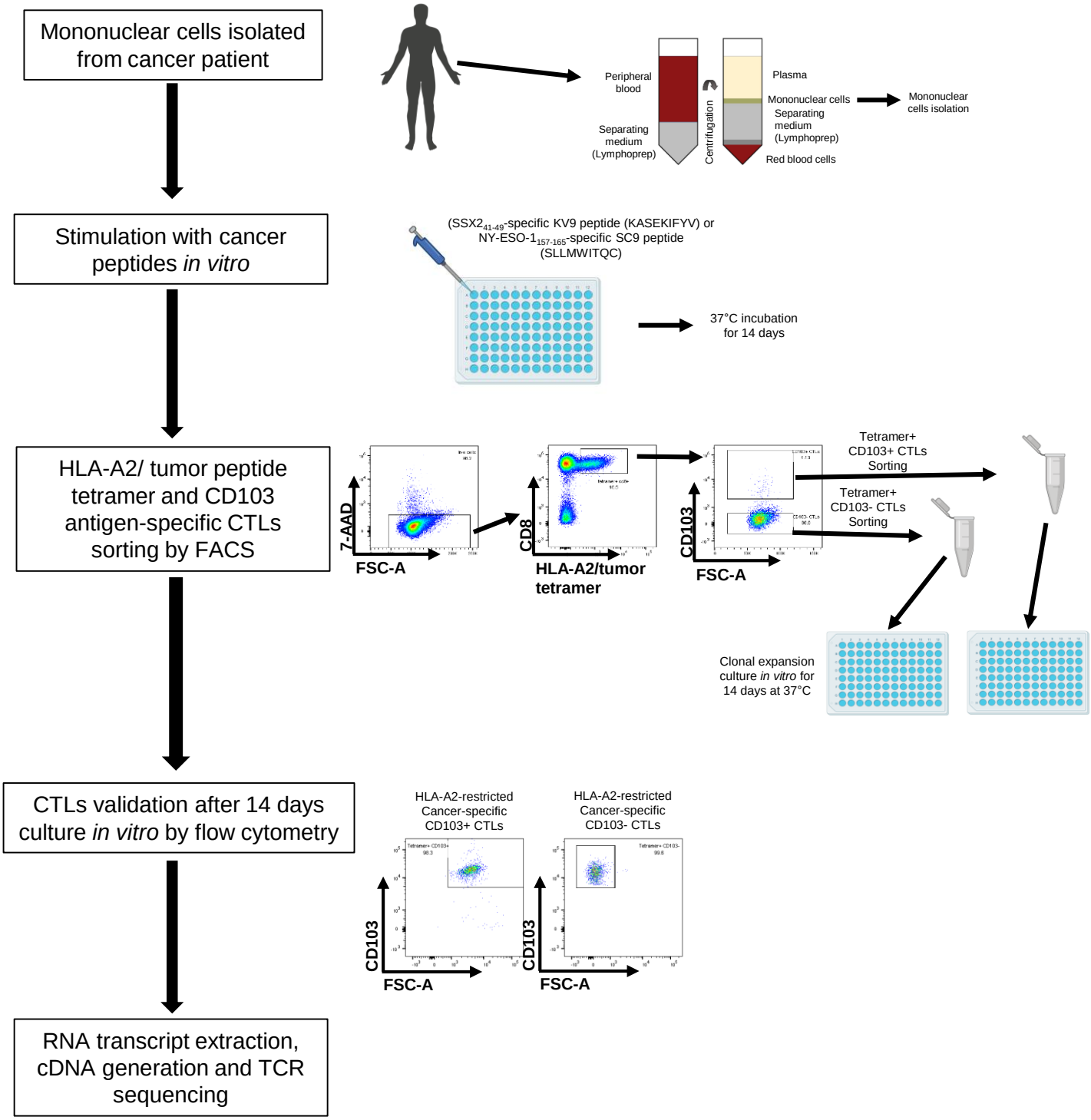
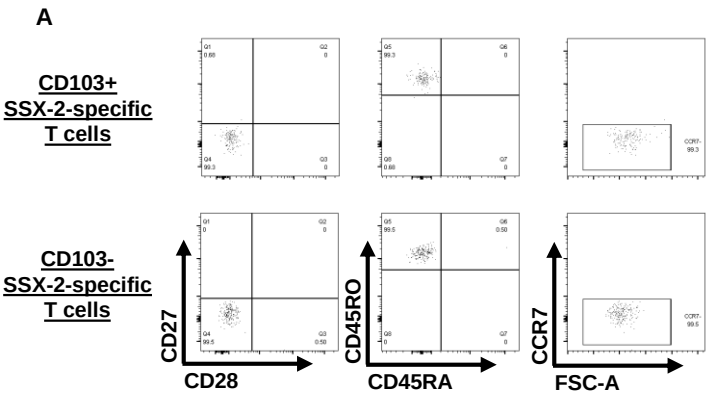
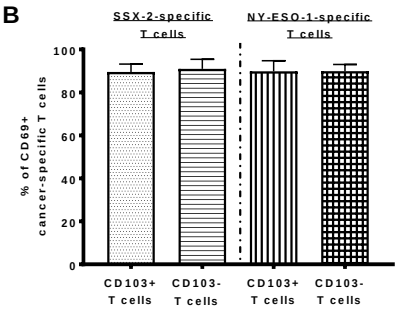


