Title: Differentiation marker-negative $CD4^+$ T cells persist after yellow fever virus vaccination and contribute to durable memory

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Abstract
Factors that contribute to durable immunological memory remain incompletely understood. In our longitudinal analyses of $CD4^+$ T cell responses to the yellow fever virus (YFV) vaccine by peptide-MHC tetramers, we unexpectedly found naïve phenotype virus-specific $CD4^+$ T cells that persisted months to years after immunization. These Marker negative T cells (T_{MN}) lacked CD95, CXCR3, CD11a, and CD49d surface protein expression, distinguishing them from previously discovered stem-cell memory T cells. Functionally, they resembled genuine naïve T cells upon *in vitro* stimulation. Single-cell TCR sequencing detected expanded clonotypes within the T_{MN} subset and identified a shared repertoire with memory and effector T cells. T cells expressing T_{MN}-associated TCRs were rare before vaccination, suggesting their expansion following vaccination. Longitudinal tracking of YFV-specific responses over the subsequent years revealed superior stability of the T_{MN} subset and their association with the longevity of the overall population. The identification of these long-lived, antigen-experienced T cells may inform the design of durable T cell-based vaccines and engineered T cell therapies.

Introduction
Functional immunological memory underlies the protective efficacy of vaccines against subsequent infections (*1, 2*). However, why protection from some vaccines last decades while others wane after a few months remains unknown. A crucial aspect of immune memory involves T cells (*3*). $CD8^+$ T cells produce anti-viral cytokines and eliminate infected cells, while $CD4^+$ T cells provide key signals for B cell maturation and high-affinity antibody production (*4*). $CD4^+$ T cells are also needed to support the expansion and maintenance of functional $CD8^+$ T cells and can directly contribute to anti-viral effects (*4-6*). Past studies in mice and humans have identified naïve-like antigen-experienced T cells with superior longevity and plasticity as a source of durable memory (*7-9*). Broadly categorized as stem cell-like memory T cells (T_{SCM}), these cells phenotypically resemble naïve T cells by positive CCR7 and CD45RA or negative CD45RO expression, yet they display differentiation markers such as CD95, CXCR3, and CD49d (*9, 10*). In people immunized with the highly efficacious and durable Yellow Fever Virus (YFV) vaccine, class I tetramer analyses identified T_{SCM} as the predominant phenotype of virus-specific $CD8^+$ T cells greater than 8 years after vaccination (*10, 11*).

The durability of $CD4^+$ T cell memory is less understood. Although capable of differentiating into T_{SCM} cells (*12-15*), $CD4^+$ T cells are generally less responsive to homeostatic cytokines IL-7 and IL-15 (*16-18*), which augment T_{SCM} differentiation in cultured $CD8^+$ T cells (*19*). Here, we examined virus-specific $CD4^+$ T cells after YFV vaccination to delineate key features of durable $CD4^+$ T cell responses. YFV-specific $CD4^+$ T cells were identified and tracked longitudinally by direct *ex vivo* class II peptide-MHC (pMHC) tetramers staining. YFV-specific $CD4^+$ T cells existed in various memory states, including a T_{SCM} subset. Unexpectedly, some tetramer-labeled T cells remained negative for all measured differentiation markers several months after vaccination. Focused analyses of these marker-negative T cells (T_{MN}) showed that they responded to cognate peptide stimulation *in vitro* and had likely undergone proliferation *in vivo* by clonal expansion. Further, their T cell receptor (TCR) sequences overlapped with that of classically defined memory T cells of the same specificity, implicating a shared clonal origin. T_{MN} cells functionally resembled genuine naïve T cells, exhibited superior stability over other memory subsets, and were associated with the long-term persistence of the overall population years after vaccination. Our findings expand the current definition of antigen-experienced T cells to include those that retain an undifferentiated phenotype. These cells opened new avenues for understanding the durability of immune responses and developing strategies to enhance long-lasting immunologic memory.

Results

Detection of naïve-like $CD4^+$ T cells after YFV vaccination

We had previously performed a longitudinal study of YFV-specific $CD4^+$ T cells to evaluate the impact of pre-existing repertoire on T cell responses to primary immunization with the YFV vaccine (*20*). Starting with this dataset, we examined the features of memory T cells that developed at least 7 months after vaccination. This showed that approximately half of the YFV-specific memory pool consisted of central memory T cells (T_{CM}), with about 21% of tetramer$^+$ cells retaining a naïve-like $CD45RO^-CCR7^+$ phenotype (Fig. 1A-B). Proportionally, the abundance of $CD45RO^-CCR7^+$ subset was highest before vaccination, decreased initially post-vaccination, then reaccumulated several months later (Fig. 1C). By frequency, $CD45RO^-CCR7^+$ tetramer$^+$ cells increased steadily after vaccination (Fig. 1D). The frequency of $CD45RO^-CCR7^+$ T cell subset did not differ by donor age but was instead associated with the robustness of the response (Fig. S1A-C). $CD45RO^-CCR7^+$ YFV-specific T cells were more abundant in populations that reached a higher frequency and positively correlated with the fold-change between the peak and the pre-vaccine baseline (Fig S1B-C). At a later memory time point, the frequencies of $CD45RO^-CCR7^+$ YFV-specific T cells were higher within larger populations that were recruited into the memory pool (Fig. 1E-F). These data suggest that $CD45RO^-CCR7^+CD4^+$ T cells is a feature of an effective T cell response.

Post-immune T cells are heterogeneous and include a differentiation marker negative subset

We hypothesized that the post-vaccine $CD45RO^-CCR7^+$ subset largely consisted of T_{SCM} cells as in $CD8^+$ T cells (*10, 11*). To test this, we performed tetramer staining on 28 YFV-specific $CD4^+$ populations from 7 individuals, recognizing 16 unique epitopes with antibodies against T_{SCM}-associated markers, CXCR3, CD95, CD11a, and CD49d (Tables S1 and S2). Staining with this broader antibody panel on blood collected 7 to 48 months after vaccination indeed identified $CD45RO^-CCR7^+$ tetramer$^+$ T cells that expressed one or more T_{SCM} markers. However, we noted that a portion of $CD45RO^-CCR7^+$ $CD4^+$ T cells remained negative for CXCR3, CD95, CD11a, and CD49d expression (Fig. 2A, S2A-B). To gain further insights into the heterogeneity within the CD45RO-$CCR7^+$ subset, we combined 1465 YFV-specific $CD4^+$ T cells from one donor and visualized combinatorial antibody staining on UMAP using the Spectre pipeline (*21*). This identified regions with low CD45RO and high CCR7 signals, which encompassed a $CXCR3^+$ (cluster 0) and a T_{SCM} marker negative population (cluster 4) (Fig. 2B-D). We defined $CD45RO^-CCR7^+$ cells lacking any measured differentiation markers as marker-negative T cells (T_{MN}) and classified those expressing at least one of CXCR3, CD95, CD11a, or CD49d as T_{SCM} cells (Table S3). On average, a quarter of the $CD45RO^-CCR7^+$ subset consisted of T_{MN} cells (Fig. 2E). Among T_{SCM} cells, the majority expressed CXCR3 alone or in combination with other differentiation markers (Fig. 2E-F, S2C). Finding antigen-specific T cells that do not express known memory or T_{SCM} markers after a clear prior exposure was unexpected. To test if T_{MN} cells functionally behave like antigen-experienced T cells despite lacking surface markers of differentiation, we treated post-vaccine PBMCs with PMA and ionomycin for 4 to 5 hours. Antigen-specific T cells were captured by tetramers, divided into distinct phenotypic subsets, and analyzed for TNF-α and IFN-γ production. This showed that post-immune T_{MN} subset produced significantly less cytokines compared to memory T cells within the same tetramer$^+$ population (Fig. 2G-H). Thus, YFV vaccination induced a diverse post-immune repertoire that included $CD4^+$ T_{SCM} cells and a naïve-like T_{MN} population that lacked phenotypic and functional features of antigen experience.

Virus-specific T_{MN} cells respond to antigens

We were intrigued by the existence of virus-specific T cells that retained a naïve functional phenotype after vaccination. Past studies have identified non-stimulatory TCR interactions that decoupled T cell activation from ligand binding (*22*). The impaired ability to respond productively to antigens may be one reason why some tetramer-labeled T cells retained a naïve phenotype. To investigate this possibility, we quantified T_{MN}, T_{SCM}, and T_{CM} cells for differences in their functional avidity by peptide stimulation. YFV-specific T cell clones were generated using samples from two donors obtained 7 to 8 months after YFV vaccination. Among the 48 clones that grew, 40 clones (90%) had the correct specificity by tetramer re-staining and/or response to peptides (Fig. 3A-B, S3A). We did not identify peptide-nonresponsive T cells as all clones that were stained with tetramers responded to peptide stimulation. To determine if T_{MN} cells might be harder to activate due to a lower functional avidity, we divided the clones according to their direct *ex vivo* phenotype and selected 5 clones each from T_{CM}, T_{SCM}, T_{MN} groups for further analyses. YFV-specific clones were stimulated with decreasing concentrations of the cognate peptide and analyzed for response by cytokine production (Fig. S3B). T_{MN}-derived clones responded similarly to peptides by TNF-α production, with no significant differences in maximal effective peptide concentration (EC50) values between groups (Fig. 3C-D). T cell clones, regardless of their *ex vivo* phenotypes, also produced similar levels of IFN-γ, IL-2, and had comparable TNF-α^{+}IFN-γ^{+}IL-2^{+} co-expression (Fig. 3E). In addition, we evaluated the proliferative capacity of T_{MN}, T_{SCM}, and T_{CM}-derived clones by CellTrace Violet (CTV) dilution and observed no significant differences in the proliferative response to peptide stimulation (Fig. 3F-G, Fig. S3C). Thus, TCR-ligand engagement is likely intact for vaccine-specific T cells that retained a naïve phenotype after vaccination.

