**Supplementary Table 1: Summary of Drug Predictions: Top Drug Prediction by Algorithm [-log(p) score] (Inferring Gene(s) where Applicable)**

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| **Sample Id** | **Highest Ranked Drug Via Summary Score A** | **Drug Target Expression1** | **Drug Response Signatures2** | **Drug Sensitivity Signatures3** | **Network Target Activity4** | **Biomarker Sensitivity Rules5** | **Biomarker Resistance Rules6** |
| **LYMPHOMAS** |
| COTC016-0201 | vorinostat1,4,5 [18.90] | theophylline [42.4] (PDE4B) | irinotecan [2.54] | lomustine [5.92] | vorinostat [5.05,5.0] (HDAC3, HDAC2) | teniposide [18.6] (TOP2A) | capecitabine [5.83] (TYMS)fluorouracil [5.83] (TYMS) |
| COTC016-0209 | vorinostat1,5 [26.70] | sorafenib [172.00] (KIT)sunitinib [172.00] (KIT)imatinib [172.00] (KIT) | irinotecan [4.70] | daunorubicin [3.29] | plerixafor [3.25] (CXCR4) | gemcitabine [43.60] (DCK) | doxorubicin [10.90] (ABCC1) |
| COTC016-0502 | mitoxantrone1,2 [12.30] | thioguanine [25.60] (PPAT) | irinotecan [2.40] | lomustine [4.97] |   | topotecan [13.20] (TOP1) | capecitabine [4.36] (TYMS)fluorouracil [4.36] (TYMS)doxorubicin [4.33] (ABCC1) |
| COTC016-0504 | vorinostat1,4,5 [14.70] | mitoxantrone [60.10] (TOP2A)doxorubicin [60.10] (TOP2A)epirubicin [60.10] (TOP2A)etoposide [60.10] (TOP2A) | irinotecan [2.63] | lomustine [4.89] | vorinostat [4.37, 2.55] (HDAC2, HDAC1) | topotecan [67.40] (TOP1) |   |
| COTC016-0509 | trazodone1 [20.00] | trazodone [68.00, 18.20] (HTR2A)clozapine [68.00] (HTR2A)thioridazine [68.00] (HTR2A) | irinotecan [4.70] | carmustine [3.72] | axitinib [4.27, 3.49] (KDR, FLT1)sunitinib [4.27, 3.49] (KDR, FLT1) | bicalutamide [15.00] (AR) |   |
| COTC016-0510 | mitoxantrone1,2 [12.20] | theophylline [50.20] (PDE4B) | irinotecan [4.70] | lomustine [4.20] | thioridazine [1.94] (DRD1) | teniposide [24.10] (TOP2A) | capecitabine [5.96] (TYMS)fluorouracil [5.96] (TYMS) |
| COTC016-1304 | mitoxantrone1,2 [12.60] | mitoxantrone [46.60] (TOP2A)doxorubicin [46.60] (TOP2A)epirubicin [46.60] (TOP2A)etoposide [46.60] (TOP2A) | methotrexate [2.66] | carmustine [4.05] |   | teniposide [46.60] (TOP2A) | capecitabine [9.08] (TYMS)fluorouracil [9.08] (TYMS) |

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| **TRANSITIONAL CELL CARCINOMAS** |
| COTC016-0207 | sunitinib1 [20.00] | raloxifene [200.00] (ESR1) | methotrexate [3.01] | daunorubicin [3.77] | finasteride [3.43] (AR) | medroxyprogesterone [200.00] (ESR1)toremifene [200.00] (ESR1) | capecitabine [3.93] (TYMS)fluorouracil [3.93] (TYMS) |
| COTC016-0213 | sunitinib1 [20.00] | axitinib [54.90] (FLT1)sunitinib [54.90, 43.50] (FLT1, PDGFRA) | irinotecan [4.70] | carmustine [4.35] | decitabine [3.17] (DNMT1) | medroxyprogesterone [40.40] (ESR1)toremifene [40.40] (ESR1) |   |
| COTC016-0508 | sunitinib1 [20.00] | acetylsalicylic acid [229.00] (PTGS2)balsalazide [229.00] (PTGS2)bromfenac [229.00] (PTGS2)celecoxib [229.00] (PTGS2)diflunisal [229.00] (PTGS2)etodolac [229.00] (PTGS2)fenoprofen [229.00] (PTGS2)ibuprofen [229.00] (PTGS2)ketorolac [229.00] (PTGS2)lenalidomide [229.00] (PTGS2)meloxicam [229.00] (PTGS2)nabumetone [229.00] (PTGS2)tolmetin [229.00] (PTGS2) | irinotecan [4.70]methotrexate [4.70] | carmustine [3.55] | temsirolimus [3.54] (MTOR) | medroxyprogesterone [159.00] (ESR1)toremifene [159.00] (ESR1) | capecitabine [3.21] (TYMS)fluorouracil [3.21] (TYMS) |
| COTC016-1601 | sunitinib1 [20.00] | acetylsalicylic acid [108.00] (PTGS2)balsalazide [108.00] (PTGS2) bromfenac [108.00] (PTGS2)celecoxib [108.00] (PTGS2)diflunisal [108.00] (PTGS2)etodolac [108.00] (PTGS2)fenoprofen [108.00] (PTGS2)ibuprofen [108.00] (PTGS2)ketorolac [108.00] (PTGS2)lenalidomide [108.00] (PTGS2)meloxicam [108.00] (PTGS2)nabumetone [108.00] (PTGS2)tolmetin [108.00] (PTGS2) | irinotecan [4.70] | carmustine [4.14] | donepezil [2.50] (ACHE)pyridostigmine [2.50] (ACHE)rivastigmine [2.50] (ACHE)tacrine [2.50] (ACHE) | bortezomib [22.30] (RAD23B)vorinostat [22.30] (RAD23B) | capecitabine [4.27] (TYMS)fluorouracil [4.27] (TYMS) |
| **OTHER CARCINOMAS** |
| COTC016-0204 | vorinostat4,5 [13.00] | anakinra [100.00] (IL1R1) | irinotecan [2.96] | lomustine [2.28] | vorinostat [3.04] (HDAC2) | bortezomib [39.90] (RAD23B)vorinostat [39.90] (RAD23B) |   |
| COTC016-0501 | etoposide1,2,3 [13.00] | anakinra [129.00] (IL1R1) | irinotecan [4.70] | carmustine [4.35] |   | teniposide [18.50] (TOP2A) |   |