Supplementary Fig. S1 Flowchart of identification, sorting and cloning of HLA-A2-restricted cancer-specific CTLs. Mononuclear cells from cancer patient was initially isolated and stimulated with cancer peptides *in vitro* for 14 days at 37°C. After 14days, mononuclear cells were stained with HLA-A2/tumor peptide tetramer and CD103 and sorted for CD103+ and CD103- cancer-specific CTLs by FACS. Sorted cells were then clonally expanded *in vitro* for 14 days at 37°C. After 14 days, CD103 and tetramer specificity is validated using flow cytometry. Clonality of CTLs were determined by RNA transcript extraction, cDNA generation and subsequent TCR sequencing.





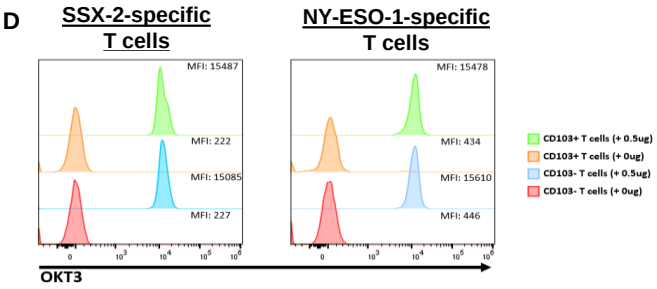
C

SSX-2-specific T cells

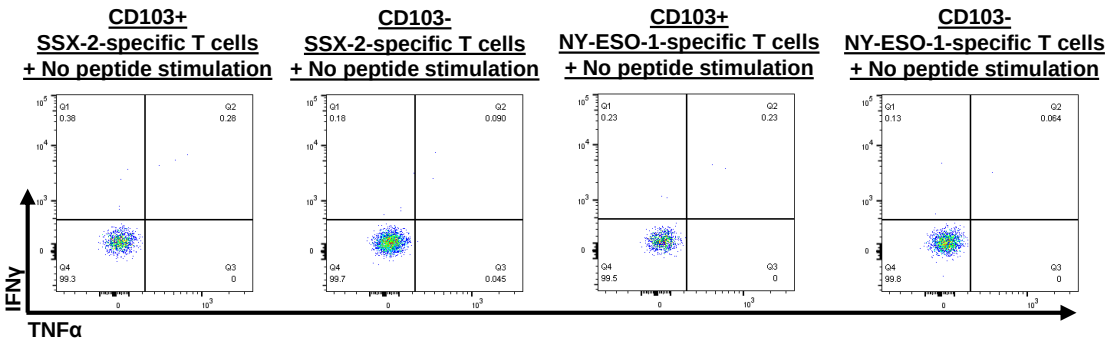
Clone type	TCRα	TCRβ
CD103+ T cells	TRAV 8-6 TRAJ 30	TRBV 6-1 TRBJ 2-7
CD103- T cells	TRAV 8-6 TRAJ 30	TRBV 6-1 TRBJ 2-7