T_{MN} cells are clonally related to memory and effector T cells

While T_{MN} cells respond well to antigens *in vitro*, it remains possible for them to be less competitive in resource-limiting environments. To investigate this, we reason that we can use TCR sequences to infer stimulation and proliferative response *in vivo*. Because T cell progenies originating from a T cell express identical TCR sequences, we can further leverage these sequences as molecular barcodes to investigate the clonal relationship between distinct phenotypic subsets. However, capturing sufficient numbers of T_{MN} cells was challenging due to their limited number within the available blood samples. To overcome this problem, we generated new tetramers using affinity-matured DR monomers containing mutations that enhanced CD4 binding to improve the overall capture efficiency (*23*). When compared to the wild-type (wt) DR, these tetramers stained a larger population of T cells without significantly skewing the phenotypic proportions (Fig. S4A-C). In total, we sorted single cells from 5 tetramer-labeled populations and obtained TCR sequences from 607 YFV-specific CD4^{+} T cells after amplification and sequencing (Fig. 4A, Table S4). Consistent with clonal expansion after vaccination, over 70% of the sequences were identified in more than one tetramer-labeled T cell. Among expanded sequences, 25 to 52% were abundant and found in at least 10 individual T cells (Fig. 4B). Most T cells displayed a T_{CM} or T_{EM} phenotype based on antibody staining at the time of sorting. T_{MN} phenotype was infrequent, expressed by 3 to 4% of sequenced T cells and confined to the two most extensively sequenced populations recognizing YF45. Consistent with *in vivo* expansion, T_{MN} cells did not preferentially express unique TCRs, but rather, they were distributed across various clone sizes (Fig. 4C). We focused the subsequent analyses on YF45-specific T cells that included the T_{MN} subset. Early post-vaccine measurements of YF45-specific T cells from HD2 and HD3 showed that both populations had generated robust responses to the YFV vaccine (Fig. 4D) (*20*). In agreement with an antigen-driven response, T_{MN} cells contained expanded clonotypes and shared overlapping sequences with various memory subsets (Fig. 4E-F, S4E). In separately generated T cell clones from the same individuals, T_{MN}-derived clones expressed TCRs that matched the sequences from *ex vivo* sorted T cells of diverse clone sizes and phenotypes (Fig. S4F).

The presence of shared TCR sequences with memory T cells, together with clonal expansion, suggest that T_{MN} cells had encountered and responded to antigens. Alternatively, there could be numerous naïve T cells in the precursor repertoire, some of which could retain a naïve phenotype if only a subset was recruited into the vaccine response. To investigate this possibility, we examined the pre-vaccination repertoire of YF45-specific T cells in these individuals to determine if T_{MN}-associated TCRs were abundant before vaccination (*20*). The changes in clonal dynamics were assessed by tetramer staining, sorting, and sequencing the TCRs of YF45-specific T cells from blood collected 14 days after vaccination. In total, we examined TCR sequences from 129 precursor T cells and 238 effector T cells (Fig. 5A, Table S5). Before vaccination, no pre-vaccine TCRs matched T_{MN}-derived TCRs from HD2 and only one sequence was identified in HD3. This shared TCR mapped to a unique sequence and not to the expanded pre-existing clonotypes in this individual. By contrast, 7% (HD2, 5 cells) and 23% (HD3, 38 cells) of TCRs in day 14 blood samples expressed a T_{MN}-associated TCR (Fig. 5B). Matched T cells in the day 14 sample expressed a variety of differentiation phenotypes and included expanded clonotypes (Fig. 5C). Together, these data indicate that T_{MN} precursors were rare in the pre-immune repertoire and underwent expansion in response to antigen stimulation after vaccination.

T_{MN} cells contribute to durable memory

While memory T cells are essential for generating rapid recall responses, naïve T cells are known for their persistence (*24, 25*). We hypothesize that this unique naïve-appearing antigen-experienced subset would retain this key property and contribute to durable immune responses. To test this idea, we analyzed additional time points from five donors who had longitudinal PBMCs collections up to 6.7 years after YFV vaccination (Fig. 6A, Fig. S5A). Past modeling of cellular turnover suggests that different phenotypic subpopulations undergo separate and distinct *in vivo* dynamics (*26, 27*). To evaluate the stability of individual phenotypic subsets, we subdivided 19 YFV-specific populations according to T_{MN}, T_{SCM}, T_{CM}, T_{EM}, and T_{EMRA} phenotypes based on CD45RO, CCR7, CD95, CXCR3, CD11a, and CD49d expression. Their time-dependent change was quantified as a fitted slope using a mixed-effects exponential decay model. This revealed different rates of decay between cells in distinct differentiation states. $CD4^+$ T_{EM} cells had the largest negative slope, indicating the greatest decrease over time. In contrast, T_{MN} cells exhibited remarkable stability, with no discernible decline observed during the follow-up period. The stability of the T_{MN} subset significantly surpassed that of other phenotypic subsets, including T_{SCM} and T_{CM} cells, which are typically considered to be long-lived (Fig.6B).

Next, we examined the decay kinetics of the overall YFV-specific $CD4^+$ T cell responses. Because some data were generated before switching to modified DR, paired analyses by wildtype and modified tetramers on the same blood sample were used to generate an equation for normalizing the frequencies across experiments (Fig. S4D). Among the five donors followed longitudinally, two received one YFV dose as typical for the YFV vaccine, while three had been revaccinated 7 months to a year after the initial dose (Table S6). We grouped the donors based on vaccine dosing to model the frequency of each $tetramer^+$ population over time. This revealed a highly durable $CD4^+$ T cell memory response after a single dose that becomes further stabilized after re-vaccination (Fig. S5B). Consistent with the longevity of YFV vaccine-mediated protection, YFV-specific $CD4^+$ T cells displayed an average half-life ($t_{1/2}$) of close to 4 years after one YFV immunization (Fig. 6C). We observed more T_{MN} cells in the two-dose group, although the difference was not statistically significant (Fig. S5C). Considering the heterogeneity at the population level, we analyzed the $tetramer^+$ populations by T_{MN} frequency and divided them into top and bottom halves (Fig. 6D). This showed that populations with more T_{MN} cells were more stable compared to populations in the bottom T_{MN} group (Fig. 6E). The T_{MN} frequency within a given virus-specific population also demonstrated a positive correlation with the stability of the overall population (Fig. 6F). By contrast, we did not find significant differences between high and low groups based on T_{SCM}, T_{CM}, T_{EM}, and T_{EMRA} frequencies (Fig. S5D). On the phenotypic level, all $tetramer^+$ populations contained various memory subsets, but the top T_{MN} group was more phenotypically diverse. We divided populations based on the first T_{MN} frequency obtained within the 1-2 years after YFV vaccination and showed that those having more T_{MN} cells exhibited a higher diversity of differentiation states over time as measured by the Shannon diversity index (Fig. 6G-H). Collectively, these data highlight the stability of the T_{MN} subset and uncover their association with durable and diverse T cell memory after YFV vaccination.

Discussion

We examined $CD4^+$ T cell memory to YFV vaccination to define key features of durable memory by direct *ex vivo* class II tetramer staining and enrichment. This showed a diverse memory pool comprised of various differentiation states after YFV vaccination. A portion of YFV-specific $CD4^+$ T cells acquired T_{SCM} phenotype after vaccination as in $CD8^+$ T cells. Unexpectedly, we also uncovered antigen-experienced T cells that lacked typical markers of T_{SCM} and other memory cells, including CD95, CD11a, CD49d, and CXCR3. Similar to genuine naïve T cells, T_{MN} cells expressed the lymphoid homing chemokine receptor, CCR7 (*28*), and functionally resembled naïve T cells after polyclonal stimulation by PMN and ionomycin. Despite their naïve appearance, T_{MN} cells are antigen-experienced. T_{MN} cells engaged with and responded to antigens *in vitro*. T_{MN} responses to the YFV vaccine *in vivo* were supported by single-cell TCR sequencing, which revealed clonal expansion and a shared repertoire with memory T cells. Longitudinal clonal tracking further identified an expansion of T_{MN}-associated TCRs during effector response. Thus, our analyses of $CD4^+$ T cell responses to the highly durable and efficacious YFV vaccine revealed that some human $CD4^+$ T cells can appear indistinguishable from genuine naïve T cells despite prior antigen experience and expansion.

