## Supplementary Materials: Pharmacogenomics in Pediatric Oncology: Review of Gene–Drug Associations for Clinical Use

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### Table S1. Drug–gene pairs and level of evidence [1,22].

| Agent                        | Pediatric Indication                        | Level 1 | Level 2 | Levels 3 and 4 |
|------------------------------|---------------------------------------------|---------|---------|-----------------|
| 6-Mercaptopurine             | ALL/AML_APL                                 | TPMT    |         | ABCB1; ABC4; ADA; AOX1; CBS; COMT; CRB1; CYP3A4; CYP2D6; DPYD; GSTA1; GSTM1; GSTP1; GSTT1; G6PD; HLA-C; HPRT1; MTHFR; MTR; NNMT; NR3C1; NUDT15; ITPA; SLCA19A1; SLCA28A2; TPMT; TYMS; UGT1A1; UGT2B15; VDR; XDH |
| 6-Thioguanine                | AML                                         | TPMT    |         | ABCB1; ABC4; ADA; AOX1; CBS; GSTA1; HPRT1; MTHFR; MTR; SLCA28A2 |
| Bevacizumab                  | High-grade glioma                           |         |         | CFH; DPYD; IL8; MTHFR; RGS5; SHMT1; VEGFA |
| Bleomycin                    | Hodgkin lymphoma                            |         |         | BLMH; CHRN82; CNR1; GSTM1; GSTP1; GSTT1; ERCC2; F5HR; IL12B; NR3C1; PTGS2; SSTR2; TACR2; TNF; TNFRSF1B |
| Carboplatin                  | Various brain malignancies                  | MTHFR; EGRF; XRCC1; ERCC1 |         | ABCB1; AKT1; ALDH1A1; ALDH3A1; ATP7A; BCL2; CYP1B1; DPYD; DSCAM; EEF3A; ERBB2; ERCC2; GGH; GSTA1; GSTM1; GSTP1; MAD1L1; MAP3K1; OPRM1; PTGS2; SLCA19A1; SLCA22A; SLCA31A1; SLCA31A2; SOX10; TYMS; UGT1A1 |
| Carmustin                    | Various brain malignancies                  |         |         | ABCB1; ABC3; BLK; EPX; GSTM1; GSTP1; GSTT1; KCH2; MGMT |
| Cisplatin                    | Various solid malignancies                  | TP53; XRCC1; ERCC1 |         | ABCB1; ABC3; ABC4; ACYP2; ADH1C; AKT1; BAIAP3; COMT; CYP2E1; DCBL1; EEF3A; EPHX1; ERCC1; ESR2; ESR3; GALNT14; GSTM1; GSTA6; GSTM1; GSTM3; GSTP1; GSTT1; KLC3; LIG3; LRP2; MAP3K1; MTHFR; MTR; MUX; NAT2; OTOS; RAD52; RPS20P2; SLCA19A1; SLCA22A; SLCA31A1; TPMT; UBE2I; VEGFA |
| Cladribine                   | AML                                         |         |         | DCK; PGDFA; PGDGR; RM1; RM2; RR2B; SLCA29A3 |
