 5-

LNCaP specific binding site 6+

LNCaP specific binding site 6-

LNCaP specific binding site 7+

LNCaP specific binding site 7-

LNCaP specific binding site 8+

CCGCCAGTTTGCTTTGCTTGACACCCCCGAAATCCA

TTCCAACTTGTTTGCTTAGTTATCTTCT

GACACCACCGAAGAGCACTGA

TTAATGTTGTGTGTCTTTCCTTTTAGC
CGAACTAGCTCTTTCACTGTGATTG
CTGGGTGCAGGATTAGGATAATG
CCATCAGCCACCTCTTCCAT
GGGACACGGCCACATTGT
TGGTCCCCAAGTCCTTCCA
CTCTTGTGGACAGGCTTAGGGATGGT

GGAATCTGGCTTAGGGATGGT
GCTTGCTTGCCAAATAAATCTTG
CAGTGGACATGCCAGTAACTTCTT
CCTCATGGAACATGCTGATCTACT
AAAAAGGCTGGCAGATCCAA
GACTGGCTGTGCCTTATTTTCTC

CAACAAAGGAAGAGCTGAATGACTAA

AGGATAAGCCAAGCCTGACAAC

TCAGGTGCCGGACTGACA

CACACCATGCTAGATTCCCTCTT GAGCTAGGATTCCAGGCTGTGA

AGAGCTAGGACTACTGAAGTGTGCTTT

TGGAGGACAGATTGCATTTCC CCCAGCAAGGGTGATCATAAA GACAAGCATTGAACCAGACCAA

CTTACCGCACCTGCCACAT

LNCaP specific binding site 8-CCTTCTTCATCTCTGCAGAAAGC LNCaP specific binding site 9+ GGAAAGCAGGGCAACACAGA LNCaP specific binding site 9-ACCCTAAGCACACAGGCTGATT LNCaP specific binding site 10+ GGATTGGTTAATGGGTGTCCAT LNCaP specific binding site 10-CCTAAGGCCAGGAGCTATTTTG abl specific binding site 1+ GAATTTGGGAATAGTGACTGAGCAT abl specific binding site 1-TCCCAGCAGTGAGGTTCCA abl specific binding site 2+ GCATAGGCCGGAGGAGTGA abl specific binding site 2-CAAACCCCCAGAGGATGCT abl specific binding site 3+ CCTGGGAGGCCCAACCT abl specific binding site 3-CTGAGGGCTGGTAATTAGGATTTC abl specific binding site 4+ AAACACCCAGCCCTCTCCTT abl specific binding site 4-AACCCCGATCATTCACAAACA abl specific binding site 5+ TCAAGGAATCGGCATCCAA abl specific binding site 5-AACTCTTCCTTTAGATCCTCACTCACA abl specific binding site 6+ CCATTTTAGCCCTGAGCTTCA abl specific binding site 6-ATGCCCTAAAGGTTGGTGATTG abl specific binding site 7+ CACAGGCTTGGTTCAGAATTCA abl specific binding site 7-GAACATCACCGGCCTTCCT abl specific binding site 8+ CCCTTCGGAGAGCTGAATGA abl specific binding site 8-GCAAGACAGGCCCCAAAA abl specific binding site 9+ CTGGCAGGACAGCCTTCAA abl specific binding site 9-ACTTCCGCATTTTGTCAACGT abl specific binding site 10+ CTTTTTTGCTATGTGGCAGTGAGT abl specific binding site 10-ATCTTTATCTTGTTTGATAGCACTTGGT Common binding site 1+ CCTACTTCTTGCCCCTGTAGATCTC Common binding site 1-CCTGTGTGATGCAGATCTCACTAGT Common binding site 2+ ACCTATGTGCAAAATACCTGGAAGT Common binding site 2-TTTGCTGAAAGACTGCTTTTCG Common binding site 3+ TTCTGGACTGCGGCAACAT Common binding site 3-GATAGGTTAAGGCTCTGCAAAGGT Common binding site 4+ TCCTTCACTCCCAAAGGTGACT Common binding site 4-GTTAGCAAAGTGCATGGGAATG Common binding site 5+ CATATGGCACGTTTCCTGCAT Common binding site 5-TCCGTCTCAGAACGTGTCAGA Common binding site 6+ TTCCAATGATGTCAAATCCCATT Common binding site 6-TCCGCCCTCTAGCGGTTA Common binding site 7+ TTGTCCCCAATGTCTTCTAGCA Common binding site 7-TTTGGGTTATGGGCCATTTG Common binding site 8+ AAGTTCTGAGAAAACAGCAGGTGAT Common binding site 8-GCCTCCTGGAAGAGCCAATAT Common binding site 9+ GGTGAGTGCTAAACAGATTGTATGCT Common binding site 9-AGCATATCTCAGGACAGAGTGTCAA Common binding site 10+ TGCCCACCCTGTGCAAA Common binding site 10-CCCCTTGGCCTGGATTCT Negative control 1+ CCTTTGCCTCTTCCCTTTCC