A T cell is typically referred to as naïve if it has not yet encountered its specific cognate antigen(s). Because a clear antigenic history is often not available, especially in human studies, specific surface markers are commonly used to infer antigen experience (*29, 30*). However, with the advances in single-cell technologies, there is increasing appreciation for the complexity within the naïve compartment. A recent multi-omic analysis discovered age-related epigenetic and transcriptional changes in naïve $CD4^+$ and $CD8^+$ T cells (*31*). Naïve T cells were defined by CD45RA, CCR7, and CD27 expression using multiple sequencing modalities. Even when naive T cells were further characterized by the lack of CD49d, CD95, and IFN-γ expression, these cells showed distinct chromatin accessibility and transcription factor expression between children and older adults (*31*). The TCR repertoire also undergoes age-related changes and displays a decrease in repertoire diversity in the elderly (*32*). Generally, these changes are thought to have occurred by homeostatic mechanisms that maintain the peripheral naïve repertoire (*33, 34*). While we did not investigate how cytokines impact T_{MN} differentiation, cells uniquely driven by a cytokine-mediated bystander response would not be expected to have a similar TCR repertoire as memory and effector T cells. Partial recruitment of precursor T cells remains formally possible, although T_{MN} precursors were not numerous and past studies in mice suggest a highly efficient recruitment process (*35, 36*). For $CD8^+$ T cells expressing OT-1 transgenic TCR, even the weakest altered peptide ligands, about 700-fold less potent than the wt sequence, induced effector response and generated memory T cells (*36*). Regardless of the mechanism of T_{MN} differentiation, our data indicate that some cells considered naïve by phenotypic criteria have actually encountered and responded to foreign antigens. Over a lifetime, these cells may accumulate and add to non-antigen experienced T cells as a part of the naïve repertoire, thereby changing naïve T cell composition over time.

Only a few select vaccines are capable of mediating life-long protection. How durable immunological memory is maintained remains a key unresolved question. While Memory T cells are the cornerstone of protective immunity by virtue of their ability to rapidly initiate a functional response to pathogen rechallenge, naïve T cells possess superior self-renewal capacity and differentiation plasticity (*3, 24, 37*). Considering the phenotypic and functional similarities between T_{MN} and naïve T cells, we asked if T_{MN} cells contribute to the longevity of T cell response after YFV vaccination. Our findings revealed remarkable stability of T_{MN} cells, exhibiting minimal decay for nearly 7 years. Their ability to persist suggests that T_{MN} cells could potentially support the longevity of the overall immune response, extending it beyond the lifespan of individual memory T cells. Consistent with this model, T_{MN} cells are more abundant in durable $CD4^+$ populations that are stable over time. Based on the diverse memory phenotypes in T_{MN}-enriched populations, we further speculate that T_{MN} cells have the potential to differentiate into multiple states, thereby contributing to the phenotypic diversity of T cell memory.

In summary, our analyses of durable $CD4^+$ T cell responses uncovered virus-specific $CD4^+$ T cells that retain a naïve functional phenotype after vaccination. T_{MN} cells differ from T_{SCM} and other memory subsets by the lack of differentiation marker expression, yet they are antigen-experienced by TCR lineage analyses. The T_{MN} subset displays superior stability over time and is linked to durable and diverse T cell memory after vaccination. Understanding the generation, maintenance, and protective potential of T_{MN} cells could aid the future development of improved vaccine strategies for a broad range of pathogens.

Limitation of Study

Our memory and naïve subsets are defined using phenotypic markers, without having examined their transcriptional or epigenetic states. While we have ruled out non-productive TCR engagement as a cause, how naïve phenotype is retained within a responding population remains unknown. Future studies will be needed to determine the differentiation trajectory toward T_{MN} state and if similar signals that drive T_{SCM} differentiation also promote T_{MN} development. As our analyses are focused on $CD4^+$ T cell responses to YFV in healthy individuals, broader studies on $CD8^+$ and $CD4^+$ T cell responses to other pathogens would be needed to understand the prevalence of antigen-experienced T_{MN} cells and how they change with advanced age and disease. Notably, our data supporting T_{MN} in long-lived responses are correlational due to the nature of observational studies. Future investigations will be necessary to establish if T_{MN} cells directly contribute to durable immunologic memory, generate protective responses upon recall, and how they might be targeted to enhance the longevity of protective memory.

Material and Methods

Study Design
This study uses cryopreserved cells stored in fetal bovine serum (FBS) with 10% DMSO from an ongoing vaccine study at the University of Pennsylvania (*20*). This study includes 7 healthy adult participants with no prior YFV exposure who received one or two doses of the 17D live-attenuated YFV vaccine (YF-VAX®, Sanofi Pasteur). Five participants were followed longitudinally for 2 to 6.7 years after vaccination. All samples were de-identified and obtained with IRB regulatory approval from the University of Pennsylvania. Subject characteristics are shown in Table S1.

Cell lines
Hi5 cells (ThermoFisher) were maintained by insect cell culture medium (ESF921, Expression Systems) supplemented with 0.02% gentamicin at 28℃.

Protein expression and tetramer production
HIS-tagged HLA-DRA/B1*0301, 0401, 0407, and 1501 protein monomers of wild type (wt) sequence or with L112W, S118H, V143M, T157I mutations (*23*) were produced by Hi5 insect cells and extracted from culture supernatant using Ni-NTA (Qiagen). HLA-DR monomers were biotinylated overnight at 4°C using BirA biotin ligase (Avidity) and purified by size exclusion chromatography using Superdex 200 size exclusion column (AKTA, GE Healthcare). Biotinylation was confirmed by gel-shift assay. Peptide exchange and tetramerization for wildtype and modified affinity-matured DR were performed using standard protocols as previously described (*38, 39*). In brief, HLA-DR proteins were incubated with thrombin (Millipore) at room temperature for 3 - 4 hours and exchanged with peptides of interest in 50-fold excess at 37°C for 16 hours. Peptide-loaded HLA-DR monomers were incubated with fluorochrome-conjugated streptavidin at 4 - 5: 1 ratio for 2 min at room temperature, followed by a 15 min incubation with an equal volume of biotin-agarose slurry (Millipore). Tetramers were buffered exchanged into PBS, concentrated using Amicon ULTRA 0.5ml 100KDa (Millipore), and kept at 4 °C for no more than 2 weeks prior to use.

***Ex vivo* T cell analyses and cell sorting**
<u>Phenotypic analyses and frequency quantification:</u> Tetramer staining was performed on at least 10 million PBMCs with 5 ug of tetramers in 100 μl reaction for 1 hour at room temperature as previously described (*20, 39, 40*). Tetramer-tagged cells were enriched by adding anti-fluorochrome and anti-HIS MicroBeads (MiltenyiBiotec). The mixture was passed through LS columns (MiltenyiBiotec). Column-bound cells were washed and eluted according to manufacturer protocol. For antibody staining, the enriched samples were stained with viability dyes, exclusion markers (anti-CD19 and anti-CD11b, BioLegend), and surface markers (anti-CD3, anti-CD4, anti-CD45RO, anti-CCR7, anti-CD11a, anti-CD95, anti-CD49d, anti-CXCR3) in 50 to 100ul of FACS buffer (PBS plus 2% FCS, 2.5mM EDTA, 0.025% Sodium Azide) for 30 minutes at 4°C. Samples were fixed with 2% paraformaldehyde and acquired by flow cytometry using LSRII (BD). Data analyses were performed by FlowJo (BD). Frequency calculation was obtained by mixing 1/10th of samples with 200,000 fluorescent beads (Spherotech) for normalization.

For longitudinal experiments involving both wt and modified DR, paired data from wt and mutant DR, with a minimum of two data points per time point for each specificity, were used to derive the equation for normalization: $\log_2(\text{Freq}_{\text{modified}})=3.72+0.35 * \log_2(\text{Freq}_{\text{wt}})$ (Fig. S4D). Frequencies generated by wt tetramers that were below the normalized values were adjusted. Mixed effects exponential decay models were used to analyze longitudinal changes in antigen-specific T cell populations and estimate the corresponding slopes. These models were implemented in *MonolixSuite 2021R1* (Lixoft) and fitted to data after vaccination. Initial T cell specificity values were lognormally distributed, exponential decay rates were normally distributed, and lognormal multiplicative error was used. The estimation of the population parameters was performed using the Stochastic Approximation Expectation-Maximization (SAEM) algorithm. Half-lives were calculated as $\ln(2)/k$, where the corresponding k values represented the estimated exponential decay rate constants. Estimated decay rates were converted into slopes as $-k$.

For multi-dimensional analyses, a total of 1465 manually gated tetramer$^+$ cells were exported from FlowJo, read into R by flowCore, and combined into one single dataset for subsequent data processing and analyses using the Spectre package in R (*21*). Staining intensities were converted using Arcsinh transformation with a cofactor of 200. Batch alignment was performed using the CytoNorm (*41*). Clustering was performed using

Phenograph with nearest neighbors set to 55 (k = 55) (*42*). UMAP was used for dimensional reduction and visualization (*43*).