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| **MELANOMAS** |
| COTC016-0210 | temsirolimus1 [10.00]thioguanine1 [10.00] | temsirolimus [59.00] (MTOR)thioguanine [40.60] (PPAT) | irinotecan [4.70] | lomustine [4.89] | anakinra [2.91] (IL1R1) | topotecan [6.10] (TOP1) |   |
| COTC016-0211 | vorinostat1,5 [20.00] | thioguanine [25.50] (PPAT) | irinotecan [4.70] | carmustine [4.45] |   | bortezomib [25.60] (RAD23B)vorinostat [25.60] (RAD23B) |   |
| COTC016-0212 | vorinostat1,4,5 [13.40] | aminoglutethimide [29.00] (CYP19A1)anastrozole [29.00] (CYP19A1)exemestane [29.00] (CYP19A1)letrozole [29.00] (CYP19A1) | irinotecan [4.70] | carmustine [4.34] | vorinostat [2.72] (HDAC1) | teniposide [17.80] (TOP2A) | capecitabine [5.24] (TYMS)fluorouracil [5.24] (TYMS) |
| COTC016-0511 | vorinostat4,5 [17.20] | doxorubicin [18.30] (TOP2A)etoposide [18.30] (TOP2A)mitoxantrone [18.30] (TOP2A)epirubicin [18.30] (TOP2A) | irinotecan [2.37] | carmustine [4.45] | vorinostat [3.62] (HDAC1) | teniposide [18.30] (TOP2A) |   |
| COTC016-1502 | vorinostat1,5 [16.30] | acetylsalicylic acid [100.00] (PTGS2)balsalazide [100.00] (PTGS2) bromfenac [100.00] (PTGS2)celecoxib [100.00] (PTGS2)diflunisal [100.00] (PTGS2)etodolac [100.00] (PTGS2)fenoprofen [100.00] (PTGS2)ibuprofen [100.00] (PTGS2)ketorolac [100.00] (PTGS2)lenalidomide [100.00] (PTGS2)meloxicam [100.00] (PTGS2)nabumetone [100.00] (PTGS2)tolmetin [100.00] (PTGS2) | irinotecan [4.70] | daunorubicin [3.88] | anakinra [2.99] (IL1R1) | bortezomib [22.10] (RAD23B)vorinostat [22.10] (RAD23B) | doxorubicin [4.43] (ABCC1) |
| **SARCOMAS** |
| COTC016-0202 | vorinostat1,5 [13.50] | felodipine [10.30] (CACNA2D1)nifedipine [10.30] (CACNA2D1) | irinotecan [4.70] | daunorubicin [4.53] | anakinra [2.31] (IL1R1) | bortezomib [14.10] (RAD23B)vorinostat [14.10] (RAD23B) |   |
| COTC016-0203 | abciximab1 [10.00]bortezomib1 [10.00]vorinostat1 [10.00] | abciximab [13.10] (ITGB3) | methotrexate [4.10] | carmustine 4.20] | chlorpromazine [2.32] (DRD2)clozapine [2.32] (DRD2)prochlorperazine [2.32] (DRD2) | bortezomib [14.80] (RAD23B)vorinostat [14.80] (RAD23B) |   |
| COTC016-0205 | sunitinib1 [22.80] | anakinra [120.00] (IL1R1) | irinotecan [4.70] | lomustine [4.05] |   | bortezomib [7.94] (RAD23B)vorinostat [7.94] (RAD23B) |   |
| COTC016-0206 | sunitinib1 [29.90] | anakinra [100.00] (IL1R1) | irinotecan [4.70] | carmustine [3.83] | abciximab [3.07] (ITGB3) | bortezomib [32.10] (RAD23B)vorinostat [32.10] (RAD23B) | capecitabine [4.07] (TYMS)fluorouracil [4.07] (TYMS) |
| COTC016-0505 | sunitinib1 [43.30] | axitinib [100.00] (FLT1)sunitinib [100.00, 41.30, 13.80, 13.20, 3.35] (FLT1, KIT, PDGFRA, FLT4, KDR) | irinotecan [4.70] | carmustine [3.79] | drotrecogin alfa [2.99] (SERPINE1) | topotecan [3.54] (TOP1) |   |
|  |  |  |  |  |  |  |  |
| COTC016-1303 | thioguanine1,3 [10.70] | raloxifene [152.00] (ESR1) | methotrexate [3.12] | carmustine [3.79] |   | medroxyprogesterone [152.00] (ESR1)toremifene [152.00] (ESR1) | capecitabine [4.42] (TYMS)fluorouracil [4.42] (TYMS) |

a Individual methods predicting efficacy for the identified drug are denoted 1-5. The Summary score represents a combined score of all methods where individual methods and biomarker rules are capped at a maximum -log(p) value of 10.0.