| Cyclophosphamide             | ALL and Hodgkin lymphoma                    | MTHFR; GSTP1; NQO1; SOD2; TP53 |         | ABCB1; ABC3; ABC4; ABCG2; ALDH1A1; ALDH2; ALDH3A1; BCR3; CRHR1; CRHR2; CYP1A2; CYP1B1; CYP1B2; CYP2C19; CYP2D6; CYP2D6; CYP3A4; CYP3A5; CYP4F2; CYP4F3; CYP4F8; CYP4F8; ERBB2; ERBB4; ERCC1; ERCC2; ESR1; ESR2; FOS; GATA1; GSTM1; HTGRB; HTGRC; ICA1; IL1B; IL1RN; IL4; IL6; IL12B; MAOA; MGMT; MMP3; MSH2; NOS3; NQO1; NQO2; PTGS2; SLC5A5; SLC22A16; TGFBI; TNF; TP53; VCAM1; VEGFA; XRCC1 |
| Cytarabine                   | ALL/AML                                     |         |         | ABCB1; ABC3; ABC6; CDA; CDK1; CYP2E1; CYP3A4; DCK; FCGR2A; GSTM1; GSTP1; GSTT1; MTHFR; NR3C1; NTSC3A; NT3E; SLOCA1B1; SLC1A1; SLC22A12; SULT2B1; TIMP3; TPMT; TYMS; UGT3; UGT1A1; VDR |
| Dacarbazine                  | Hodgkin's disease, neuroblastoma            |         |         | CYP1A2; CYP2E3; GSTM1; IRF1; IL6; MGMT; MLH1; MSH2 |
| Dasatinib                    | CML                                         |         |         | ABCB1; ABC2; AB1; BCR-ABL; CYP1A2; CYP2C19; CYP2D6; CYP3A4; CYP3A5; EPHA2; FM53; FYN; KIT; LCK; PGDGRB; SRC; UGT1A1; YES1 |
| Agent          | Pediatric Indication          | Level 1                    | Level 2                    | Levels 3 and 4                                    |
|----------------|-------------------------------|----------------------------|----------------------------|--------------------------------------------------|
| Daunorubicin   | ALL/AML                       | ABCB1; ABCC1; CB1R; CB2R3; CYP1B1; ABCB11; ABCG5; ABCG2; CYP1A1; CYP1A2; CYP1B1; CYP3A4; EGRF; GSTM1; GSTP1; GSTT1; MTHFR; NQO1; NOS3; NRF2; NQCI1; SLC19A1; SLC22A16; TAP1; TOP2A; TOP2B; TM; TMY; UGT1A1 |
| Decitabine     | AML                           | CDKN2B; CD4; DCK; DNMT1; DPDY; EGRF; FO5; HBG1; ICAM1; MGMT; MMR; MSH2; NQO1; NTRK2; SLC28A1; TIMP3; TP53 |
| Docetaxel      | Nasopharyngeal carcinoma      | ABCB1; ABCC1; ABCC6; ABCG2; ABCG2; ATP7A; BRC1; BRC2; CASP7; CHTSt3; CYP2C8; CYP2D6; CYP3A4; CYP3A5; CYP4B1; CYP19A1; DPDY; EPXH1; ERBB2; ERCC1; ERCC2; GBR2; GSTMs; GSTP1; GSTT5; HNF4A; IF2; IL1R2; IL1B; IL6; MAPK7; MDM4; MTHFR; NAT2; NR112; NDUFB4; OMR2; PIK3CA; PPAPR; PRDX4; PRTG5; PTGSI; PTGSI2; RPL13; SLC10A2; SLC10A3; SLC19A1; SLC22A16; TAP1; TOP2A; TOP2B; TMY; UGT1A1; UGT1A3; UGT1A4; UGT1A6; UGT1A9; UGT2B15; VEGFA; XPC; XRCC4 |
| Etoposide      | ALL, AML and Hodgkin lymphoma | ABCB1; ABCC1; ABCC2; ABCG6; ABCG2; AC1L3; AGPA2; ALDH3A1; BCR2; CYP1A2; CYP2A6; CYP2B6; CYP2C8; CYP2C9; CYP2C19; CYP2D6; CYP3A4; CYP3A5; CYP3A6; GSTM1; GSTT1; IL1; IL6; NQCI1; NOS3; NTRK2; PRNP; SLC19A1; TAP1; TF; TP52; TMY; UGT1A1; UGT1A3; UGT1A4; UGT1A6; UGT1A9; UGT1A10; UGT1A17; UGT1A3; UGT1A4; UGT1A6; UGT1A7A; C8orf34; SEMA3C |