Function response: T cells were rested overnight, followed by 4 - 5 hours of stimulation by phorbol myristate acetate (PMA, 5 ng/ml, Sigma) and ionomycin (500 ng/ml, Sigma) in the presence of monensin (2 uM, Sigma) and Brefeldin A (5 ug/ml, Sigma). Tetramer and surface antibody staining were performed as above. Intracellular staining with antibodies to TNF-α, IFN-γ, IL-2, CD3 and CD4 (Biolegend) was performed following BD Cytofix/Cytoperm Fixation/Permeabilization Kit according to manufacturer protocol (BD).

Cell sorting: Cell numbers were increased to around 60 million $CD3^+$ or $CD4^+$ T cells, stained in up to 10 ug of each tetramer in a 100 ul reaction. Antibody staining was performed as above without fixation. Individual tetramer-labeled cells were isolated for TCR sequencing or T cell cloning by index sorting using the purity mode on FACS Aria (BD).

Generation and stimulation of T cell clones

Clone generation: Cells were stained with tetramers and enriched with magnetic beads as described above. Single tetramer-stained $CD4^+$ T cells were sorted into individual wells in a round bottom 96-well plate containing 10^5 irradiated PBMCs, 10^4 JY cell line (ThermoFisher), PHA (1:100, ThermoFisher), IL-7 (25 ng/ml, PeproTech), and IL-15 (25 ng/ml, PeproTech). IL-2 (50 IU/ml, PeproTech) was added on day 5 and replenished every 3-5 days. Cells were resupplied with fresh medium with IL-2 (50 IU/ml), PHA (1:100), and 10^5 irradiated PBMCs every two weeks.

DCs generation: Monocytes from HLA-DR allele-matched donors were isolated using negative enrichment kits (RosetteSep Human Monocyte Enrichment Cocktail, StemCell). 10 million cryopreserved monocytes were cultured in 15 ml DC media (RPMI 1640 plus Glutamine,10% FCS, 1X Pen/Strep, 10 mM HEPES) in the presence of 100 ng/ml GM-CSF and 500 U/ml IL-4. Three days later, half the culture media was replaced with fresh DC media with 100 ng/ml GM-CSF, 500 U/ml IL-4, and 0.05 mM 2-mercaptoethanol. Cells in suspension were harvested at 5 to 6 days and added to a flat-bottom 96-well plate at 25,000 DCs per well. DCs were treated with 100 ng LPS and peptides (0.00001 ug/ml to 10ug/ml) for 16 hours and replenished with fresh media before co-culturing with T cells.

Stimulation of T cell clones: T cell clones were rested overnight in fresh media without IL-2 and added to wells containing matured DCs at 1:1 ratio in the presence of monensin (2 uM, Sigma) and Brefeldin A (5 ug/ml, Sigma). After 5 hours, cells were transferred into a new 96-well round bottom plate, washed once with FACS buffer, and stained with viability dyes, exclusion markers (anti-CD19 and anti-CD11b, BioLegend) for 30 minutes at 4°C. Intracellular staining with antibodies to TNF-α, IFN-γ, IL-2, CD3 and CD4 (Biolegend) was performed following BD Cytofix/Cytoperm Fixation/Permeabilization Kit according to manufacturer protocol (BD). Half maximal effective concentration (EC50) was determined using the percentage of T cell clones that produced TNF-α in response to decreasing peptide concentrations (10, 1, 0.1, 0.01, 0.001, 0.0001, and 0.00001 ug/ml). A non-linear fit without constraint was applied to log-transformed concentration using the equation Y=Bottom + (Top-Bottom)/(1+10^((LogEC50-X)*HillSlope)) in Prism (GraphPad). For proliferation assay, T cell clones were labeled with 1:1000 diluted CellTrace Violet (CTV, ThermoFisher Scientific) following manufacturer protocol. The CTV-stained cells were rested in fresh media without IL-2 for 16 hours. 25,000 rested T cells were co-cultured with DC pulsed with 10 ug/ml cognate peptides or treated with PHA as a positive control (1:100, ThermoFisher). After 5 days, cells were harvested and stained with viability dyes and surface antibodies (anti-CD19, anti-CD11b, anti-CD3, and anti-CD4, BioLegend) for 30 minutes at 4°C followed by fixation with 2% paraformaldehyde. Samples were acquired by flow cytometry using LSRII (BD) and analyzed by FlowJo (BD).

Single-cell TCR sequencing and analyses

Single-cell TCR Sequencing by nested PCRs was performed using the primer sets and the protocol as previously described (*20, 44*). In brief, reverse transcription was performed with CellsDirect One-Step qRT-PCR kit according to the manufacturer's instructions (CellsDirect, Invitrogen) using a pool of 5' TRVB-region specific primers and 3' C-region primers. The cDNA library was amplified using a second set of multiple internally nested V-region and C-region primers with HotStarTaq DNA polymerase kit (Qiagen). The final PCR reaction was performed on an aliquot of the second reaction using a primer containing common base sequence and a third internally nested Cβ primer. PCR products were gel purified (Qiagen) and sequenced on Novaseq 6000 platform (Illumina). TCR sequences were pre-processed as previously described (*20*). In brief, forward and reverse reads were converted into one paired end read using pandaseq (*45*). Data were demultiplexed by the unique combination of plate, row, and column barcodes. Consensus TCRβ sequences were identified using the V(D)J alignment software MiXCR (*46*). A threshold of a read count of 200 reads per sequence was applied to the consensus sequences. If more than one TCRα or TCRβ chain passes this criterion we retain the dominant TCRβ and the two TCRα chains with the highest read count. For data obtained from cells several months after vaccination, we additionally require phenotypic annotation based on antibody staining from index sort data. Data were excluded if phenotypic information was not retained or ambiguous. For downstream analyses, data wrangling was performed using the tidyverse package. TCRs were matched by TCRβ if only the beta chain was available, or by TCRβ plus at least one TCRα if alpha chain(s) were called. Circos plots were made using the circlize package of R software (*47*).

Statistical Methods
Normality was assessed using D'Agostino-Pearson test. Spearman was used if either of the two variables being correlated was non-normal. Otherwise, Pearson was used to measure the degree of association. Least squares linear regression was used to calculate the best-fitting line. Statistical comparisons were performed using two-tailed Student's t-test, paired t-test, Welch's one-way ANOVA, repeated measures one-way ANOVA, two-way ANOVA, or mixed effects model. A p-values of <0.05 was used as the significance level and adjusted if multiple comparisons were performed. Statistical analyses were performed using GraphPad Prism. Lines and bars represent the mean and variability is represented by the standard error of the mean (SEM). * P < 0.05, ** P < 0.01, *** P < 0.001, **** P < 0.0001.

Supplementary Materials
Figure S1: $CD45RO^-CCR7^+$ YFV-specific $CD4^+$ T cells by age and their relationship to the effector response.
Figure S2: YFV $tetramer^+$ $CD45RO^-CCR7^+$ T cells contain various phenotypic subsets
Figure S3: Tetramer staining and peptide responses of YFV-specific T cell clones.
Figure S4: T_{MN} cells are antigen-experienced.
Figure S5: Longitudinal dynamics of YFV-specific populations.
Table S1: Donor characteristics.
Table S2: List of YFV peptides.
Table S3: phenotypic markers.
Table S4: YFV-specific $CD4^+$ T cells 7months or longer after vaccination.
Table S5: YF45 $tetramer^+$ T cells before and 14 days after YFV vaccination.
Table S6: Longitudinal follow-up visits.

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Competing interests: The authors declare no competing interests.

Data and material availability: All data needed to evaluate the conclusions in the paper are present in the paper or the supplementary materials.

