**Supplemental Figure 1: CAR-T cell phenotype cultured in IL2 are phenotypically similar to IL2/IL15low.**

Flow cytometry analysis of the distribution of CD45RA+CCR7+ population over time (days 14, 23, and 32) in T cells cultured in the presence of IL2 alone or IL2/IL15low (left). Graph summarizes the upper right quadrant (CD45RA+CCR7+) (right).

**Supplemental Figure 2: Characterization of T cell product post enrichment process.**

Flow cytometry analysis shows percent CD45RA+ CD62L+ T cells after CD62L enrichment for three representative donors.

**Supplemental Figure 3: IL15 maintains less-differentiated CAR-T cells with decreased effector phenotype.**

A)Representative flow cytometry analysis shows percent CD95+ CAR-T cells.B) Changes in frequency of CD45RA+ and CD45RO+ T cells over time (left) and representative flow cytometry analysis of CD45RA+/CD45RO+ CD19-CAR T cells on day 32 (right). C) Effector function was measured by frequency of IFNγ+ cells after co-culturing CAR-T cells with target cells (CD19+ LCL and CD19- KG1A) at a 1:1 Effector:Target ratio for 5 hours (left). A representative flow cytometry analysis of IFNγ+ CAR-T cells after co-culture with CD19+ LCL (right).

**Supplemental Figure 4: Differential gene expression in the CD4 T cells cultured in IL15 or IL2.**

Hierarchical clustering shows global gene expression changes in CD4 T cells between the two culture conditions on day 14 (P< 0.01, false discovery rate <5%, Benjamini-Hochberg’s method). Yellow and blue colors indicate increased and decreased expression, respectively.

**Supplemental Figure 5: Phenotypic and functional assessment of CAR-T/IL15 cells.**

A)Flow cytometry analysis of PD-1+ CAR-T/IL2 and CAR-T/IL15 cells. B) Flow cytometry (right) and immunoblot analysis (left) shows p-STAT5 levels in CAR-T cells cultured in IL2 or IL15. C) Measurement of recursive killing capacity by culturing CD19-CAR-T cells with target cells (Raji) at a 1:3 Effector:Target ratio for 3 days, followed by additional tumor challenge at a 1:3 ratio. Bar graphs show number of remaining viable tumor (left) and CAR-T cells (right) on day 5. \*p < 0.05; \*\*\*\*p < 0.0001.

**Supplemental Figure 6: IL15 exerts similar phenotypic changes in PBMC-derived and CD62L+-derived CAR-T products.** A) PBMC- and CD62L+-derived CAR-T cells were expanded in IL2 or IL15 for 15 days, and the Tscm population (CCR7+CD45RA+; CD62L+CD27+; CD62L+CD127+) was identified using flow cytometry. B) CD19-CAR-T cells were co-cultured with tumor cells (CD19+ Raji and CD19- KG1A) at a 1:1 Effector:Target ratio for 4 days. After 4 days, number of CAR-T cells from PBMC-derived and CD62L+-derived CAR-T populations were counted by flow cytometry and graphed. C) Western Blot analysis at day 15 compares level of Bcl2 and p-rps6 proteins indicative of mTORC1 activity in both populations under the IL2 or IL15 cytokine condition. D) Raji-ffluc tumor progression was monitored by bioluminescent imaging and overall survival was compared following treatment with PBMC- or CD62L+-derived CAR-T populations propagated in IL2 or IL15 (experimental design similar to Figure 6). \*p < 0.05; \*\*p < 0.01.

**Supplemental Figure 7: IL13Rα2-CAR-T cells cultured in IL15 exhibit a Tscm phenotype with a superior metabolic and antitumor function.** Graph summarizing flow cytometric analysis of changes in Tscm phenotype of IL13Rα2-CAR-T cells A) CD45RA+ CCR7+, CD62L+CD27+ and CD62L+CD127+ and B) exhaustion phenotype (2B4+ and Lag3+) over extended culture. C) Immunoblot analysis of indicated proteins in CAR-T cells cultured in IL2or IL15. GAPDH was used as a loading control. D) OCR of IL13Rα2-CAR-T/IL2 and IL13Rα2-CAR-T/IL15 cells in response to indicated mitochondrial modulators: oligomycin; FCCP; rotenone. Bar graph represents the differences in mean fluorescent intensity (MFI) of mitochondria potential (TMRM) (middle panel) and glucose uptake (2-NBDG) (right panel) measurements in CAR-T cells. E) IL13Rα2-CAR-T cells isolated after *in vivo* tumor challenge and co-cultured with tumor *in vitro* for 5 hours. Representative flow cytometry shows activated IL13Rα2-CAR-T cells (right) and bar graphs summarize frequency of TNFα+CD107α+ and TNFα+IFNγ+ CAR-T cells (left). F) Measurement of recursive killing capacity by culturing IL13Rα2-CAR-T cells with target cells (glioma cell line) at a 1:4 Effector:Target ratio for 2 days, followed by additional tumor challenge 1:4 ratio on days 2, 4, and 6. Bar graph shows number of remaining viable tumor cells on day 7. G) Bioluminescent flux plot quantifying tumor burden in response to PBMC-derived IL13Rα2-CAR-T cells propagated in IL2 or IL15 (left). Kaplan Meier survival curve depicts overall survival (n=7 mice per group) (right). \*p < 0.05; \*\*p < 0.01.

**Supplemental Figure 8: Phenotypic characteristics of CAR-T cells cultured in different cytokine condition.** A) Cell expansion of CAR-T cells cultured in indicated cytokine condition. Comparison of B) CD4/CD8 subsets, C) percent CAR+ and D) MFI of CAR+ T cells in each culture condition.

**Supplemental Figure 9: CAR-T cells cultured in low dose IL2 have similar phenotypic and functional characteristics as standard IL2 culture condition.** A) Kaplan-Meier survival curve depicts overall survival of mice bearing Raji-ffluc lymphoma untreated or treated with CD19-CAR-T cells cultured in different IL2 titrations (experimental design similar to Figure 6). B) Immunoblot analysis of indicated proteins in CAR-T cells cultured in IL2or IL15. GAPDH was used as a loading control. C) Flow cytometric analysis of changes in Tscm phenotype (CCR7+, CD62L+CD27+) and exhaustion phenotype (Lag3+) in CAR-T cells cultured in IL2 (25 or 50 U/ml) or IL15.

**Supplemental Table 1: Primer List for all qPCR analyses.**