Negative control 1-GGATCAATGGCAGCTGTGGTA Negative control 2+ GCAGTGTCAGGTTTGGAGCAA Negative control 2-TCATTCGCCCTCCTCTTGAT Negative control 3+ CCTCATTGGCTGGACAAGGA Negative control 3-CTCTCCACTGCCAGCTGTGA Negative control 4+ CTGCATGCTCAAGGAGTGTGTT Negative control 4-CACAGAATCAGTCTAGGGTGCTCTT Negative control 5+ AGTTTGGGACAGACGGGAAA Negative control 5-GCTGATTCAATTACCTCCCAGAA Negative control 6+ (7) CCCATGCCAGCAGTAGCTAGA Negative control 6- (7) GCACTCACAGAATGCACAGAAAA Negative control 7+ (7) AAGAGGACCATCTCATTTTGG Negative control 7- (7) GCTGTCTCCCCGACCTTTC Negative control 8+ (7) TTTGCAGTGAGTGCTATGAGAAACT Negative control 8- (7) CCCTGAAAGAAAAGAGCTGTCAGT Negative control 9+ (7) GGAGTAAAGCTGCTCAGGGAGAA Negative control 9- (7) GCCTGGCTGAGTCGGTCAT Negative control 10+ (7) GGTTACACACGTTAGGTATTCATCATG Negative control 10- (7) TTGCTGTGCCCGTGTAGCT

Supplementary Table S2: Antibody information

Antibody	Catalogue number	Company
anti-FoxA1	ab23738	Abcam
anti-CCNE2	ab32103	Abcam
anti-CCNA2	ab7956	Abcam
anti-Rb	ab6075	Abcam
anti-H3K4me1	ab8895	Abcam
anti-phosphorylated RNA pol II	ab5131	Abcam
(phospho S5)		
anti-acetyl-Histone H3	ab47915	Abcam
anti-CBP(451)	sc-1211	Santa Cruz Biotechnology
anti-CDK2(M2)	sc-163	Santa Cruz Biotechnology
anti-phosphor-CDK2 (Thr160)	sc-101656	Santa Cruz Biotechnology
anti-MYBL2 (N-19)	sc-724	Santa Cruz Biotechnology
anti-E2F1 (KH95)	sc-251	Santa Cruz Biotechnology
anti-MED1 (M-255)	sc-8998	Santa Cruz Biotechnology
anti-CREB1	17-600	Millipore
anti-Phospho-Rb (Ser795)	9301	Cell Signaling Technology