Main Figures

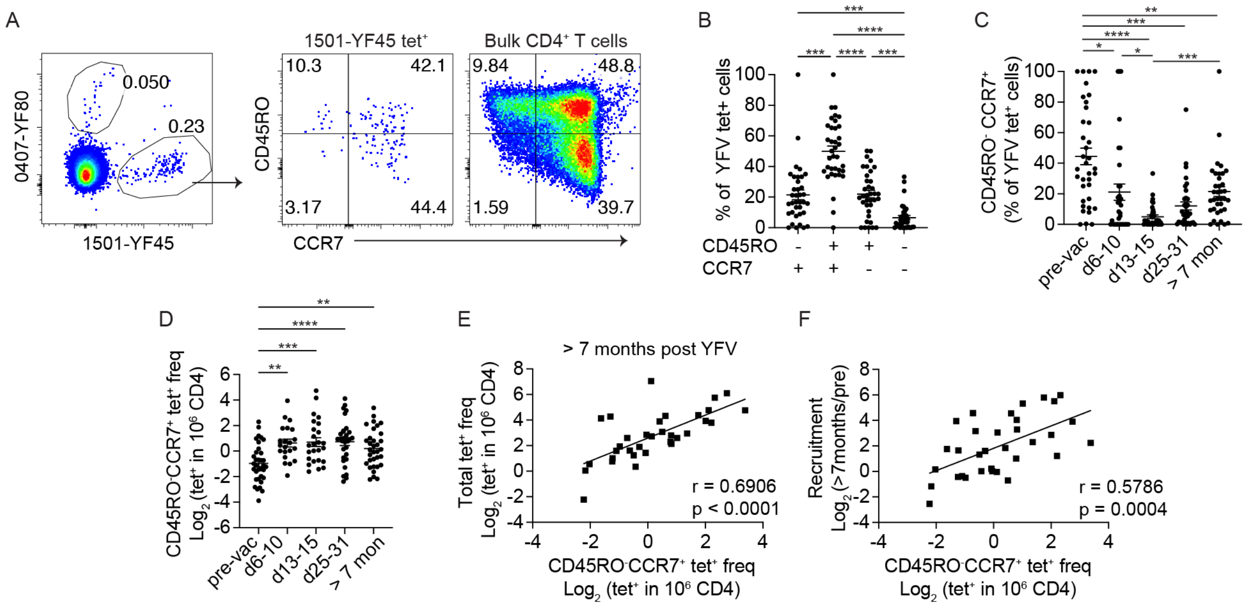

Figure 1: Identification of a CD45RO$^-$CCR7$^+$ subset of virus-specific CD4$^+$ T cells after YFV vaccination. (A) Direct *ex vivo* tetramer and antibody staining of a representative YFV tetramer$^+$ population using blood collected about 7 months after YFV vaccination. (B) The percentage of YFV tetramer$^+$ T cells with the indicated combination of CD45RO and CCR7 expression. Plot summarizes data from 36 specificities 7 to 34 months after YFV vaccination from 7 donors. (C-D) The abundance of CD45RO$^-$CCR7$^+$ YFV tetramer$^+$ CD4$^+$ T cells in 7 healthy subjects was quantified as a percentage of tetramer$^+$ cells (C) or by frequency (D). Each symbol represents data from a distinct YFV-specific population. Experiments were repeated an average of 3.3 times. (E-F) Correlation between the frequency of CD45RO$^-$CCR7$^+$ subset with the corresponding overall frequency (E) and the fold change between memory frequency and the pre-vaccine baseline (F) (n = 36). RM one-way ANOVA (B) or Mixed-effect analysis (C and D) was performed and corrected with Tukey's multiple comparisons test. For E and F, Pearson correlation was computed.

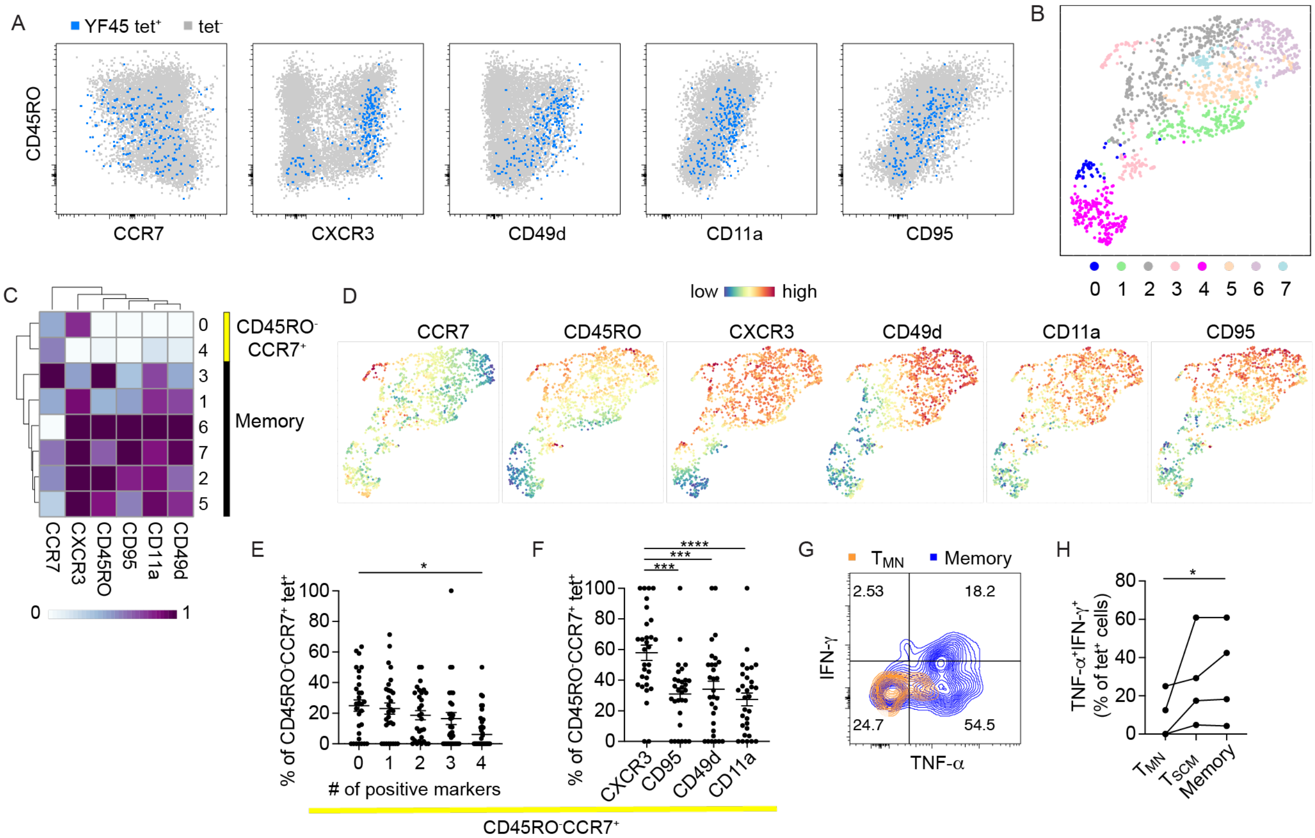

Figure 2: Post-vaccine CD4$^+$ T cells are heterogeneous and include naïve-like subsets. (A) FACS plots show the expression of the indicated marker on a representative YFV-specific population. The tetramer$^+$ population is overlaid onto tetramer$^-$ bulk CD4$^+$ T cells. (B) UMAP displays Phenograph-defined clusters. Data combine 1465 CD4$^+$ cells labeled by 7 YFV tetramers from HD3. (C-D) The staining intensity of individual markers is shown on a heatmap for each cluster (C) or displayed on the UMAP. (E-F) The relative abundance of CD45RO$^-$CCR7$^+$ YFV-specific T cells by the indicated numbers of markers (E) or the type of markers (F). Frequency in F combines all cells positive for a particular marker within the CD45RO$^-$CCR7$^+$ subset. Each symbol represents a tetramer$^+$ population (n = 28). Experiments were repeated an average of 2.5 times. (G) PBMCs were stimulated for 4 - 5 hours by PMA and ionomycin and assayed for cytokine production by intracellular cytokine staining. The plot shows representative TNF-a and IFN-g expression by T_{MN} cells and non-CD45RO$^-$CD28$^+$ (memory) T cells from the same tetramer-labeled population. (H) T cell responses by TNF-a and IFN-g production for the indicated phenotypic subset. Each population was identified with a pool of 5-7 tetramers of the same DR allele, using cells from 3 donors. For E and F, RM one-way ANOVA was performed and corrected with Tukey's multiple comparison test. For H, the Friedman test was performed and corrected using Dunn's multiple comparison test.

