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**Fig. S1. Detection of AIM**<sup>+</sup> **T cells. (A)** Representative flow cytometric gating strategy showing the identification of AIM<sup>+</sup> memory CD4<sup>+</sup> and CD8<sup>+</sup> T cells via flow cytometry. (**B**) Stimulation indices of individual donor responses at 6–9M. (**C**) Frequencies of intracellular AIM<sup>+</sup> memory CD4<sup>+</sup> T cells after DMSO and peptide pool stimulation. (**D**) Frequencies of AIM<sup>+</sup> memory CD4<sup>+</sup> T cells measured by intracellular staining, plotted with raw values (left) and DMSO background subtracted values (right). Statistical significance was determined by Mann–Whitney U test (C and D). \**P* < 0.05, \*\**P* < 0.01, \*\*\**P* < 0.001, \*\*\*\**P* < 0.0001. Bars shown median.



**Fig. S2. Effect of vaccination on the frequency of spike-specific T cells.** (**A**) Frequencies of AIM<sup>+</sup> memory CD4<sup>+</sup> T cells targeting different regions of SARS-CoV-2. (**B**) Frequencies of AIM<sup>+</sup> memory CD8<sup>+</sup> T cells targeting the spike protein of SARS-CoV-2. Statistical significance was determined by Mann–Whitney U test (A and B). n.s. = P > 0.05, \*P < 0.05, \*P < 0.01, \*\*\*\*P < 0.001, \*\*\*\*P < 0.001. Bars shown median.



Fig. S3. Characterization of T cell cytokine production and inhibitory receptor expression. (A) Permutation test comparisons of cytokine expression profiles among AIM<sup>+</sup> memory CD4<sup>+</sup> T cells (related to Fig. 2C). (B) Percentages of IFN- $\gamma^+$  spike-specific memory CD8<sup>+</sup> T cells with polyfunctional cytokine and cytotoxic molecule expression after peptide stimulation. (C) Representative flow cytometry plots showing the identification of inhibitory receptor expression among tetramer-binding CD8<sup>+</sup> T cells. (D) Percentages of tetramer-binding CD8<sup>+</sup> T cells with inhibitory receptor expression. Statistical significance was determined by permutation test (A) and Mann–Whitney U test (B and D). n.s. = P > 0.05, \*P < 0.05, \*\*P < 0.01, \*\*\*\*P < 0.001. Bars shown median.



**Fig. S4. Classification of AIM**<sup>+</sup> **populations sorted for scRNA-seq.** (**A**) Representative flow cytometric gating strategy for the identification and sorting of AIM<sup>+</sup> CD4<sup>+</sup> and CD8<sup>+</sup> T cells for scRNA-seq. (**B**) Distribution of conventional AIM<sup>+</sup> cells with CD4 or CD8 protein expression separated by donor and time point. Cells classified as 'other' either lacked expression of CD4 and CD8 or expressed both CD4 and CD8. (**C**) UMAP and clustering of all sorted cells, including NK cells and unconventional T cells. (**D**) Classification of NK cells and unconventional T cells. (**E**) Expression of transcripts corresponding to conventional and unconventional T cell subsets. (**F**) Distribution of donor groups and time points across each UMAP cluster. (**G**) Frequencies of sorted AIM<sup>+</sup> memory CD4<sup>+</sup> and CD8<sup>+</sup> T cells after spike peptide pool stimulation. (**H**) Comparison of frequencies of AIM<sup>+</sup> populations after DMSO and spike peptide pool stimulation.



**Fig. S5. Protein expression among spike-specific T cells determined via CITE-seq. (A)** Heatmap showing protein expression measured via CITE-seq using a reduced panel for convalescent donors sampled on day 35. (**B**) Violin plots showing the expression of activation markers separated by donor group and time point.



Fig. S6. Transcriptomic comparison of spike-specific T cells before and after vaccination. (A) Proportions of AIM<sup>+</sup> CD4<sup>+</sup> T cells from individual donors belonging to each CD4<sup>+</sup> T cell cluster. (B) GSEA summary of differentially expressed genes between CD4<sup>+</sup> T cells at 6-9M versus 18M. (C) Dot plots of the percentages of CD4<sup>+</sup> T cells from mild, severe and recently vaccinated donors with expression of *IFNG*. (D) Dot plots of the percentages of CD4<sup>+</sup> T cells from mild, severe and recently vaccinated donors with expression of *IL10*. (E) Percentages of CD4<sup>+</sup> T cells with expression of *IL10*. (F) Proportions of AIM<sup>+</sup> CD8<sup>+</sup> T cells from individual donors belonging to each CD8<sup>+</sup> T cell cluster. Statistical significance was determined by Broad GSEA test (B) and Mann–Whitney U test (C and D). Adjusted p-values calculated using the Benjamini–Hochberg (B) method. n.s. = P > 0.05, \*P < 0.05, \*\*P < 0.01, \*\*\*P < 0.001



**Fig. S7. Clonal characterization of spike-specific T cells before and after vaccination.** (**A**) Proportions of CD4<sup>+</sup> and CD8<sup>+</sup> T cells classified by the degree of clonal expansion. (**B**) *IFNG* expression among expanded CD8<sup>+</sup> T cell clonotypes after vaccination separated by donor.



Fig. S8. Transcriptomic signatures of CD8<sup>+</sup> T cell clonotypes detected at one or both time points. (A) Volcano plot showing differentially expressed genes between existing and newly detected CD8<sup>+</sup> T cell clonotypes at 18M. (B) GSEA summary of differentially expressed genes between existing and newly detected CD8<sup>+</sup> T cell clonotypes at 18M. (C) GSEA plot showing significantly enriched pathways at 18M. WP: WikiPathways; R: Reactome. Statistical significance was determined by Mann–Whitney U test (A) and Broad GSEA test (C) and. Adjusted p-values calculated using the Bonferroni method (A). n.s. = P > 0.05, \*P < 0.05



Fig. S9. Characterization of hybrid spike-specific T cell responses in donors with CLL. (A) Overview of donors and sampling time points from a cohort of patients undergoing treatment for CLL. (B) Frequencies of AIM<sup>+</sup> memory CD4<sup>+</sup> T cells. (C) Frequencies of AIM<sup>+</sup> memory CD8<sup>+</sup> T cells. (D) Percentages of AIM<sup>+</sup> memory CD4<sup>+</sup> T cells expressing cytokines. (E) Percentages of total memory CD8<sup>+</sup> T cells expressing IFN- $\gamma$ . Statistical significance was determined by paired Wilcoxon Signed-Rank Test (B, C, D, E). n.s. = P > 0.05, \*P < 0.05



**Fig. S10. Summary of hybrid T cell immunity shaped by infection and vaccination.** Schematic representation of the key findings.