Supplementary References

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- Pruitt KD, Tatusova T, Maglott DR. NCBI reference sequences (RefSeq): a curated non-redundant sequence database of genomes, transcripts and proteins.
 Nucleic Acids Res 2007; 35: D61-5.
- 3. Dong Q, Meng P, Wang T, et al. MicroRNA let-7a inhibits proliferation of human prostate cancer cells in vitro and in vivo by targeting E2F2 and CCND2. PLoS One 2010; 5: e10147.
- 4. Davis JN, Wojno KJ, Daignault S, et al. Elevated E2F1 inhibits transcription of the androgen receptor in metastatic hormone-resistant prostate cancer. Cancer Res 2006; 66: 11897-906.
- 5. Carroll JS, Liu XS, Brodsky AS, et al. Chromosome-wide mapping of estrogen receptor binding reveals long-range regulation requiring the forkhead protein FoxA1. Cell 2005; 122: 33-43.
- 6. Lupien M, Eeckhoute J, Meyer CA, et al. FoxA1 translates epigenetic signatures into enhancer-driven lineage-specific transcription. Cell 2008; 132: 958-70.
- 7. Wang Q, Li W, Zhang Y, et al. Androgen receptor regulates a distinct transcription program in androgen-independent prostate cancer. Cell 2009; 138: 245-56.

Supplementary Figure legends

Supplementary Figure S1. Effects of FoxA1 silencing on CWR22Rv1 and LNCaP cell proliferation. A, FoxA1 silencing decreases CWR22Rv1 cells growth. The cell proliferation was measured after siRNA transfection, using the WST-1 assay. ** p < 0.01. B, FoxA1 silencing induces G1-S arrest in CWR22Rv1 cells. Seventy-two hours after siRNAs transfection, cells were fixed, stained with propidium iodide, and analyzed by flow cytometry. * p < 0.05, ** p < 0.01. C, Effects of FoxA1 silencing on androgen-stimulated cell-cycle entry. Forty-eight hours after siRNA transfection, LNCaP cells were treated with or without 10 nM DHT for 24 hours, and analyzed by flow cytometry. D, FoxA1 silencing does not decrease androgen-dependent prostate cancer cell growth. LNCaP cells were transfected with two independent FoxA1 siRNAs in the absence (-) or presence (+) of 10 nM DHT. The cell proliferation was measured after siRNA transfection, using the WST-1 assay.

Supplementary Figure S2. Expression and function of CCNE2 and CCNA2 in CWR22Rv1, LNCaP and abl cells. A, FoxA1 silencing decreases mRNA and protein expression of CCNE2 in CWR22Rv1 cells. Left panel: Seventy-two hours after siRNA transfection, total RNA was isolated and amplified by real-time RT-PCR using gene specific primers. Expression data are summarized in heat maps. Right panel: Western blots were performed using the antibodies indicated 72 hours after siRNA transfection. B, CCNE2 or CCNA2 silencing decreases CWR22Rv1 cells growth. The cell proliferation was measured after siRNA transfection, using the WST-1 assay. ** p < 0.01. C, Comparison of cell-cycle distribution of LNCaP cells stably expressing CCNE2 or

CCNA2 with abl cells. LNCaP cells stably expressing CCNE2 or CCNA2 were treated with or without 10 nM DHT for 24 hours. abl cells were cultured in the absence of DHT. Cell-cycle profiles were analyzed by flow cytometry.

Supplementary Figure S3. Mapping the FoxA1 Cistromes in LNCaP and abl cells and correlation with clinical CRPC/ADPC gene expression data. A, Comparison of FoxA1 whole genome binding in LNCaP and abl cells. FoxA1 binding sites were divided into 3 categories: Common binding sites (blue), abl-specific binding sites (red) and LNCaPspecific binding sites (dark green). Dashed lines indicate two cutting-off MAT score value of 3.72 and 1.28. B, Direct ChIP validation of FoxA1 ChIP-chip. FoxA1 binding at cell type-specific binding sites, common binding sites and negative control regions were determined by ChIP assays in LNCaP and abl cells. ** p < 0.01. C, Association between cell type-specific FoxA1-binding sites and differential expressed genes in CRPC versus ADPC. Curves in each panel indicate the distribution of "number of genes with FoxA1 binding sites". Distributions were estimated by shuffling the corresponding FoxA1 binding sites 1,000 times. Red dot in each panel presents our observation. P-values in the first and third rows were calculated according to normal distribution (z-test), whereas pvalues in the second row were determined non-parametrically (see "Supplementary Materials and Methods"). D, Correlation between cell type-specific FoxA1-binding sites and differential expressed genes in CRPC versus ADPC. P-values upon each bar show the significance level of association between FoxA1 binding and gene having FoxA1 binding sites with 40 kb of the TSS.