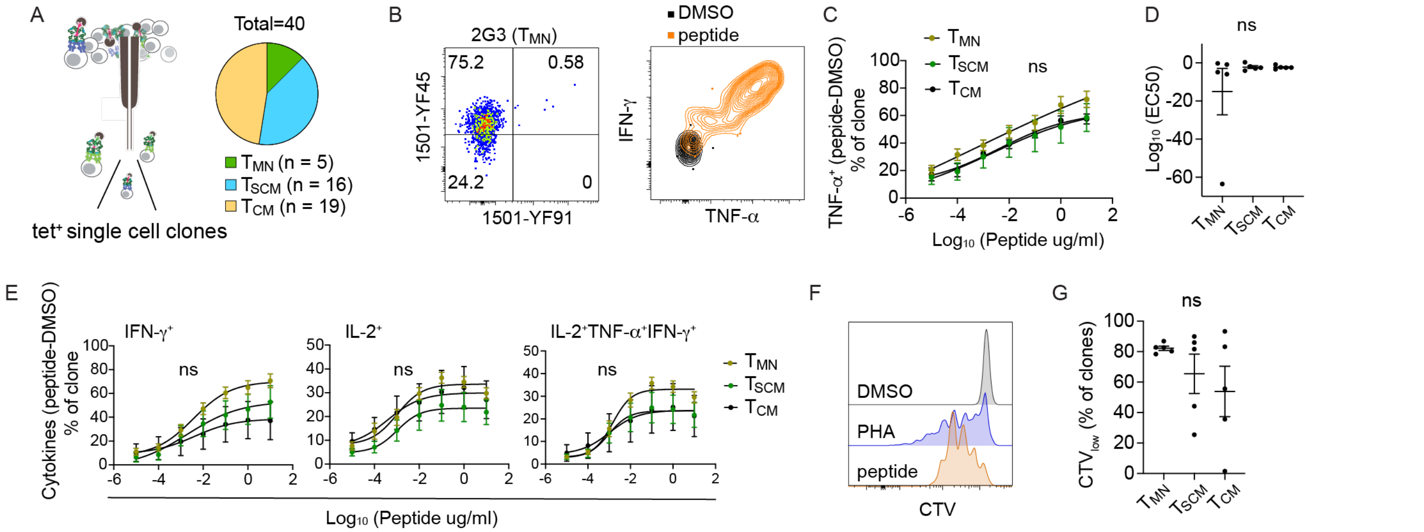

Figure 3: T_{MN}-derived T cell clones respond to antigen stimulation. (A) Schematics of single-cell T cell cloning. Post-vaccine T cells from HD2 and HD3 were stained with 1501-YF45 tetramers, sorted based on T_{MN}, T_{SCM}, or T_{CM} phenotypes, and expanded for 2 to 3 weeks in culture. (B) *In vitro* expanded T cell clones were restained with tetramers and cultured with vehicle or peptide-treated monocyte-derived dendritic cells. Representative plots show tetramer staining and cytokine production by intracellular cytokine staining. (C-D) T cell clones were stimulated with decreasing concentrations of YFV peptide. The response was measured by TNF-a production (C) and quantified by EC50 values after subtracting the background signal from vehicle-treated control (D). (E) Peptide dose response of T cell clones by IFN-g, IL-2, and $IL2^{+}TNF\text{-}a^{+}IFN\text{-}g^{+}$ production. (F) Representative histograms show CTV dilution in response to 10ug/ml of peptide stimulation. (G) Plot summarizes the frequency of CTV_{low} population after a 5-day culture for clones in each phenotypic group. All experiments were repeated at least twice with n= 5 in each group. For (C) and (E), RM two-way ANOVA was performed and corrected with Tukey's multiple comparison test. For (D) and (G), Kruskal-Wallis test and Dunn's multiple comparison test were used.

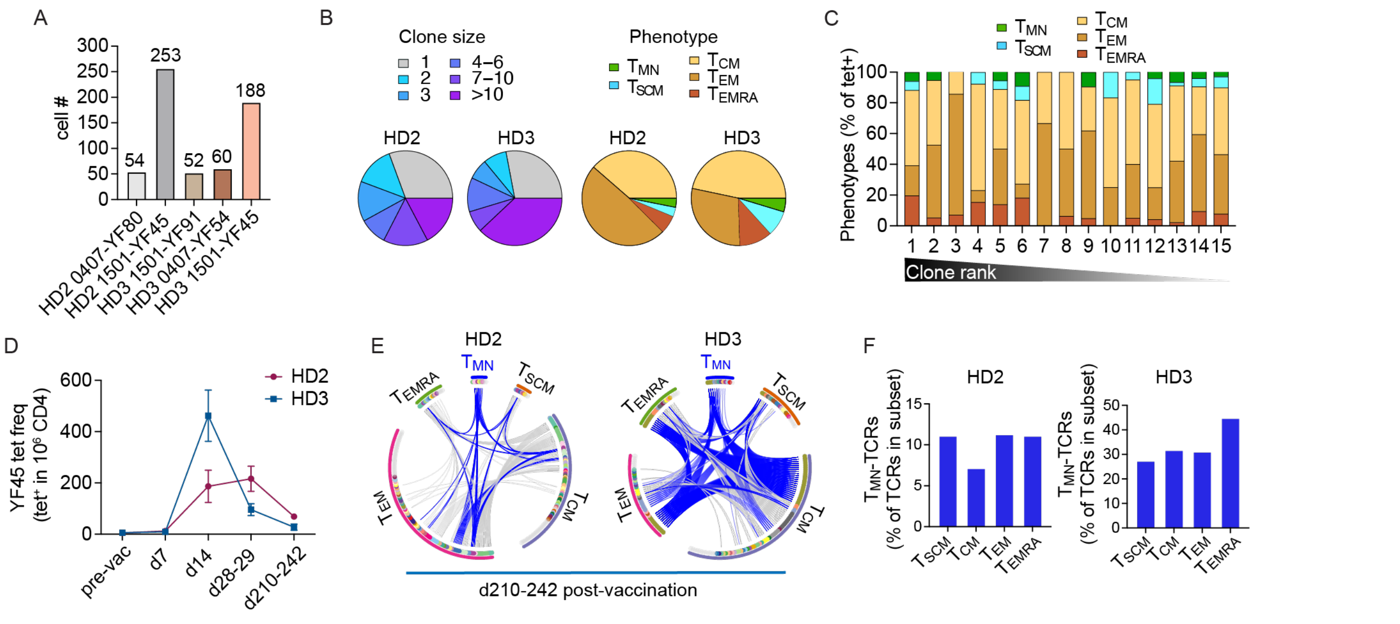

Figure 4: T_{MN} cells are clonally related to memory T cells. (A) The plot summarizes the number of cells sequenced from indicated specificity and donor collected 242 (HD2) and 210 (HD3) days after primary YFV vaccination. (B) Clone size and phenotypic distribution of YFV tetramer$^+$ populations in A. Phenotypic information were obtained by index sorting. T_{MN} (CD45RO$^-$CCR7$^+$CXCR3$^-$CD95$^-$CD11a$^-$CD49d$^-$), T_{SCM} (CD45RO$^-$CCR7$^+$ and positive for at least one of CXCR3, CD95, CD11a, or CD49d), T_{CM} (CD45RO$^+$CCR7$^+$), T_{EM} (CD45RO$^+$CCR7$^-$), T_{EMRA} (CD45RO$^-$CCR7$^-$). Cells with ambiguous phenotypes were excluded. (C) Distribution of phenotypes in B by clonotype frequency, ranked from largest to unique clonotypes. (D) Pre-vaccine frequency and early post-vaccine dynamics of YF45-specific T cells preceding the memory time point. (E) Each circus plot represents TCRs from YF45 tetramer$^+$ cells obtained 242 (HD2) or 210 (HD3) days after vaccination, separated by the associated indexed phenotypes. Cells are ordered by frequency within each arc. Gray marks cells expressing unique TCRs, other colors represent expanded or shared sequences. Shared TCRb or TCRa/b, when a TCRa is available, is connected by a line across distinct phenotypic subsets. Blue lines highlight TCRs from T_{MN} cells that are shared with cells expressing other phenotypes. (F) The percentage of TCRs in each memory subset that matched T_{MN}-derived sequences.

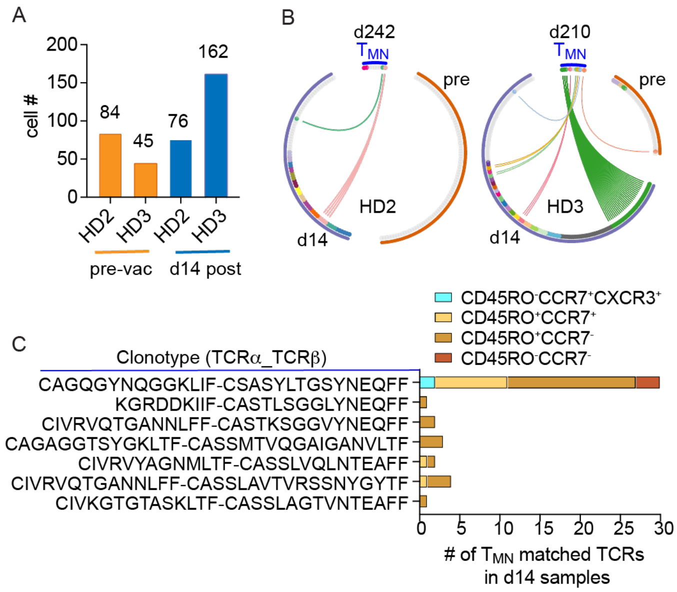

Figure 5: T_{MN} cells are clonally related to effector T cells. (A) The number of TCRs from YF45 tetramer^{+} T cells from the indicated donors, before vaccination and 14 days after YFV vaccination. (B) Lines link T_{MN}-derived TCRs in the day 210-242 post-vaccine samples with matched TCRs expressed by T cells in a previous time point from each donor. Shared TCRs are matched by TCRb or TCRa/b when a TCRa is available. (C) The CDR3 sequences and the phenotypes of T cells in the d14 sample that matched a T_{MN}-derived clonotype in the memory time point.