Donor group and time point	Characteristic	Value
Mild (non-hospitalized)	Total number	50
	Number with paired time points	31
6–9 months convalescence	Total number	44
• • • • • • • • • • • • • • • • • • • •	Unvaccinated	44
	Median age at infection (range)	54.5 (43-78)
	Male / Female	33 / 11 (75/25
		%)
18 months convalescence	Total number	37
	Unvaccinated	3
	Vaccinated	34
	Vaccine platform	
	(Comirnaty, SpikeVax, Vaxzevria,	27, 3, 2, 2
	unknown)	/
	Median age at infection (range)	57 (43-78)
	Male / Female	28 / 9 (76/24
		%)
Severe (hospitalized)	Total number	53
	Number with paired time points	24
6–9 months convalescence *	I otal number	45
	Unvaccinated	45
	Median age at infection (range)	57 (33-68)
	Male / Female *	34 / / (76/16
		%)
	Admitted to ICU	26
		21
18 months convalescence		32
	Unvaccinated	1
		25
		10 0 0 0
		10, 0, 0, 3
	Modian ago at infaction (rango)	57 5 (22-76)
	Mala / Fomala	37.3(33-70)
		23/9(12/20
	Admitted to ICU	/0)
	Required ventilator	10
		10

#### Table S1. Summary of donors with a history of mild or severe disease.

The exact date of infection or vaccination was unavailable for four donors with mild disease and two donors with severe disease. \*Clinical information was unavailable from four donors. ICU: intensive care unit.

Donor group and time point	Characteristic	Value
Mild (non-hospitalized)	Total number	14
<ul> <li>Paired 6–9M and 18M</li> </ul>	Median age at infection (range)	54 (43-66)
time points for each	Male / Female	10 / 4
donor	HLA combinations	
<ul> <li>All donors vaccinated</li> </ul>	A24	3
at the 18M time point	A2 A24	6
	A2 B7	2
	A24 B7	2
	A2 A24 B7	1
Severe (hospitalized)	Total number	14
<ul> <li>Paired 6–9M and 18M</li> </ul>	Median age at infection (range)	57.5 (33-68)
time points for each	Male / Female	11 / 3
donor	HLA combinations	
<ul> <li>All donors vaccinated</li> </ul>	A2	5
at the 18M time point	A24	5
- 1	A2 A24	2
	A2 B7	1
	A2 A24 B7	1

 Table S2. Summary of donors selected for tetramer analysis.

### Table S3. Summary of donors selected for single-cell RNA-sequencing (scRNA-seq).

Donor group and time point	Characteristic	Value
Mild	Donor IDs	22, 123, 126
<ul> <li>Non-hospitalized</li> </ul>	Age	67, 59, 57
<ul> <li>6–9 months convalescence</li> </ul>	Sex	M, M, M
<ul> <li>18 months convalescence</li> </ul>	Vaccine platform	
	Vaxzevria (Donor IDs)	22
	Comirnaty (Donor IDs)	123, 126
Severe	Donor IDs	53, 73, 145
<ul> <li>Non-hospitalized</li> </ul>	Age	56, 62, 56
<ul> <li>6–9 months convalescence</li> </ul>	Sex	M, F, F
<ul> <li>18 months convalescence</li> </ul>	Vaccine platform	
	Comirnaty (Donor IDs)	53, 73
	Unknown (Donor IDs)	145
Recently vaccinated	Donor IDs	4868
<ul> <li>Non-hospitalized</li> </ul>	Age	54
<ul> <li>Baseline: 2 weeks before vaccination</li> </ul>	Sex	F
or 13 months convalescence	Vaccine platform	
<ul> <li>Dose 2+: 2 weeks after second dose</li> </ul>	SpikeVax (Donor IDs)	4868
vaccination or 15 months		
convalescence		
Recently convalescent	Donor IDs	850, 852, 854
<ul> <li>Non-hospitalized</li> </ul>	Unvaccinated	3
<ul> <li>Day 35 convalescence</li> </ul>	Age	Unavailable
<ul> <li>Unvaccinated</li> </ul>	Sex	F, F, M

Donor group and time point	Characteristic	Value
B cell abnormality	Total number	7
<ul> <li>Treated with BTK inhibition</li> </ul>	Median age at convalescent time point	69
for CLL	(range)	(46-77)
<ul> <li>Convalescent</li> </ul>	Male / Female	4/3
Post-dose 4	Hospitalized	6

Table S4. Summary of donors with B cell abnormalities (CLL).

CLL: chronic lymphocytic leukemia; BTK: Bruton's tyrosine kinase

#### Table S5. Summary of healthy vaccinated donors.

Donor group and time point	Characteristic	Value
<ul> <li>Vaccinated healthy controls</li> <li>3 month post-vaccination follow-up (two doses received)</li> <li>18 month post-vaccination follow-up (three or four doses received)</li> </ul>	Total number	14
With breakthrough infection	Total number	5
	Median age at vaccination	32
	(range)	(26-55)
	Male / Female	2/3
	Vaccine platform	
	Comirnaty only	2
	Comirnaty and SpikeVax	3
	Clinical history	
	Two doses > breakthrough	1
	Two doses > breakthrough > third dose	1
	Three doses > breakthrough	3
Without breakthrough infection	Total number	9
<ul> <li>All received four vaccine</li> </ul>	Median age at vaccination	46
doses by the 18 month	(range)	(28-59)
follow-up	Male / Female	4 / 5
	Vaccine platform	
	Comirnaty only	6
	Comirnaty and SpikeVax	3

STEP 1: Stain for viability at room temperature for 10 minutes.							
Marker	Fluorophore	Supplier	Dilution	Product number	Clone		
LIVE/DEAD	For 405 nm	Invitrogen	1X in PBS	L34957	-		
Fixable Aqua	excitation						
STEP 2: Stain for c	hemokine recep	otors at 37°C fo	or 10 minutes.		1		
Marker	Fluorophore	Supplier	Dilution	Product	Clone		
				number			
CCR7	APC-Cy7	BioLegend	1:50	353212	G043H7		
CCR4	BB700	BD	1:50	566475	1G1		
CCR6	BUV737	BD	1:75	612780	11A9		
CXCR3 AF647		BioLegend	1:100	353712	G025H7		
STEP 3: Stain with	remaining antib	odies at room	temperature for	or 30 minutes i	n BD Brilliant		
Stain Buffer Plus.							
Marker	Fluorophore	Supplier	Dilution	Product	Clone		
				number			
CD40L	BV421	BioLegend	1:25	310824	24-31		
4-1BB	PE-Cy7	BioLegend	1:25	309818	4B4-1		
CD4	BUV496	BD	1:25	612936	SK3		
CD14	BV510	BioLegend	1:100	301842	M5E2		
CD19	BV510	BioLegend	1:100	302242	HIB19		
CD45RA	BV570	BioLegend	1:200	304132	HI100		
CD69	BV650	BioLegend	1:50	310934	FN50		
CD3	BUV805	BD	1:50	612895	UCHT1		
CD8	BUV395	BD	1:250	563795	RPA-T8		
STEP 4: Wash and fix cells in 1% paraformaldehyde.							