Supplementary Figure S4. FoxA1 functions on the UBE2C and CDK1 enhancers. A, Higher H3K4me1 level and greater recruitment of FoxA1, p-Pol II, CBP and MED1 to the UBE2C and CDK1 enhancers in abl cells. ChIP assays were performed using indicated antibodies. * p < 0.05, *** p < 0.01. B, Effects of FoxA1 silencing on FAIRE enrichment at the UBE2C and CDK1 enhancer regions. LNCaP and abl cells were transfected with siFoxA1 or siControl. FAIRE-qPCR experiments were performed 72 hours posttransfection. Relative enrichment compared to uncrosslinked DNA is shown. * p < 0.05, *** p < 0.01.

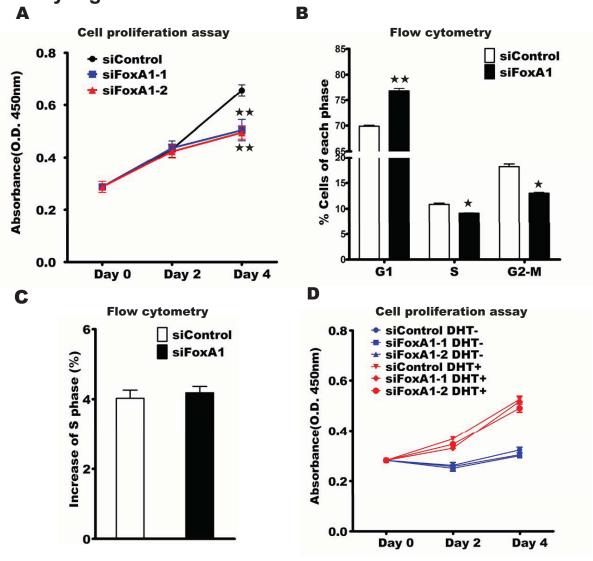
Supplementary Figure S5. Functional studies of FoxA1 collaborating factors MYBL2 and CREB1. A, ChIP analyses of MYBL2 and CREB1 binding at the UBE2C and CDK1 enhancers. * p < 0.05, ** p < 0.01. B, Effects of MYBL2 or CREB1 silencing on FoxA1 recruitment to the UBE2C and CDK1 enhancers. LNCaP and abl cells were transfected with siMYBL2, siCREB1 or siControl. FoxA1 ChIP assays were performed 72 hours posttransfection. * p < 0.05, ** p < 0.01. C, Quality controls for ChIP assays after MYBL2 and CREB1 silencing. LNCaP and abl cells were transfected with siMYBL2, siCREB1 or siControl. MYBL2 (Left panel) or CREB1 (Right panel) ChIP assays were performed 72 hours posttransfection * p < 0.05, ** p < 0.01. D, Effects of MYBL2, CREB1 or FoxA1 silencing on p-Pol II level and/or FoxA1 binding on the CCNE2, E2F1, UBE2C and CDK1 enhancers. Left panel: LNCaP and abl cells were transfected with siRNA targeting each transcription factor or siControl. ChIP assays were performed 72 hours posttransfection using antibodies against p-Pol II. * p < 0.05, ** p < 0.01. Right panel: Quality controls for ChIP assays after FoxA1 silencing. LNCaP and abl cells were