NY-ESO-1-specific T cells

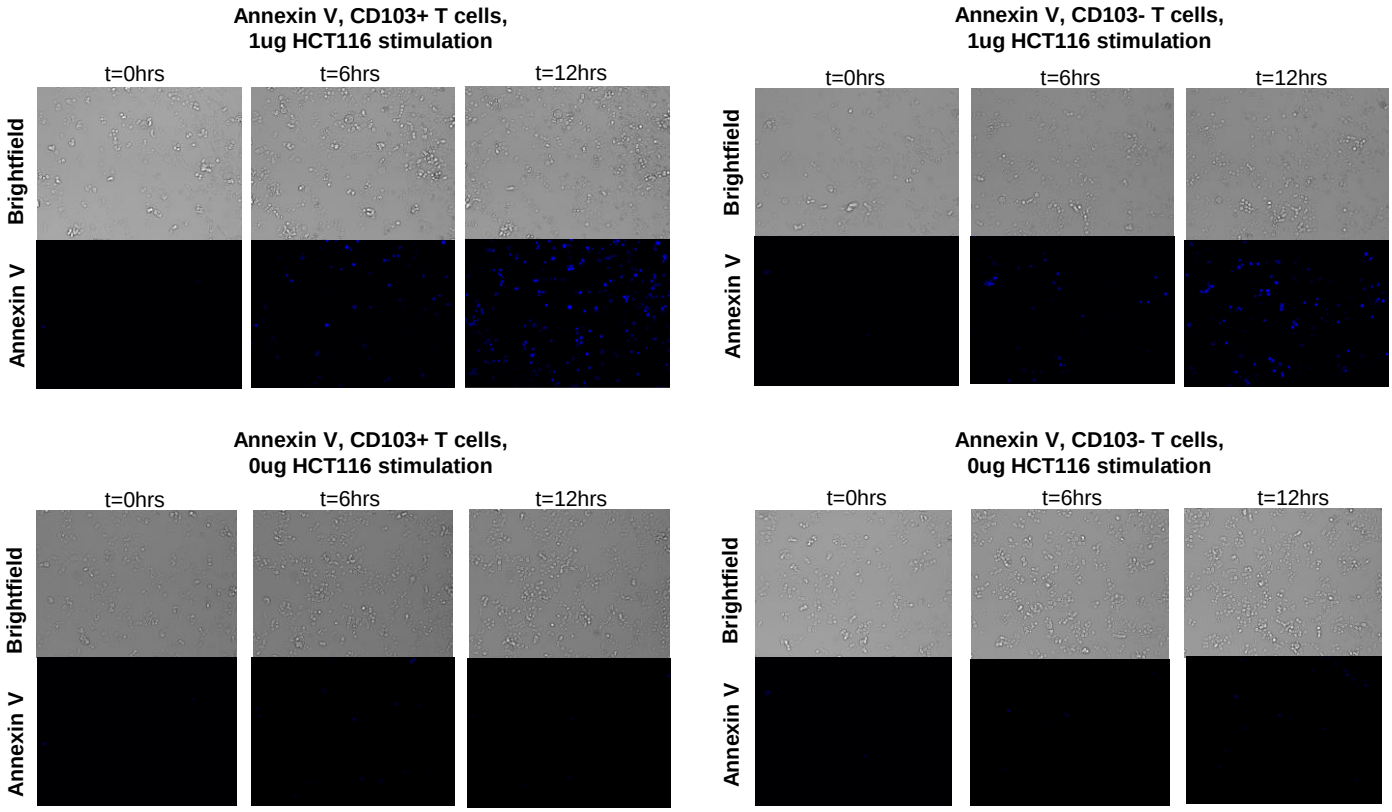
Clone type	TCRα	TCRβ
CD103+ T cells	TRAV 12-2 TRAJ 31	TRBV 12-4 TRBJ 1-2
CD103- T cells	TRAV 12-2 TRAJ 31	TRBV 12-4 TRBJ 1-2



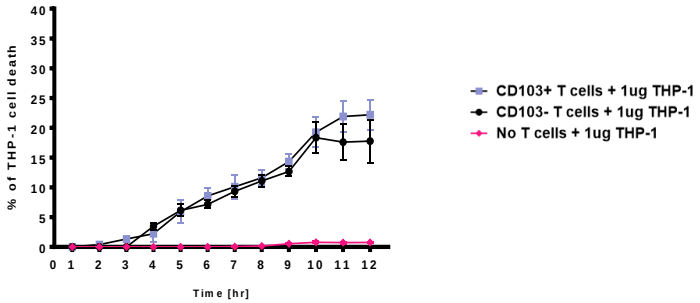
Supplementary Fig. S2 Phenotype of paired CD103$^+$ and CD103$^-$ cancer-specific T cells. A. Representative of FACS dot plots of the differentiation stage of CD103+ and CD103- cancer-specific T cells (SSX-2-specific). B. The frequency of CD103+ and CD103- cancer-specific T cells expressing the standard Trm marker of CD69. C. T cell receptor sequences of CD103$^+$ or CD103$^-$ T cells of SSX-2-specific *(top)* and NY-ESO-1-specific *(bottom)* T cells. D. T cell receptor densities (by OKT3 staining MFI) of either CD103$^+$ or CD103$^-$ T cells of SSX-2-specific T cells *(left)* or NY-ESO-1-specific T cells *(right)* following OKT3 binding staining of 0.5μg.