## Table S6. Surface staining protocol for flow cytometry.

STEP 1: Stain for chemokine receptors at 37°C for 10 minutes.								
Marker	Fluorophore	Supplier	Dilution	Product number	Clone			
CCR7	APC-Cy7	BioLegend	1:50	353212	G043H7			
CCR4	BB700	BD	1:50	566475	1G1			
CCR6	BUV737	BD	1:75	612780	11A9			
CXCR3	AF647	BioLegend	1:50	353712	G025H7			
STEP 2: Stain wit in BD Brilliant Sta	h surface antibod in Buffer Plus.	ies and viabil	ity dye at ro	om temperatur	e for 30 minutes			
Marker	Fluorophore	Supplier	Dilution	Product number	Clone			
PD-1	BV711	BioLegend	1:25	329928	EH12.2H7			
CD4	BUV496	BD	1:25	612936	SK3			
CD14	BV510	BioLegend	1:100	301842	M5E2			
CD19	BV510	BioLegend	1:100	302242	HIB19			
CD45RA	BV570	BioLegend	1:200	304132	HI100			
CD8	BUV395	BD	1:250	563795	RPA-T8			
LIVE/DEAD	For 405 nm	Invitrogen	1:1667	L34957	-			
Fixable Aqua	excitation							
CD38	APC-R700	BD	1:50	564979	HIT2			
STEP 3: Fix and   (Invitrogen, #00-5	permeabilize with 523-00) according	FoxP3 Trans g to the provi	cription Fac ded protoco	tor Staining Βι Ι.	Iffer Set			
STEP 4: Stain wit Brilliant Stain Buf	h intracellular ant fer Plus and 1X P	ibodies at roc ermeabilizatio	om temperat on Buffer.	ure for 30 minu	utes in BD			
Marker	Fluorophore	Supplier	Dilution	Product number	Clone			
CD40L	BV421	BioLegend	1:25	310824	24-31			
IL-17A	eFluor660	Invitrogen 1:25 50		50-7178-42	eBio64CAP17			
IL-2	PE-Dazzle594	BioLegend	1:33	500344	MQ1-17H12			
4-1BB	PE-Cy7	BioLegend	1:100	309818	4B4-1			
TNFa	BV650	BD	1:166	563418	MAb11			
CD3	BUV805	BD	1:250	612895	UCHT1			
CD69	BUV563	BD	1:200	748764	FN50			
IFN-γ	PE	BioLegend	1:400	506507	B27			
Granzyme B	BB790	BD	1:500	624296	GB11			
STEP 5: Wash and fix cells in 1% paraformaldehyde.								

## Table S7. Surface and intracellular staining protocol for flow cytometry.

Table	S8.	Tetramer.	surface	and	intrace	ellular	staining	protocol	for flow	cytometry	-
		,						p			-