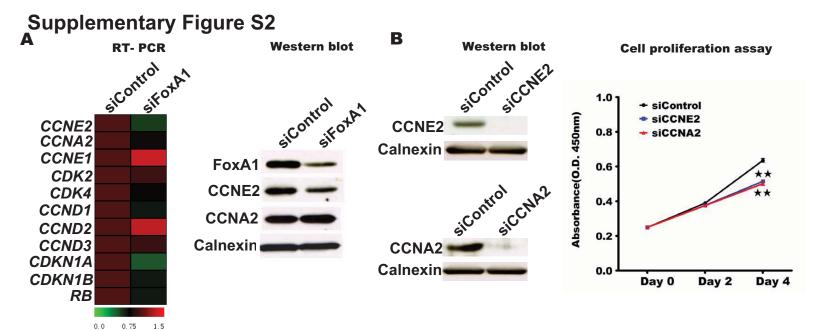
transfected with siFoxA1 or siControl. FoxA1 ChIP assays were performed 72 hours posttransfection. \star p < 0.05, $\star\star$ p < 0.01.

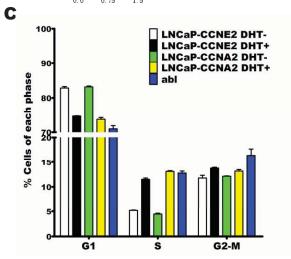
Supplementary Figure S6. FoxA1 collaborates with MYBL2 and CREB1 to regulate target gene expression and cell proliferation. A, Effects of FoxA1 silencing on MYBL2 or CREB1 binding to the UBE2C and CDK1 enhancers. LNCaP and abl cells were transfected with siMYBL2, siCREB1 or siControl. ChIP assays were performed 72 hours posttransfection using an anti-MYBL2 antibody (Left panel) or an anti-CREB1 antibody (Right panel). \star p < 0.05, $\star\star$ p < 0.01. B, Enhanced interactions between FoxA1 and MYBL2 or CREB1 on regulatory regions of FoxA1 target genes in abl versus LNCaP cells. Re-ChIP assays were performed in LNCaP and abl cells with antibodies against FoxA1 (for first ChIP) and MYBL2 (for re-ChIP) (Left panel), or antibodies against CREB1 (for first ChIP) and FoxA1 (For re-ChIP). C, Effects of FoxA1, MYBL2, CREB1 or CBP silencing on AcH3 level on the UBE2C and CDK1 enhancers. LNCaP and abl cells were transfected with siRNA targeting each factor or siControl. ChIP assays were performed 72 hours posttransfection using an anti-AcH3 antibody. $\star p < 0.05$, $\star \star p < 0.01$. D, Effects of MYBL2 or CREB1 silencing on FAIRE enrichment at the UBE2C and CDK1 enhancers. LNCaP and abl cells were transfected with siMYBL2, siCREB1 or siControl. FAIRE-qPCR experiments were performed 72 hours posttransfection. Relative enrichment compared to uncrosslinked DNA is shown. $\star p < 0.05$, $\star \star p < 0.01$. E, Effects of MYBL2 or CREB1 silencing on UBE2C and CDK1 mRNA expression. LNCaP and abl cells were transfected with indicated siRNA. Real-time RT PCR was performed using UBE2C and CDK1 specific primers 72 hours after siRNA transfection. ** p < 0.01. F,