| Everolimus     | Subependymal astrocytoma      | ABCB1; BRF; CYP3A4; CYP3A5; CYP2C8; HI1F1A; KRAS; PIK3CA; VEGFA |
| Hydroxyurea    | AML                           | ABCB1; CND1; CYP2D6; CYP3A4; HBB; KRAS; MAP3K5; MGMT; PDGFR; SNM2 |
| Ifosfamide     | For recurrence of Rhabdomyosarcoma | ABCB1; ABC4; ALDH1A1; ALDH2; ALDH3A1; CYP2A6; CYP2B6; CYP2C8; CYP2C9; CYP2C19; CYP2D6; CYP3A4; CYP3A5; CYP3A6; GSTM1; GSTT1; IL1B; IL6; NR112; TNF |
| Imatinib       | ALL                           | ABCB1; ABC1; ABC2; ABCC6; ABCG2; BCR-ABL; BCL2L1; BLK; CSF1R; CSF1; CYP1A1; CYP1B1; CYP1A2; CYP2B6; CYP2C8; CYP2C9; CYP2C19; CYP2D6; CYP3A4; CYP3A5; CYP4F4; CYP4F5; DDR1; DDR2; FMOD; GSTT1; IFN; IFI1; IFI1; LCK; KIT; PREG; PDGFRB; PIK3CA; SLC10A3; SLC19A1; TNF; UGT1A1; UGT1A3; UGT1A4; UGT1A6; UGT1A9; UGT2B15; VEGFA |
| Irinotecan     | Rhabdomyosarcoma              | ABCB1; ABC2; ABCC6; CYP3A4; SLC19A1; UGT1A1; ABC1; ABC3; ABC4; ACACA; AG1; ALDH1A1; AP1B; BCH; BCR; CDK1; CDK6; CES1; CES2; CES3; CYP3A4; CYP3B6; CYP1A2; CYP2C8; CYP2C9; CYP2D6; CYP2E1; DPDY; DR5; EGRF; ERBB2; ESR2; FO5; FST1; HLA-B; HLA-DRB1; IFN; IFG; IL1B; IL6; ITGAS; KNCQ5; MGMT; MLH1; MSH2; MT-ATP6; MTHFR; NQO1; NQCI1; PON1; PTGSE; RB1; SLC19A1; TF; TP53; TMY; UGT1A3; UGT1A4; UGT1A6; UGT1A9; UGT1A10; VEGFA; XRCC1; ACHE; CYP2A6; CYP2C9; CYP3A4; TOP1 |
| L-Asparaginase | ALL and Hodgkin lymphoma      | CYP3A4; GATA3; GSTM1; GSTP1; GSTT1; MTHFR; NOS3; NTRK2; SLC28A1; TMY; UGT1A1 |
| Lomustine      | Bone marrow suppression       | ABCB1; CYP2D6; CYP2D6; CYP3A4; MGMT |
| Mechlorethamine| Hodgkin lymphoma              | EBB2; IL8RB |
| Agent | Pediatric Indication | Level 1 | Level 2 | Levels 3 and 4 |
|-------|----------------------|---------|---------|----------------|
| Methotrexate | ALL/AML_APL | MTHFR; SLCO1B1; ABCB1; ATIC; MTRR | ABCC1; ABC2; ABCC3; ABCC4; ABCG2; ACOX1; ADA; ADORA2A; ALOX5; AOX1; ARID5B; CBS; CCND1; COMT; CRB1; CYP1A2; CYP3A4; CYP7A1; C10orf56; DHFR; DPYD; ENOSF1; ERBB2; FABP1; FMRI; GGH; GSTM1; GSTP1; GSTT1; G6PD; HLA-A; HLA-C; ILB; IL1RN; IL6; ITPA; LRRC1; MTHFD1; MTR; NALCN; NAT2; NOS3; NQO1; NR3C1; PTPRM; RB1; SLC16A7; SLC19A1; SLC22A6; SLC22A7; SLC22A1; SLC21A2; SHMT1; TGFBI; TNF; TNFAIP3; TNFRSF1B; TP3; TPM1; TMY5; UGT1A1; UGT2B1; VDR; XDH |