Reagent         Fluorophore         Supplier         Final conc.         Product number         Clone           Dasatinib         -         STEMCELL         50 µM         73082         -           STEP 2: Incubate with one relevant PE tetramer/tetramer pool at room temperature for 20 minutes. Each tetramer should be equivalent to 0.2 µl of pMHC (0.5 µg/ml, total 10µl volume).         Reagent         Fluorophore           Tetramer pool consisting of: SARS-CoV-2 ORF3 A*0201 LLXDRLNQL         Fluorophore         PE           SARS-CoV-2 ORF3 A*0201 LLYDANYFL         PE         PE           SARS-CoV-2 ORF3 A*0201 LLYDANYFL         PE         CMV pp65 A*0201 NLVPMVATV         PE           SARS-CoV-2 ORF3 A*0201 NLVPMVATV         PE         CMV pp65 A*0201 NLVPMVATV         PE           SARS-CoV-2 spike A*0201 YLOPRTFLL         BV421         SARS-CoV-2 spike A*0201 YLOPRTFLL         BV421           SARS-CoV-2 spike A*0201 YLOPRTFLL         BV421         SARS-CoV-2 spike A*0201 YLOPRTFLL         BV421           SARS-CoV-2 spike A*0202 SPRRARSVA         BV421         SARS-CoV-2 spike A*0202 SPRRARSVA         BV421           SARS-CoV-2 spike A*0203 SPRRARSVA         BV421         SARS-CoV-2 spike A*0201 NLVPMVATV         BV421           STEP 4: Wash cells. Stain for viability at room temperature for 10 minutes.         Marker         Fluorophore         Supplier         Dilution
Image: Constant in the
Dasatinib         -         STEMCELL         50 µM         73082         -           STEP 2: Incubate with one relevant PE tetramer/tetramer pool at room temperature for 20 minutes. Each tetramer should be equivalent to 0.2 µl of pMHC (0.5 µg/ml, total 10µl volume).           Reagent         Fluorophore           Tetramer pool consisting of:         SARS-CoV-2 nucleocapsid A*0201 LLUDRLNQL         PE           SARS-CoV-2 ORF3A A*0201 ALSKGVHFV         PE         PE           SARS-CoV-2 ORF3A A*0201 LLYDANYFL         PE         CMV pp65 A*0201 NLVPMVATV         PE           SARS-CoV-2 nucleocapsid B*0702 SPRWYFYYL         PE         PE           CMV pp65 A*0201 NLVPMVATV         PE         STEP 3: Incubate with one relevant BV421 tetramer at room temperature for 20 minutes.           Reagent         Fluorophore         SARS-CoV-2 spike A*0201 YLQPRTFLL         BV421           SARS-CoV-2 spike A*0201 YLQPRTFLL         BV421         SARS-CoV-2 spike B*0702 SPRRARSVA         BV421           CMV pp65 A*0201 NLVPMVATV         BV421         SARS-CoV-2 spike B*0702 SPRRARSVA         BV421           SARS-CoV-2 spike A*0201 mLivitrogen         11x in         L34957         -           STEP 4: Wash cells. Stain for viability at room temperature for 10 minutes.         Fuorophore         S3212         G043H7           CXCR7         APC-Cy7         BioLegend
STEP 2: Incubate with one relevant PE tetramer/tetramer pool at room temperature for 20           minutes. Each tetramer should be equivalent to 0.2 µl of pMHC (0.5 µg/ml, total 10µl volume).           Reagent         Fluorophore           Tetramer pool consisting of:         SARS-CoV-2 nucleocapsid A*0201 LLDRLNQL           SARS-CoV-2 ORF3 A*0201 LLYDANYFL         PE           SARS-CoV-2 ORF3 A*0201 LLYDANYFL         PE           SARS-CoV-2 ORF3 A*0201 LLYDANYFL         PE           CMV pp65 A*0201 NLVPMVATV         PE           STEP 3: Incubate with one relevant BV421 tetramer at room temperature for 20 minutes.           Reagent         Fluorophore           SARS-CoV-2 spike A*0201 YLQPRTFLL         BV421           SARS-CoV-2 spike A*2020 QYIKWPWYI         BV421           SARS-CoV-2 spike A*2020 QYIKWPWYI         BV421           SARS-CoV-2 spike A*2020 SPRRARSVA         BV421           CMV pp65 A*0201 NLVPMVATV         BV421           STEP 4: Wash cells. Stain for viability at room temperature for 10 minutes.         Marker           Fluorophore         Supplier           Dilution         Product number         Clone
minutes. Each tetramer should be equivalent to 0.2 µl of pMHC (0.5 µg/ml, total 10µl volume).           Reagent         Fluorophore           Tetramer pool consisting of:         SARS-CoV-2 nucleocapsid A*0201 LLLDRLNQL         PE           SARS-CoV-2 ORF3A A*0201 ALSKGVHFV         PE         SARS-CoV-2 ORF3A A*0201 LLYDANYFL           SARS-CoV-2 ORF3A A*0201 LLYDANYFL         PE         CMV pp65 B*0702 TPRVTGGGAM         PE           CMV pp65 A*0201 NLVPMVATV         PE         STEP 3: Incubate with one relevant BV421 tetramer at room temperature for 20 minutes.           Reagent         Fluorophore         SARS-CoV-2 spike A*0201 YLQPRTFLL         BV421           SARS-CoV-2 spike A*0201 YLQPRTFLL         BV421         SARS-CoV-2 spike A*020 QYIKWPWYI         BV421           SARS-CoV-2 spike A*0201 NLVPMVATV         BV421         SARS-CoV-2 spike A*0702 SPRRARSVA         BV421           SARS-CoV-2 spike A*0702 SPRRARSVA         BV421         STEP 4: Wash cells. Stain for viability at room temperature for 10 minutes.         Marker         Fluorophore         Supplier         Dilution         Product number         Clone           LIVE/DEAD         For 405 nm         Invitrogen         1X in         L34957         -           Fixable         excitation         Argua         -         -         -           Argua         Invitrogen
Reagent         Fluorophore           Tetramer pool consisting of: SARS-CoV-2 nucleocapsid A*0201 LLLDRLNQL SARS-CoV-2 ORF3 A*0201 ALSKGVHFV         PE           SARS-CoV-2 ORF3 A*0201 ALSKGVHFV         PE           SARS-CoV-2 ORF3 A*0201 LLYDANYFL         PE           CMV pp65 B*0702 TPRVTGGGAM         PE           CMV pp65 A*0201 NLVPMVATV         PE           STEP 3: Incubate with one relevant BV421 tetramer at room temperature for 20 minutes.         Reagent           Reagent         Fluorophore           SARS-CoV-2 spike A*0201 YLQPRTFLL         BV421           SARS-CoV-2 spike A*0201 YLQPRTFLL         BV421           SARS-CoV-2 spike A*2402 QYIKWPWYI         BV421           SARS-CoV-2 spike B*0702 SPRRARSVA         BV421           CMV pp65 A*0201 NLVPMVATV         BV421           STEP 4: Wash cells. Stain for viability at room temperature for 10 minutes.         Clone           LIVE/DEAD         For 405 nm         Invitrogen         1X in         L34957         -           Fixable         excitation         PBS         -         -         -           Aqua         Invitrogen         1X in         L34957         -         -           GCR7         APC-Cy7         BioLegend         1:50         353212         G043H7           C
Tetramer pool consisting of:         PE           SARS-CoV-2 nucleocapsid A*0201 LLIDRLNQL         PE           SARS-CoV-2 ORF3 A*0201 LLYDANYFL         PE           SARS-CoV-2 ORF3 A*0201 LLYDANYFL         PE           CMV pp65 B*0702 TPRVTGGGAM         PE           CMV pp65 A*0201 NLVPMVATV         PE           STEP 3: Incubate with one relevant BV421 tetramer at room temperature for 20 minutes.         Reagent           SARS-CoV-2 spike A*0201 YLQPRTFLL         BV421           SARS-CoV-2 spike A*0201 YLQPRTFLL         BV421           SARS-CoV-2 spike A*0201 NLVPMVATV         BV421           SARS-CoV-2 spike A*0201 NLVPMVATV         BV421           SARS-CoV-2 spike B*0702 SPRRARSVA         BV421           CMV pp65 A*0201 NLVPMVATV         BV421           STEP 4: Wash cells. Stain for viability at room temperature for 10 minutes.         Marker           Marker         Fluorophore         Supplier           Dilution         Product number         Clone           LIVE/DEAD         For 405 nm         Invitrogen         1X in           Fixable         excitation         PBS         G043H7           Aqua         Dilution         Product number         Clone           CCR7         APC-Cy7         BioLegend         1:50         353212
