**Supplementary Figure Legends**

**Supplementary Figure S1**

Differential metabolite levels in BRCA1 I26A compared to normal MEFs.The complete set of identified differential steady-state metabolite levels are represented as a heat map.

**Supplementary Figure S2**

Control immunofluorescence microscopy images using Oct1-deficient MEFs.Cells were incubated either with no primary Ab or with the Oct1-specific Ab, followed by incubation with Alexa488-conjugated secondary Ab.

**Supplementary Figure S3**

Small increase in Oct1 proteins levels in MEFs with a C-terminal BRCA1 mutation. **A,** Oct1 protein levels are slightly elevated in BRCA1-S1598F MEFs compared to WT, but still low compared to I26A MEFs. **B,** O2 consumption rate (OCR) was assessed using a metabolic extracellular flux analyzer.

**Supplementary Figure S4**

Equivalent infection rates in Oct1 and control CRISPR infection rates in BRCA1-I26A MEFs. Flow plots of BRCA1-I26A MEFs infected with GFP-expressing lentiviral CRISPR constructs against Oct1, or empty vector controls, shown in Fig. 2F-I.

**Supplementary Figure S5**

Quality-control and validation of RNAseq. **A,** Unsupervised hierarchical clustering of replicate samples for all RNAseq gene abundance values. Correlations of similarities between total transcriptomes of all samples are shown as a heat map. **B,** WT or BRCA1-I26A MEFs infected with lentiviruses expressing Cas9 and either control or Oct1-specific gRNAs. The vector additionally carried a GFP cassette. Cells were sorted for GFP positivity, lysates prepared, and subjected to immunoblotting with PGC-1α antibodies. Oct1 and β–actin are shown as controls.

**Supplementary Figure S6**

CRISPR-mediated Oct1 loss in either BRCA1-I26A MEFs or MCF-7 cells minimally affects HIF-1α and c-Myc levels. **A,** Immunoblot is shown of MEFs infected with lentiviruses encoding Cas9, and Oct1-specfic gRNA, and GFP. Cells were sorted based on GFP positivity. **B,** Similar experiment performed using MCF-7 cells.

**Supplementary Figure S7**

Equivalent infection rates in Oct1 and control CRISPR infection rates in MCF-7 cells. Flow plots of MCF-7 cells infected with GFP-expressing lentiviral CRISPR constructs against Oct1, or empty vector controls are shown.

**Supplementary Figure S8**

MG-132 treatment reveals ubiquitylated Oct1 bands in the presence of urea. Experiment was performed similarly to Fig. 3A.

**Supplementary Figure S9**

O2 consumption rate (OCR) was assessed in MCF-7 cells transduced with either empty vector control (EV), or viruses expressing WT or K9/403R Oct1.

**Supplementary Figure S10**

Oct1 protein stability in WT and I26A MEFs. Experiment was performed similarly to Figure 4B. Averages of four independent experiments are shown.

**Supplementary Figure S11**

Immunoprecipitating in vitro ubiquitylation assay products with control rabbit IgG antibodies results in recovery of background ubiquitylation. Assay was performed similarly to Fig. 4E, but using isotype control antibodies.

**Supplementary Figure S12**

The same as in Figure 6A except with individual datapoints (Supplemental Table S4) superimposed.

**Supplementary Figure S13**

Elevated *Oct1* (*Pou2f1*) mRNA levels correlate with poor patient outcome in gastric but not breast cancer A) 876 Gastric cancer samples (all stages and types) were stratified by median *Pou2f1* expression. B) Similar analysis for 255 triple-negative breast cancer. ER+, PR+ and Her2+ samples produced similar results (not shown). 206789\_s\_at is shown, but results were robust across probesets. Analysis performed using KM-Plotter ([54](#_ENREF_54)).

**Supplementary Table S1**

Original and normalized GC-MS metabolite readings from control and I26A MEFs.

**Supplementary Table S2**

RNAseq gene expression changes in I26A MEFs (Oct1 CRISPR vs control).

**Supplementary Table S3**

RNAseq analysis of dysregulated genes from Oct1-KO and control I26A MEFs.

**Supplementary Table S4**

RNAseq analysis of dysregulated genes from Oct1-KO and control I26A MEFs.