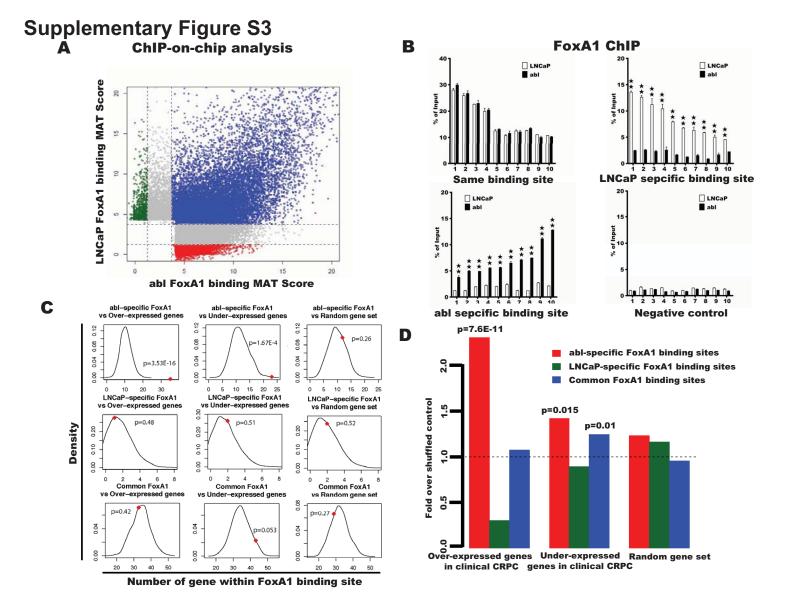
MYBL2 and CREB1 silencing decreases CWR22Rv1 cell growth. The cell proliferation was measured after siRNA transfection, using the WST-1 assay. $^{\star\star}p < 0.01$.

Supplementary Figure S1

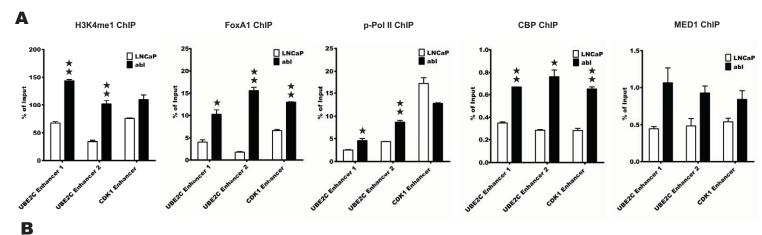


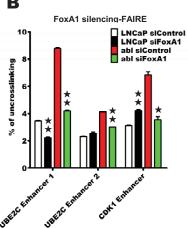


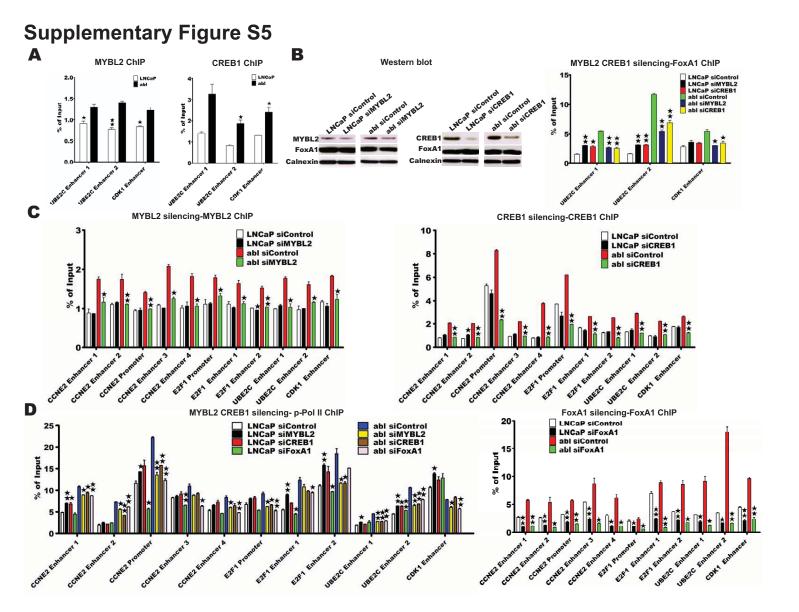




Supplementary Figure S4







Supplementary Figure S6