SARS-CoV-2 ORF3a A*0201 ALSKGVHFV         PE           SARS-CoV-2 ORF3 A*0201 ALSKGVHFV         PE           SARS-CoV-2 ORF3 A*0201 LLYDANYFL         PE           CMV pp65 B*0702 TPRVTGGGAM         PE           CMV pp65 A*0201 NLVPMVATV         PE           STEP 3: Incubate with one relevant BV421 tetramer at room temperature for 20 minutes.         Fluorophore           SARS-CoV-2 spike A*0201 YLQPRTFLL         BV421           SARS-CoV-2 spike A*0202 YIKWPWYI         BV421           SARS-CoV-2 spike A*0202 VIKWPWYI         BV421           SARS-CoV-2 spike B*0702 SPRARSVA         BV421           SARS-CoV-2 spike A*0201 NLVPMVATV         BV421           SARS-CoV-2 spike B*0702 SPRARSVA         BV421           SARS-CoV-2 spike B*0702 SPRARSVA         BV421           SARS-CoV-2 spike B*0702 SPRARSVA         BV421           STEP 4: Wash cells. Stain for viability at room temperature for 10 minutes.         Marker           Marker         Fluorophore         Supplier         Dilution         Product number         Clone           CX7         APC-Cy7         BioLegend         1:500         353212         G043H7           CXCR3         PE-Cy5         BioLegend         1:100         75690         2A9-1           STEP 6: Stain with surface antibodies at room temperature for
SARS-CoV-2 ORF3 A*0201 LLYDANYFL         PE           SARS-CoV-2 ORF3 A*0201 LLYDANYFL         PE           CMV pp65 B*0702 TPRVTGGGAM         PE           CMV pp65 A*0201 NLVPMVATV         PE           STEP 3: Incubate with one relevant BV421 tetramer at room temperature for 20 minutes.         Reagent           Reagent         Fluorophore           SARS-CoV-2 spike A*0201 YLQPRTFLL         BV421           SARS-CoV-2 spike A*0201 YLQPRTFLL         BV421           SARS-CoV-2 spike A*0201 YLQPRTFLL         BV421           SARS-CoV-2 spike A*0201 SPRARSVA         BV421           SARS-CoV-2 spike A*0201 NLVPMVATV         BV421           SARS-CoV-2 spike B*0702 SPRARSVA         BV421           SARS-CoV-2 spike B*0702 SPRARSVA         BV421           SARS-CoV-2 spike B*0702 SPRPRARSVA         BV421           CMV pp65 A*0201 NLVPMVATV         BV421           STEP 4: Wash cells. Stain for viability at room temperature for 10 minutes.         Marker           Marker         Fluorophore         Supplier         Dilution         Product number         Clone           CXCR3         PE-Cy5         BioLegend         1:50         353756         G025H7           CX3CR1         BUV615         BioLegend         1:200         563795         RPA-T8
SARS-CoV-2         ORF3 A*0201 LLYDANYFL         PE           SARS-CoV-2 nucleocapsid B*0702 SPRWYFYL         PE           CMV pp65 B*0702 TPRVTGGGAM         PE           CMV pp55 A*0201 NLVPMVATV         PE           STEP 3: Incubate with one relevant BV421 tetramer at room temperature for 20 minutes.         Fluorophore           SARS-CoV-2 spike A*0201 YLQPRTFLL         BV421           SARS-CoV-2 spike A*0202 SPRARSVA         BV421           CMV pp65 A*0201 NLVPMVATV         BV421           SARS-CoV-2 spike B*0702 SPRRARSVA         BV421           CMV pp65 A*0201 NLVPMVATV         BV421           STEP 4: Wash cells. Stain for viability at room temperature for 10 minutes.         To minutes.           Marker         Fluorophore         Supplier           IVE/DEAD         For 405 nm         Invitrogen         1X in           Fixable         excitation         PBS         -           Aqua         Invitrogen         1200         353212         G043H7           CXCR3         PE-Cy5         BioLegend         1:200         353756         G025H7           CX3CR1         BUV615         BioLegend         1:200         563795         RPA-T8           CD38         BUV396         BioLegend         1:200         612946
SARS-CoV-2 nucleocapsid B'07/02 SPRWYFYYL         PE           CMV pp65 B*0702 TPRVTGGGAM         PE           CMV pp65 A*0201 NLVPMVATV         PE           STEP 3: Incubate with one relevant BV421 tetramer at room temperature for 20 minutes.         Reagent           Reagent         Fluorophore           SARS-CoV-2 spike A*0201 YLQPRTFLL         BV421           SARS-CoV-2 spike A*2402 QYIKWPWYI         BV421           SARS-CoV-2 spike B*0702 SPRRARSVA         BV421           CMV pp65 A*0201 NLVPMVATV         BV421           SARS-CoV-2 spike B*0702 SPRRARSVA         BV421           CMV pp65 A*0201 NLVPMVATV         BV421           STEP 4: Wash cells. Stain for viability at room temperature for 10 minutes.         Marker           Marker         Fluorophore         Supplier         Dilution         Product number         Clone           LIVE/DEAD         For 405 nm         Invitrogen         1X in         L34957         -           Fixable         excitation         PBS         G043H7         -           Aqua         Invitrogen         1X in         L34957         -           CCR7         APC-Cy7         BioLegend         1:50         353212         G043H7           CXCR3         PE-Cy5         BioLegend         1:100 </td
CMV pp65 B*0702 1PKV1GGGAM         PE           CMV pp65 A*0201 NLVPMVATV         PE           STEP 3: Incubate with one relevant BV421 tetramer at room temperature for 20 minutes.         Fluorophore           SARS-CoV-2 spike A*0201 YLQPRTFLL         BV421           SARS-CoV-2 spike A*2402 QYIKWPWYI         BV421           SARS-CoV-2 spike B*0702 SPRARSVA         BV421           CMV pp65 A*0201 NLVPMVATV         BV421           STEP 4: Wash cells. Stain for viability at room temperature for 10 minutes.         Marker           Marker         Fluorophore         Supplier           Dilution         Product number         Clone           LIVE/DEAD         For 405 nm         Invitrogen         1X in           STEP 5: Stain for chemokine receptors at 37°C for 10 minutes.         Marker         Fluorophore           Marker         Fluorophore         Supplier         Dilution         Product number           CCR7         APC-Cy7         BioLegend         1:50         353212         G043H7           CXCR3         PE-Cy5         BioLegend         1:200         353756         G025H7           CXCR3         PE-Cy5         BioLegend         1:200         353756         G025H7           CX3CR1         BUV615         BioLegend         1:200
CMV pp65 A '0201 NLVPMVATV         PE           STEP 3: Incubate with one relevant BV421 tetramer at room temperature for 20 minutes.         Reagent         Fluorophore           SARS-CoV-2 spike A*0201 YLQPRTFLL         BV421         BV421           SARS-CoV-2 spike A*2402 QYIKWPWYI         BV421           SARS-CoV-2 spike B*0702 SPRRARSVA         BV421           CMV pp65 A*0201 NLVPMVATV         BV421           STEP 4: Wash cells. Stain for viability at room temperature for 10 minutes.         BV421           Marker         Fluorophore         Supplier         Dilution         Product number         Clone           LIVE/DEAD         For 405 nm         Invitrogen         1X in         L34957         -           Fixable         excitation         Invitrogen         1X in         B4957         -           Aqua         Invitrogen         1X in         B4957         -         -           STEP 5: Stain for chemokine receptors at 37°C for 10 minutes.         Marker         Fluorophore         Supplier         Dilution         Product number         Clone           CXCR3         PE-Cy7         BioLegend         1:200         353212         G043H7           CXCR3         PE-Cy7         BioLegend         1:200         2A9-1         STEP 6: Stain with surface antibodi