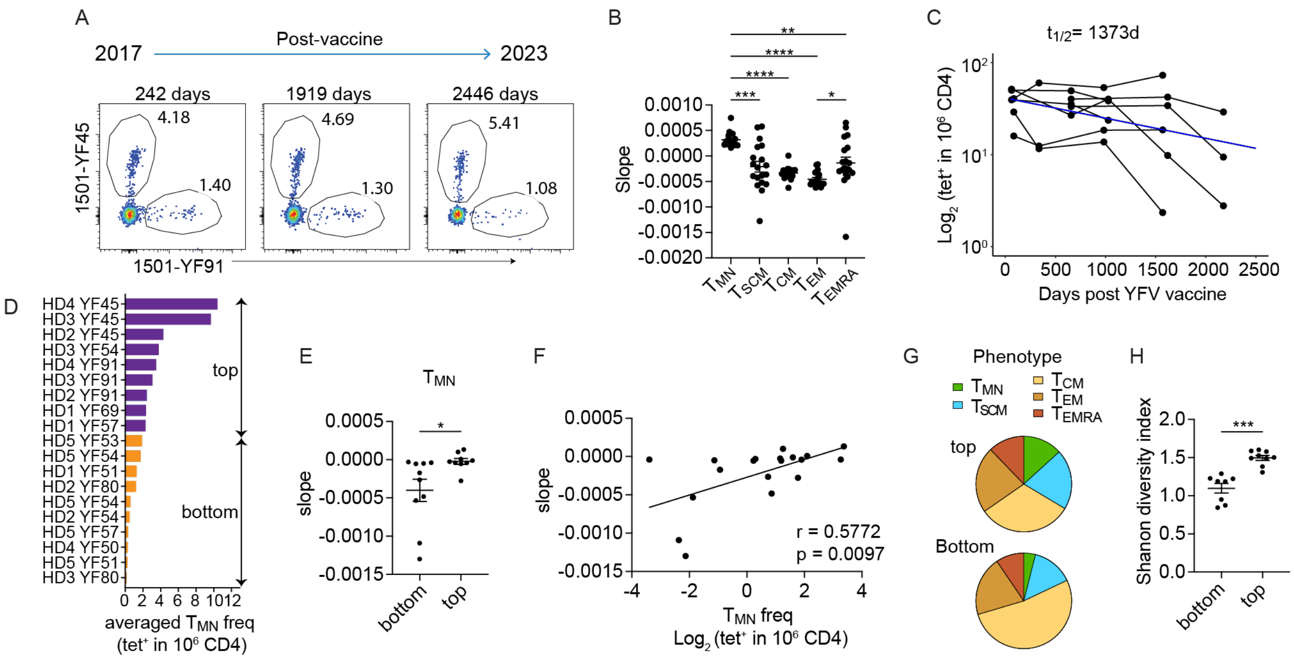

Figure 6: T_{MN} cells are stable and associated with durable T cell memory. (A) Representative plots show YFV-specific $CD4^+$ T cells over the indicated time points from HD2. (B) Each $tetramer^+$ population of a given specificity was subdivided according to phenotypes. The change over time for each phenotypic subset was quantified by the estimated slope using a mixed effects exponential decay model (n = 19 $tetramer^+$ populations from 5 donors). (C) A mixed effects exponential decay model fitted to the dynamics of YFV-specific $CD4^+$ T cells after a single YFV vaccination (n = 8 populations, combined from donors 4 and 5). The estimated decay (blue line) was used for calculating the half-life ($t_{1/2}$). (D) Ranking of $tetramer^+$ populations by the averaged frequency of T_{MN} T cells within each population across all time points. (E) Plot summarizes the estimated slopes of individual $tetramer^+$ populations, divided into top and bottom halves by T_{MN} frequency in D. (F) The correlation between slopes characterizing the change over time for the overall $tetramer^+$ populations and their corresponding averaged T_{MN} frequencies. (G) Pie-charts show the distribution of memory subsets. Populations were divided into top and bottom groups by the first measured T_{MN} frequency obtained within 1-2 years after YFV vaccination. (H) Phenotypic diversity of each $tetramer^+$ population was quantified using Shannon Diversity Index, categorized into top or bottom groups based on T_{MN} frequency as in G. Each symbol represents one $tetramer^+$ population. Experiments were repeated an average of 2.3 times. Data are represented as mean ± SEM. For (B), RM one-way ANOVA was performed and corrected with Tukey's multiple comparisons test. Welch's t-test was performed for (E) and (H). For (F), Spearman correlation was performed.

Supplementary Material

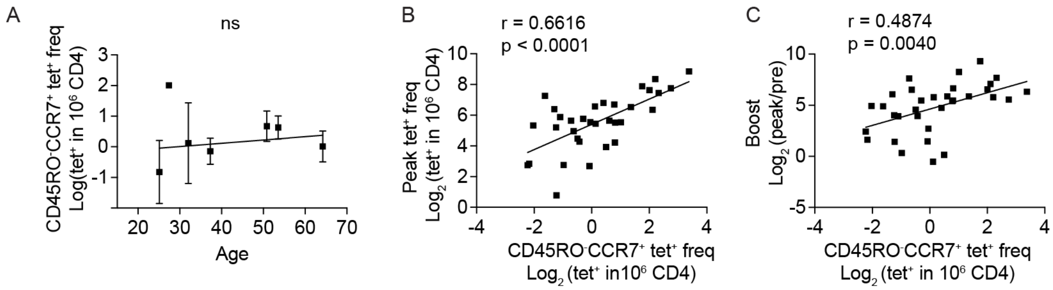

Figure S1: $CD45RO^{-}CCR7^{+}$ YFV-specific $CD4^{+}$ T cells by age and their relationship to the effector response. (A) The frequency of post-immune $CD45RO^{-}CCR7^{+}$ YFV tetramer^{+} $CD4^{+}$ T cells in relationship to donor age. Distinct tetramer^{+} populations from the same donor are combined and represented as an average (n = 7). (B) The correlation between the frequency of $CD45RO^{-}CCR7^{+}$ YFV tetramer^{+} cells measured at least 7 months after vaccination and the highest total tetramer^{+} frequency from a previous time point measured within the first month after vaccination (n = 36). (C) The correlation between $CD45RO^{-}CCR7^{+}$ YFV tetramer^{+} T cell frequency at least 7 months after vaccination and the fold-change between peak frequency and the pre-vaccine baseline. Pearson correlation was computed.

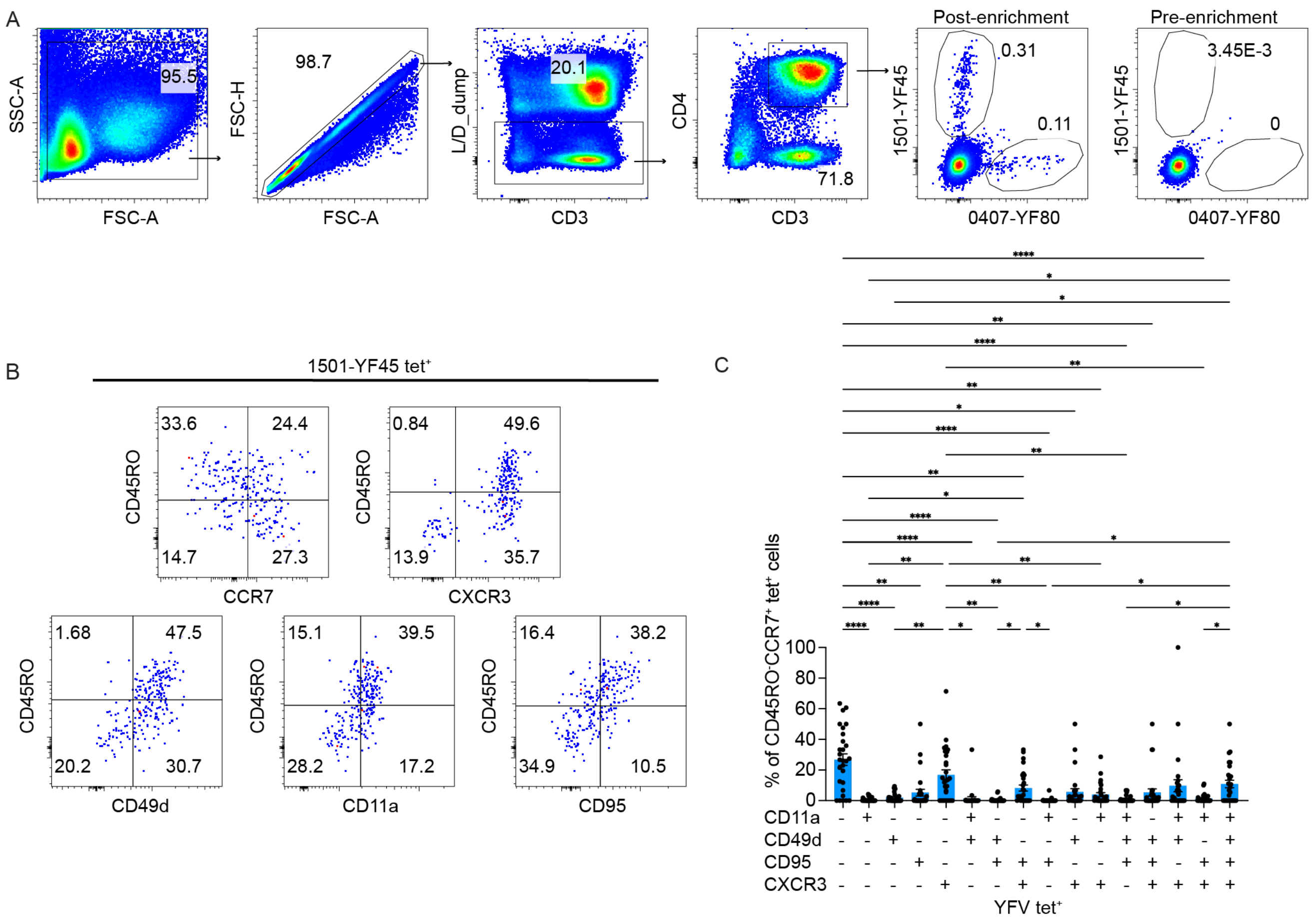

Figure S2: YFV tetramer$^+$ CD45RO$^-$CCR7$^+$ T cells contain various phenotypic subsets. (A) Representative plots show the gating strategy used to identify tetramer$^+$ cells. (B) FACS plots show the phenotype of YF45-specific T cells by the indicated antibody staining. (C) Boolean gates for CD11a, CD49d, CD95, and CXCR3 were applied onto manually gated CD45RO$^-$CCR7$^+$ YFV tetramer$^+$ T cells. The plot shows various phenotypic combinations. Each symbol represents a tetramer$^+$ population (n = 28). One-way ANOVA was performed and corrected with Tukey's multiple comparison test.