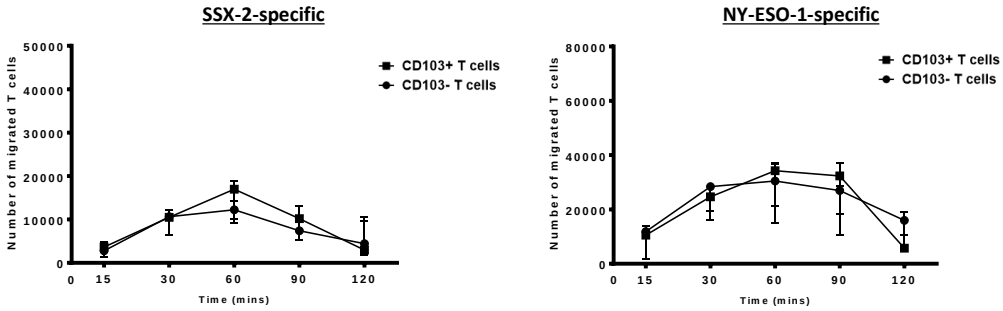
Supplementary Fig. S3. T cell-mediated response of cancer-specific T cells without external antigen stimulation. Flow cytometry plots of IFNγ and TNFα responses by CD103+ of CD103- SSX-2-specific or NY-ESO-1-specific T cells following co-culture with **HCT116 cancer cell line without external tumor antigen peptide stimulation.**



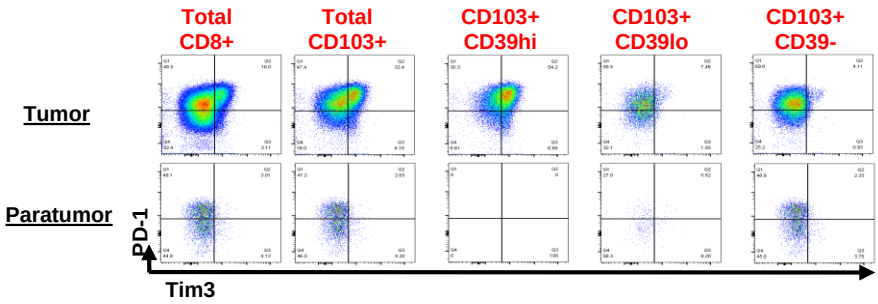
Supplementary Fig. S4. T cell cytotoxic events. Brightfield and Annexin V images of antigen stimulated HCT116 cell death following co-exposure with either $CD103^{+}$ *(left)* or $CD103^{-}$ *(right)* SSX-specific T cells at 0,6 and 12 hours, with 0μM-stimulated HCT116 co-culture as controls. Annexin V excited at 632nm excitation and illustrated in blue.



Supplementary Fig. S5 Anti-tumor T cells cytotoxicity E-Cadherin- THP-1. Percentage of THP-1 cell death across a 12-hour time period following co-culture with no T cells as controls. (N, number of repeats=3). Data represented as median±s.e.m.



Supplementary Fig. S6 CD103+ or CD103- cancer-specific T cells migration towards E-Cadherin- THP-1. The number of T cells (either $CD103^+$ or $CD103^-$ T cells) that migrated across a transwell membrane over a time period of 2 hours. SSX-2-specific T cell clones shown on the *left* and NY-ESO-1-specific T clones shown on the *right.* (N, number of repeats=3).



Supplementary Fig. S7 *Ex vivo* phenotypic analysis of CD103^{+} TILs. Representative flow cytometry plot of CD103^{+} CD39^{high}, CD103^{+} CD39^{low}, CD103^{+} CD39^{-} or total CD8^{+} T cells expressing either PD-1 or Tim3, derived from the paired tumor and paratumor tissue of one lung cancer patient.

Supplementary Table 1 Clinical parameters of cancer patients (for *ex vivo* analysis)

Clinical parameters of cancer patients		
Age	40-59	2
	60-69	1
	≥70	2
	average (range)	65.6 (59-80)
	Total	*5*
Sex	Male	3
	Female	2
Tumor type	**Lung**	**5**
Tumor origin	metastatic	0
	non-metastatic	5
Clinical tumor TNM stage	T1N0M0	4
	T2N1M0	1
Identification of cancer	Adenocarcinoma	3
	Squamous cell carcinoma	2

Supplementary Table 2 TCR sequencing of T cell clones

Clone	TRAV	CDR3(aa)	TRAJ	TRBV	CDR3(aa)	TRBJ
SSX2_CD103-Pos	8-6	CAVSDQNRDDKIIFGKG	30	6-1	CASSQGLTYGPSSYEQYFGPG	2-7
SSX2_CD103-Neg	8-6	CAVSDQNRDDKIIFGKG	30	6-1	CASSQGLTYGPSSYEQYFGPG	2-7
Ny-ESO_CD103-Pos	12-2	CAVDNNARLMFGDG	31	12-4	CASSQGAYGYTFGSG	1-2
Ny-ESO_CD103-Neg	12-2	CAVDNNARLMFGDG	31	12-4	CASSQGAYGYTFGSG	1-2