Sincubate with one relevant BV421 tetramer at room temperature for 20 minutes.         Reagent       Fluorophore         SARS-CoV-2 spike A*0201 YLQPRTFLL       BV421         SARS-CoV-2 spike A*2402 QYIKWPWY1       BV421         SARS-CoV-2 spike A*200 QYIKWPWY1       BV421         SARS-CoV-2 spike A*0201 NLVPMVATV       BV421         STEP 5: Nain for viability at room temperature for 10 minutes.         Marker       Fluorophore       Supplier       Dilution       Product number       Clone         CXCR3       PE-Cy7       BioLegend       1:200       353212       G043H7         CXCR3       PE-Cy5       BioLegend
RedgentPitotophoreSARS-CoV-2 spike A*0201 YLQPRTFLLBV421SARS-CoV-2 spike A*2402 QYIKWPWYIBV421SARS-CoV-2 spike B*0702 SPRRARSVABV421CMV p65 A*0201 NLVPMVATVBV421STEP 4: Wash cells. Stain for viability at room temperature for 10 minutes.BV421MarkerFluorophoreSupplierDilutionProduct numberCloneLIVE/DEADFor 405 nmInvitrogen1X inL34957-FixableexcitationPBSAquaInvitrogen1X inL34957-STEP 5: Stain for chemokine receptors at 37°C for 10 minutes.MarkerCloneCCR7APC-Cy7BioLegend1:50353212G043H7CXCR3PE-Cy5BioLegend1:200353756G025H7CX3CR1BUV615BioLegend1:1007506902A9-1STEP 6: Stain with surface antibodies at room temperature for 30 minutes in BD Brilliant Stain Buffer Plus.BUV396BioLegend1:200MarkerFluorophoreSupplierDilutionProduct numberCloneCD8BUV396BioLegend1:200663795RPA-T8CD38BUV496BD1:200624285T47-530PD-1BUV737BD1:50612946HIT2LAG3BUV805BD1:50612895UCHT1CD14BV510BioLegend1:100301842M5E2CD19BV510BioLegend1:1003022
SARS-COV-2 spike A 0201 rtuber RTFLL         B 421           SARS-COV-2 spike A*2402 QYIKWPWYI         BV421           SARS-CoV-2 spike B*0702 SPRARSVA         BV421           CMV pp65 A*0201 NLVPMVATV         BV421           STEP 4: Wash cells. Stain for viability at room temperature for 10 minutes.         BV421           Marker         Fluorophore         Supplier         Dilution         Product number         Clone           LIVE/DEAD         For 405 nm         Invitrogen         1X in         L34957         -           Aqua         excitation         Invitrogen         1X in         L34957         -           Marker         Fluorophore         Supplier         Dilution         Product number         Clone           CCR7         APC-Cy7         BioLegend         1:50         353212         G043H7           CXCR3         PE-Cy5         BioLegend         1:200         353756         G025H7           CXCR3         PE-Cy5         BioLegend         1:200         353756         G025H7           CXCR3         PE-Cy5         BioLegend         1:200         563795         RPA-T8           DB         Termerature         Fluorophore         Supplier         Dilution         Product number         Clone     <
SARS-COV-2 spike A 2402 QTRWPWT1       BV421         SARS-COV-2 spike B*0702 SPRARSVA       BV421         CMV pp65 A*0201 NLVPMVATV       BV421         STEP 4: Wash cells. Stain for viability at room temperature for 10 minutes.       Marker         Marker       Fluorophore       Supplier       Dilution       Product number       Clone         LIVE/DEAD       For 405 nm       Invitrogen       1X in       L34957       -         Aqua       PBS       -       -       -       -         Marker       Fluorophore       Supplier       Dilution       Product number       Clone         CCR7       APC-Cy7       BioLegend       1:50       353212       G043H7         CXCR3       PE-Cy5       BioLegend       1:200       353756       G025H7         CXCR3       PE-Cy5       BioLegend       1:100       750690       2A9-1         STEP 6: Stain with surface antibodies at room temperature for 30 minutes in BD Brilliant Stain       Buffer Plus.       Buffer Plus.         Marker       Fluorophore       Supplier       Dilution       Product number       Clone         CD8       BUV396       BD       1:200       563795       RPA-T8         CD38       BUV396       BD
SARC-C0-2 Spike B 0702 SPRCARSYRBV421CMV pp65 A*0201 NLVPMVATVBV421STEP 4: Wash cells. Stain for viability at room temperature for 10 minutes.MarkerFluorophoreSupplierDilutionProduct numberCloneLIVE/DEADFor 405 nmInvitrogen1X inL34957-AquaexcitationPBSSTEP 5: Stain for chemokine receptors at 37°C for 10 minutes.Product numberCloneCCR7APC-Cy7BioLegend1:50353212G043H7CXCR3PE-Cy5BioLegend1:200353756G025H7CX3CR1BUV615BioLegend1:1007506902A9-1STEP 6: Stain with surface antibodies at room temperature for 30 minutes in BD Brilliant Stain Buffer Plus.BUV396BioLegend1:200MarkerFluorophoreSupplierDilutionProduct numberCloneCD8BUV396BioLegend1:200612946HIT2LAG3BUV496BD1:200612485T47-530PD-1BUV737BD1:50612791EH12.1CD3BUV805BD1:50612895UCHT1CD14BV510BioLegend1:100301842M5E2CD19BV510BioLegend1:100302242HIB19
STEP 4: Wash cells. Stain for viability at room temperature for 10 minutes.MarkerFluorophoreSupplierDilutionProduct numberCloneLIVE/DEADFor 405 nmInvitrogen1X inL34957-AquaSTEP 5: Stain for chemokine receptors at 37°C for 10 minutes.STEP 5: Stain for chemokine receptors at 37°C for 10 minutes.CloneMarkerFluorophoreSupplierDilutionProduct numberCloneCCR7APC-Cy7BioLegend1:50353212G043H7CXCR3PE-Cy5BioLegend1:200353756G025H7CX3CR1BUV615BioLegend1:1007506902A9-1STEP 6: Stain with surface antibodies at room temperature for 30 minutes in BD Brilliant StainBuffer Plus.MarkerFluorophoreSupplierDilutionProduct numberCloneCD8BUV396BioLegend1:200563795RPA-T8CD38BUV496BD1:200612946HIT2LAG3BUV661BD1:200612945T47-530PD-1BUV737BD1:50612895UCHT1CD3BUV805BD1:50612895UCHT1CD14BV510BioLegend1:100302242HIB19
MarkerFluorophoreSupplierDilutionProduct numberCloneLIVE/DEADFor 405 nm excitationInvitrogen1X in PBSL34957-AquaSTEP 5: Stain for chemokine receptors at 37°C for 10 minutesMarkerFluorophoreSupplierDilutionProduct numberCloneCCR7APC-Cy7BioLegend1:50353212G043H7CXCR3PE-Cy5BioLegend1:200353756G025H7CX3CR1BUV615BioLegend1:1007506902A9-1STEP 6: Stain with surface antibodies at room temperature for 30 minutes in BD Brilliant Stain Buffer Plus.BioLegend1:200563795RPA-T8MarkerFluorophoreSupplierDilutionProduct numberCloneCD8BUV396BioLegend1:200663795RPA-T8CD38BUV496BD1:200612946HIT2LAG3BUV661BD1:200624285T47-530PD-1BUV737BD1:50612895UCHT1CD3BUV805BD1:50612895UCHT1CD14BV510BioLegend1:100301842M5E2CD19BV510BioLegend1:100302242HIB19
Initial constraintFor 405 nm excitationInvitrogen1X in PBSL34957-Aquastep 5: Stain for chemokine receptors at 37°C for 10 minutesMarkerFluorophoreSupplierDilutionProduct numberCloneCCR7APC-Cy7BioLegend1:50353212G043H7CXCR3PE-Cy5BioLegend1:1007506902A9-1STEP 6: Stain with surface antibodies at room temperature for 30 minutes in BD Brilliant StainBUV615BioLegend1:200STEP 6: Stain with surface antibodies at room temperature for 30 minutes in BD Brilliant StainBUV396BioLegend1:200563795RPA-T8CD8BUV396BioLegend1:200612946HIT2LAG3BUV661BD1:200612946HIT2LAG3BUV661BD1:200612945T47-530PD-1BUV737BD1:50612791EH12.1CD3BUV805BD1:50612895UCHT1CD14BV510BioLegend1:100301842M5E2CD19BV510BioLegend1:100302242HIB191:100302242HIB19
Fixable AquaFor 400 mmInvitiogenIX mE04007STEP 5: Stain for chemokine receptors at 37°C for 10 minutes.MarkerFluorophoreSupplierDilutionProduct numberCloneCCR7APC-Cy7BioLegend1:50353212G043H7CXCR3PE-Cy5BioLegend1:200353756G025H7CX3CR1BUV615BioLegend1:1007506902A9-1STEP 6: Stain with surface antibodies at room temperature for 30 minutes in BD Brilliant Stain Buffer Plus.BioLegend1:200563795RPA-T8MarkerFluorophoreSupplierDilutionProduct numberCloneCD8BUV396BioLegend1:200612946HIT2LAG3BUV661BD1:200624285T47-530PD-1BUV737BD1:50612895UCHT1CD3BUV805BD1:50612895UCHT1CD14BV510BioLegend1:100302242HIB19