| Nelarabine | T-cell ALL and T-cell Lymphoblastic lymphoma | ADA | ABCB1; ABCC1; ABCC1; ABCC2; ABCG2; BCR-ABL; CSF1R; CYP2B6; CYP2C8; CYP2C9; CYP2D6; CYP3A4; DRR1; DRR2; KIT; PDKG1; SLCO2A1; TYK2; UGT1A1 |
| Nilotinib | CML | ABCB1; ABCC1; ABL1; ABCG2; BCR-ABL; CSF1R; CYP2B6; CYP2C8; CYP2C9; CYP2D6; CYP3A4; DDR1; DRR2; KIT; PDKG1; SLCO2A1; TYK2; UGT1A1 |
| Pazopanib | Rhabdomyosarcoma and Ewing tumor | CYP3A4; HFE; FGFR1; FGFR3; FLT1; FLT4; ITP; KDR; KIT; LCK; PDKG1; PDGFRB; PDGFRB; UGT1A1 |
| Prednisone | ALL and Hodgkin lymphoma | ABCB1; ABC3; AGT; CYP2C19; CYP3A4; GSTM1; GSTP1; GSTT1; IL10; MTHFR; NOS3; NPPA; NR1I2; NR2CI; PDGFRB; SLCO1A2; TGFBI; TMY5; UGT1A1; VDR |
| Procarbazine | Hodgkin lymphoma | MAOA; MGMT; MSH2; XDH |
| Rituximab | Non-Hodgkin lymphoma | FCGR3A | FCGR2A; IL2; IL6; TGFBI |
| Sunitinib | Gastrointestinal stromal tumors | ABCB1; ABCC1; ABCG2; CSF1R; CYP3A4; KIT; FLT1; FLT3; FLT4; GFRAs; KDR; PDGFRB; PDGFRB; TYK2 |
| Temozolomide | Newly-diagnosed glioblastoma multiforme | ABCB1; AGT; CYP3A4; MGMT; MSH2; PTGS2; TNF |
| Temsirolimus | New treatment approaches for Rhabdomyosarcoma | ABCB1; CCND1; CYP2D6; CYP3A4; ESR1; FKBP1; MTOR |
| Teniposide | ALL | ABCB1; ABCC1; CYP1A2; CYP2A6; CYP2B6; CYP2C8; CYP2C9; CYP2E1; CYP3A4; GSTM1; GSTT1; TOP2; TOP2A |
| Thiopeta | Various solid malignancies | ALDH1A1; ALDH3A1; CYP1A2; CYP2B6; CYP2C8; CYP2C9; CYP2C19;CYP2E1; CYP3A4; ERBB2; GATA1; GSTA1; GSTM1; GSTP1; G3MT |
| Topotecan | AML | ABCB1; ABCC1; ABCG2; ACOX1; ADH; AOX1; CAT; CCR5; CYP3A4; ERBB2; GCH1; LEP; MLH1; MSH2; MTHFR; NR1I2; TAPI1; TOP1; TOP1MT; TP3; VEGFA |
| Vinblastine | Hodgkin lymphoma | ABCB1; ABCB1; ABCC1; ABCG2; BCR-ABL; CSF1R; CYP2B6; CYP2C8; CYP2C9; CYP2E1; CYP3A4; GSTM1; GSTP1; GSTT1; IL1B; NR1I2; POR; SULT1A1; TFG; TUBA1B; TUBB; TUBB3 |
| Vincristine | ALL; Hodgkin’s disease, non-Hodgkin lymphoma, Wilms’ tumor, neuroblastoma, rhabdomyosarcoma | ABCB1; ABCB1; ABCC1; ABCG2; BCR-ABL; CSF1R; CYP2B6; CYP2C8; CYP2C9; CYP2E1; CYP3A4; AGT; APOA1; CYP2; CES1; CCR5; CYP3A4; CYP3A5; EGRF; GATA1; GSTM1; GSTP1; GSTT1; IGFI; IL6; MAF; MAFB; MTHFR; NR1I2; NR3C1; POR; PRNP; PTGS2; SLCO1A1; STAT3; TNF; TP3; TPMT; TUBA1B; TUBB; TUBB3; TMY5; UGT1A1; VDR |
References

1. Cacabelos, R.; Fernandez-Novoa, L.; Carril, J.C.; Corzo, L.; Lombardi, V.; Tellado, I.; Carrera, I.; Bello, A.; Fraile, C.; Takeda, M. *World Guide for Drug Use and Pharmacogenomics*, 1st ed.; Euroespes Publishing: Corunna, Spain, 2012; p. 2920.