AquaI BOAquaI BOSTEP 5: Stain for chemokine receptors at 37°C for 10 minutes.MarkerFluorophoreSupplierDilutionProduct numberCloneCCR7APC-Cy7BioLegend1:50353212G043H7CXCR3PE-Cy5BioLegend1:200353756G025H7CX3CR1BUV615BioLegend1:1007506902A9-1STEP 6: Stain with surface antibodies at room temperature for 30 minutes in BD Brilliant Stain Buffer Plus.MarkerFluorophoreSupplierDilutionProduct numberCloneCD8BUV396BioLegend1:200563795RPA-T8CD38BUV496BD1:200612946HIT2LAG3BUV661BD1:200624285T47-530PD-1BUV737BD1:50612791EH12.1CD3BUV805BD1:50612895UCHT1CD14BV510BioLegend1:100301842M5E2CD19BV510BioLegend1:100302242HIB19
STEP 5: Stain for chemokine receptors at 37°C for 10 minutes.MarkerFluorophoreSupplierDilutionProduct numberCloneCCR7APC-Cy7BioLegend1:50353212G043H7CXCR3PE-Cy5BioLegend1:200353756G025H7CX3CR1BUV615BioLegend1:1007506902A9-1STEP 6: Stain with surface antibodies at room temperature for 30 minutes in BD Brilliant Stain Buffer Plus.BioLegend1:200563795RPA-T8MarkerFluorophoreSupplierDilutionProduct numberCloneCD8BUV396BioLegend1:200563795RPA-T8CD38BUV496BD1:200612946HIT2LAG3BUV661BD1:200612791EH12.1CD3BUV805BD1:50612895UCHT1CD14BV510BioLegend1:100301842M5E2CD19BV510BioLegend1:100302242HIB19
MarkerFluorophoreSupplierDilutionProduct numberCloneCCR7APC-Cy7BioLegend1:50353212G043H7CXCR3PE-Cy5BioLegend1:200353756G025H7CX3CR1BUV615BioLegend1:1007506902A9-1STEP 6: Stain with surface antibodies at room temperature for 30 minutes in BD Brilliant Stain Buffer Plus.SupplierDilutionProduct numberCloneCD8BUV396BioLegend1:200563795RPA-T8CD38BUV496BD1:200612946HIT2LAG3BUV661BD1:200624285T47-530PD-1BUV737BD1:50612791EH12.1CD3BUV805BD1:50612895UCHT1CD14BV510BioLegend1:100301842M5E2CD19BV510BioLegend1:100302242HIB19
CCR7         APC-Cy7         BioLegend         1:50         353212         G043H7           CXCR3         PE-Cy5         BioLegend         1:200         353756         G025H7           CX3CR1         BUV615         BioLegend         1:100         750690         2A9-1           STEP 6: Stain with surface antibodies at room temperature for 30 minutes in BD Brilliant Stain Buffer Plus.         Marker         Fluorophore         Supplier         Dilution         Product number         Clone           CD8         BUV396         BioLegend         1:200         563795         RPA-T8           CD38         BUV496         BD         1:200         612946         HIT2           LAG3         BUV661         BD         1:200         612945         T47-530           PD-1         BUV737         BD         1:50         612791         EH12.1           CD3         BUV805         BD         1:50         612895         UCHT1           CD14         BV510         BioLegend         1:100         301842         M5E2           CD19         BV510         BioLegend         1:100         302242         HIB19
CXCR3         PE-Cy5         BioLegend         1:200         353756         G025H7           CX3CR1         BUV615         BioLegend         1:100         750690         2A9-1           STEP 6: Stain with surface antibodies at room temperature for 30 minutes in BD Brilliant Stain Buffer Plus.         Step 1:200         563795         RPA-T8           Marker         Fluorophore         Supplier         Dilution         Product number         Clone           CD8         BUV396         BioLegend         1:200         563795         RPA-T8           CD38         BUV496         BD         1:200         612946         HIT2           LAG3         BUV661         BD         1:200         624285         T47-530           PD-1         BUV737         BD         1:50         612911         EH12.1           CD3         BUV805         BD         1:50         612895         UCHT1           CD14         BV510         BioLegend         1:100         301842         M5E2           CD19         BV510         BioLegend         1:100         302242         HIB19
CX3CR1BUV615BioLegend1:1007506902A9-1STEP 6: Stain with surface antibodies at room temperature for 30 minutes in BD Brilliant Stain Buffer Plus.BUV100Product numberCloneMarkerFluorophoreSupplierDilutionProduct numberCloneCD8BUV396BioLegend1:200563795RPA-T8CD38BUV496BD1:200612946HIT2LAG3BUV661BD1:200624285T47-530PD-1BUV737BD1:50612791EH12.1CD3BUV805BD1:50612895UCHT1CD14BV510BioLegend1:100301842M5E2CD19BV510BioLegend1:100302242HIB19
STEP 6: Stain with surface antibodies at room temperature for 30 minutes in BD Brilliant Stain Buffer Plus.MarkerFluorophoreSupplierDilutionProduct numberCloneCD8BUV396BioLegend1:200563795RPA-T8CD38BUV496BD1:200612946HIT2LAG3BUV661BD1:200624285T47-530PD-1BUV737BD1:50612791EH12.1CD3BUV805BD1:50612895UCHT1CD14BV510BioLegend1:100301842M5E2CD19BV510BioLegend1:100302242HIB19
Buffer Plus.         Fluorophore         Supplier         Dilution         Product number         Clone           CD8         BUV396         BioLegend         1:200         563795         RPA-T8           CD38         BUV496         BD         1:200         612946         HIT2           LAG3         BUV661         BD         1:200         624285         T47-530           PD-1         BUV737         BD         1:50         612791         EH12.1           CD3         BUV805         BD         1:50         612895         UCHT1           CD14         BV510         BioLegend         1:100         301842         M5E2           CD19         BV510         BioLegend         1:100         302242         HIB19
MarkerFluorophoreSupplierDilutionProduct numberCloneCD8BUV396BioLegend1:200563795RPA-T8CD38BUV496BD1:200612946HIT2LAG3BUV661BD1:200624285T47-530PD-1BUV737BD1:50612791EH12.1CD3BUV805BD1:50612895UCHT1CD14BV510BioLegend1:100301842M5E2CD19BV510BioLegend1:100302242HIB19
CD8BUV396BioLegend1:200563795RPA-T8CD38BUV496BD1:200612946HIT2LAG3BUV661BD1:200624285T47-530PD-1BUV737BD1:50612791EH12.1CD3BUV805BD1:50612895UCHT1CD14BV510BioLegend1:100301842M5E2CD19BV510BioLegend1:100302242HIB19
CD38BUV496BD1:200612946HIT2LAG3BUV661BD1:200624285T47-530PD-1BUV737BD1:50612791EH12.1CD3BUV805BD1:50612895UCHT1CD14BV510BioLegend1:100301842M5E2CD19BV510BioLegend1:100302242HIB19
LAG3BUV661BD1:200624285T47-530PD-1BUV737BD1:50612791EH12.1CD3BUV805BD1:50612895UCHT1CD14BV510BioLegend1:100301842M5E2CD19BV510BioLegend1:100302242HIB19
PD-1         BUV737         BD         1:50         612791         EH12.1           CD3         BUV805         BD         1:50         612895         UCHT1           CD14         BV510         BioLegend         1:100         301842         M5E2           CD19         BV510         BioLegend         1:100         302242         HIB19
CD3         BUV805         BD         1:50         612895         UCHT1           CD14         BV510         BioLegend         1:100         301842         M5E2           CD19         BV510         BioLegend         1:100         302242         HIB19
CD14         BV510         BioLegend         1:100         301842         M5E2           CD19         BV510         BioLegend         1:100         302242         HIB19
CD19 BV510 BioLegend 1:100 302242 HIB19
CD45RA BV570 BioLegend 1:200 304132 HI100
TIM3         BV605         BioLegend         1:100         502936         344823
HLA-DR BV650 BD 1:100 564231 G46-6
IIGII         PE-Dazzle594         BioLegend         1:100         3/2/15         A15153G           OD407         DD000         DD         4:400         Output         UIII 7D M04
CD127         BB030         BD         1:100         Custom         HIL-/R-M21           OD07         DV/200         Distance         4:50         000000         00000
CD21         BV/8b         BioLegend         1:50         302832         O323           CD4         DE Over 5         Invitragen         4:400         25:0040.00         DMA: 4:5
CD4         PE-Cy5.5         Invitrogen         1:400         35-0042-82         RMA-4.5           CD05         BB700         Biolograph         4:50         205004         DV0
CD90         DD/UU         DioLegend         1:50         305034         DX2           CD20         DV/711         DioLegend         1:400         220200         A4

# Table S9. Surface and oligo-conjugated antibody staining protocol for single-cellsorting and CITE-seq.

STEP 1: Stain for viability at room temperature for 10 minutes.							
Marker	Fluorophore	Supplier	Dilution	Product	Clone		
	-			number			
LIVE/DEAD	For 405 nm excitation	Invitrogen	1X in	L34957	-		
Fixable		-	PBS				
Aqua							
STEP 2: Stai	n for chemokine receptor	rs at 37°C for <sup>·</sup>	10 minutes.	1			
Marker	Conjugate	Supplier	Dilution	Product	Clone		
				number			
CCR7	TotalSeq-C0148	BioLegend	1:300	353251	G043H7		
CXCR5	TotalSeq-C0144	BioLegend	1:500	356939	J252D4		
CXCR3	TotalSeq-C0140	BioLegend	1:500	353747	G025H7		
CX3CR1	TotalSeq-C0179	BioLegend	1:500	355705	K0124E1		
CCR4	TotalSeq-C0071	BioLegend	1:500	359425	L291H4		
CCR5	TotalSeq-C0141	BioLegend	1:500	359137	J418F1		
CCR6	TotalSeq-C0143	BioLegend	1:500	353440	G034E3		
CXCR6	TotalSeq-C0804	BioLegend	1:500	356023	K041E5		
STEP 3: Stai	n with remaining antibod	ies at room tei	nperature f	or 30 minutes	s in BD Brilliant		
Stain Buffer F	Plus. Use one hashing ar	ntibody per sai	nple.				
Marker	Fluorophore	Supplier	Dilution	Product	Clone		
	-			number			
CD40L	BV421	BioLegend	1:25	310824	24-31		
4-1BB	PE-Cy7	BioLegend	1:25	309818	4B4-1		
CD4	FITC	BD	1:25	345768	SK3		
CD14	BV510	BioLegend	1:100	301842	M5E2		
CD19	BV510	BioLegend	1:100	302242	HIB19		
CD69	BV650	BioLegend	1:50	310934	FN50		
CD8	BV711	BV711 BioLegend		301044	RPA-T8		
Marker	er Conjugate Supplier Diluti		Dilution	Product	Clone		
				number			
CD4	TotalSeq-C0072	BioLegend	1:1250	300567	RPA-T4		
CD8	TotalSeq-C0046	BioLegend	1:10000	344753	SK1		
CD45RA	TotalSeq-C0063	BioLegend	1:4000	304163	HI100		
CD127	TotalSeq-C0390	BioLegend	1:333	351356	A019D5		
CD27	TotalSeq-C0154	BioLegend	1:500	302853	O323		
PD-1	TotalSeq-C0088	BioLegend	1:500	329963	EH12.2H7		
ICOS	TotalSeq-C0171	BioLegend	1:500	313553	C398.4A		
HLA-DR	TotalSeq-C0159	BioLegend	1:500	307663	L243		
CD122	TotalSeq-C0246	BioLegend	1:500	339021	TU27		
CD28	TotalSeq-C0386	BioLegend	1:500	302963	CD28.2		
CD95	TotalSeq-C0156	BioLegend	1:500	305651	DX2		
CD38	TotalSeq-C0389	BioLegend	1:500	303543	HIT2		
CD71	TotalSeq-C0394	BioLegend	1:500	334125	CY1G4		
Hashtag	Conjugate	Supplier	Dilution	Dilution Product Clone			
				number			
Hashtag 1	TotalSeq-C0251	BioLegend	1:100	394661	LNH-94; 2M2		
Hashtag 2	TotalSeq-C0252	BioLegend	1:100	394663	LNH-94; 2M2		
Hashtag 3	TotalSeq-C0253	BioLegend	1:100	394665	LNH-94; 2M2		
Hashtag 4	TotalSeq-C0254	BioLegend	1:100	394667	LNH-94; 2M2		