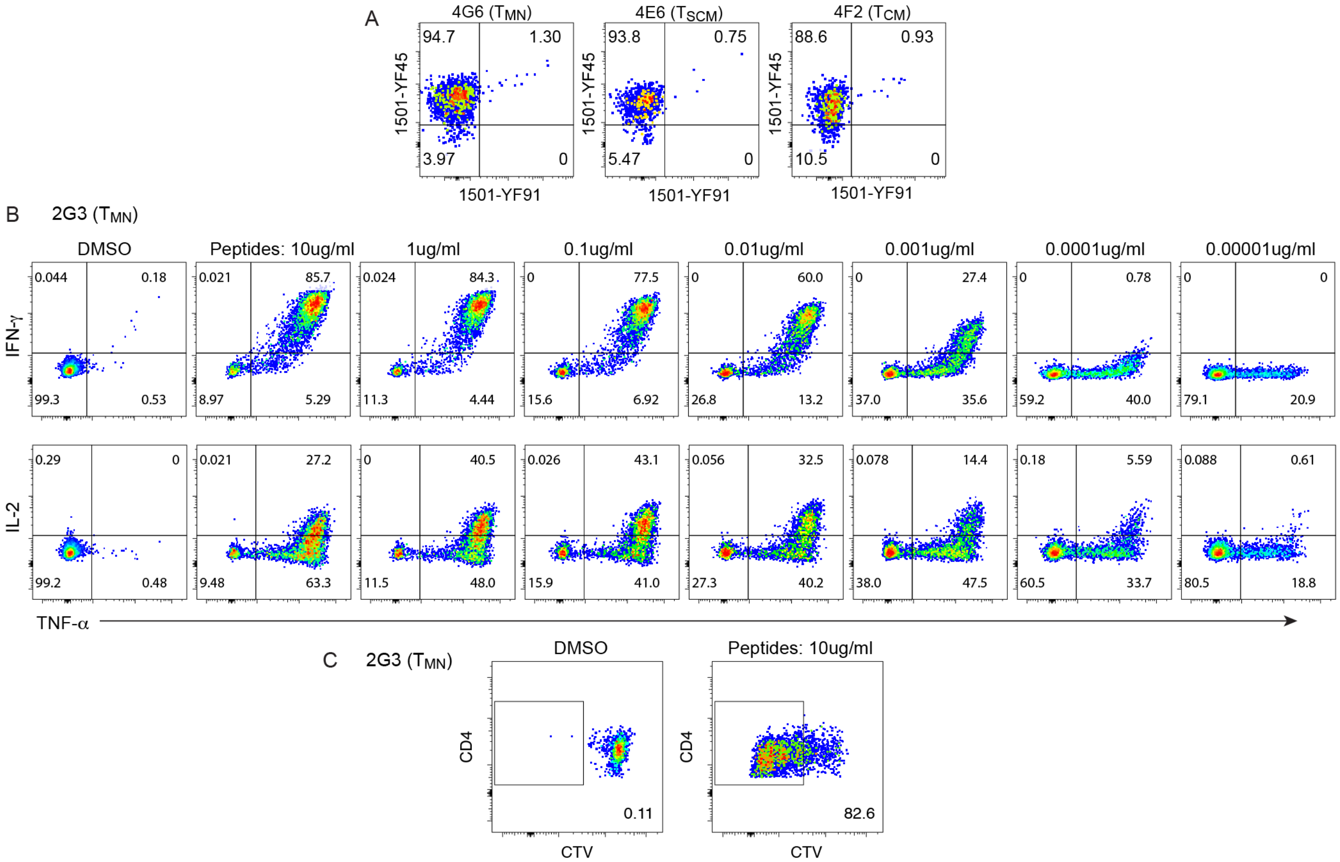

Figure S3: Tetramer staining and peptide responses of YFV-specific T cell clones. (A) Representative tetramer staining of T_{MN}, T_{SCM}, and T_{CM}-derived YFV-specific T clones. (B) Plots show cytokine response by a T_{MN} clone to decreasing concentrations of the cognate YF45 peptide after a 5-hour co-culture with peptide-loaded DCs. (C) Representative plots show CTV staining of a CTV-labeled T cell clone after a 5-day culture with vehicle-treated or peptide-loaded DCs.

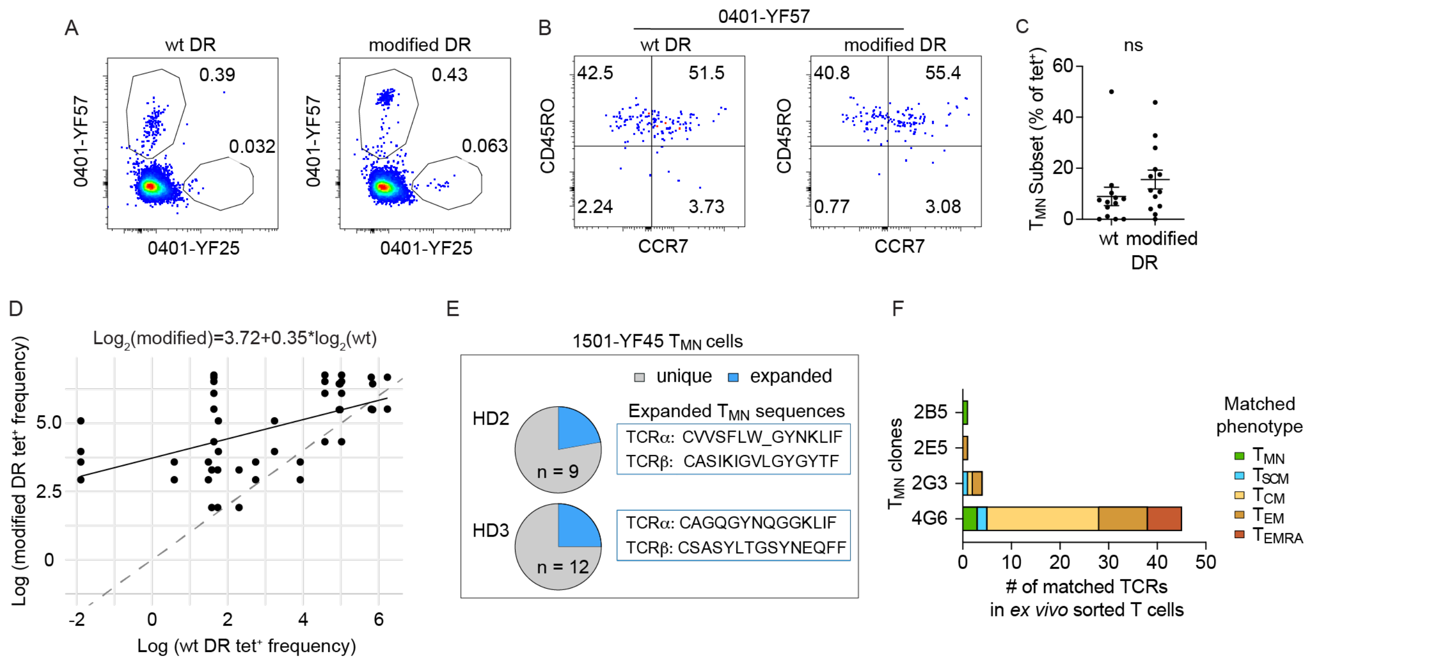

Figure S4: T_{MN} cells are antigen-experienced. (A) Representative plots show the identification of YFV-specific T cells using tetramers generated from wt or modified DR (L112W, S118H, V143M, T157I). (B) CD45RO and CCR7 expression of YF57-specific T cells stained by wt or modified DR. (C) Quantification of T_{MN} fraction within tetramer$^+$ populations identified by wt or modified tetramers using the same sample. (D) The plot displays paired data from wt and modified DR, with a minimum of two data points per time point for each specificity, which were used to derive the equation for normalization (top). (E) Pie-charts show the distribution of unique versus expanded clonotypes within T_{MN} subset of YF45-specific T cells obtained 210-242 days after YFV vaccination. The sequences of the expanded clonotype from each donor are as indicated. (F) T_{MN}-derived T cell clones were re-stained with tetramers and sorted for TCR sequencing. Clone-derived TCRs were compared with sequences from directly sorted T cells. The graph shows clones with matched TCRs and indicates the number of matched cells and their associated *ex vivo* phenotypes. For (C), Wilcoxon matched-pairs signed rank test was performed.

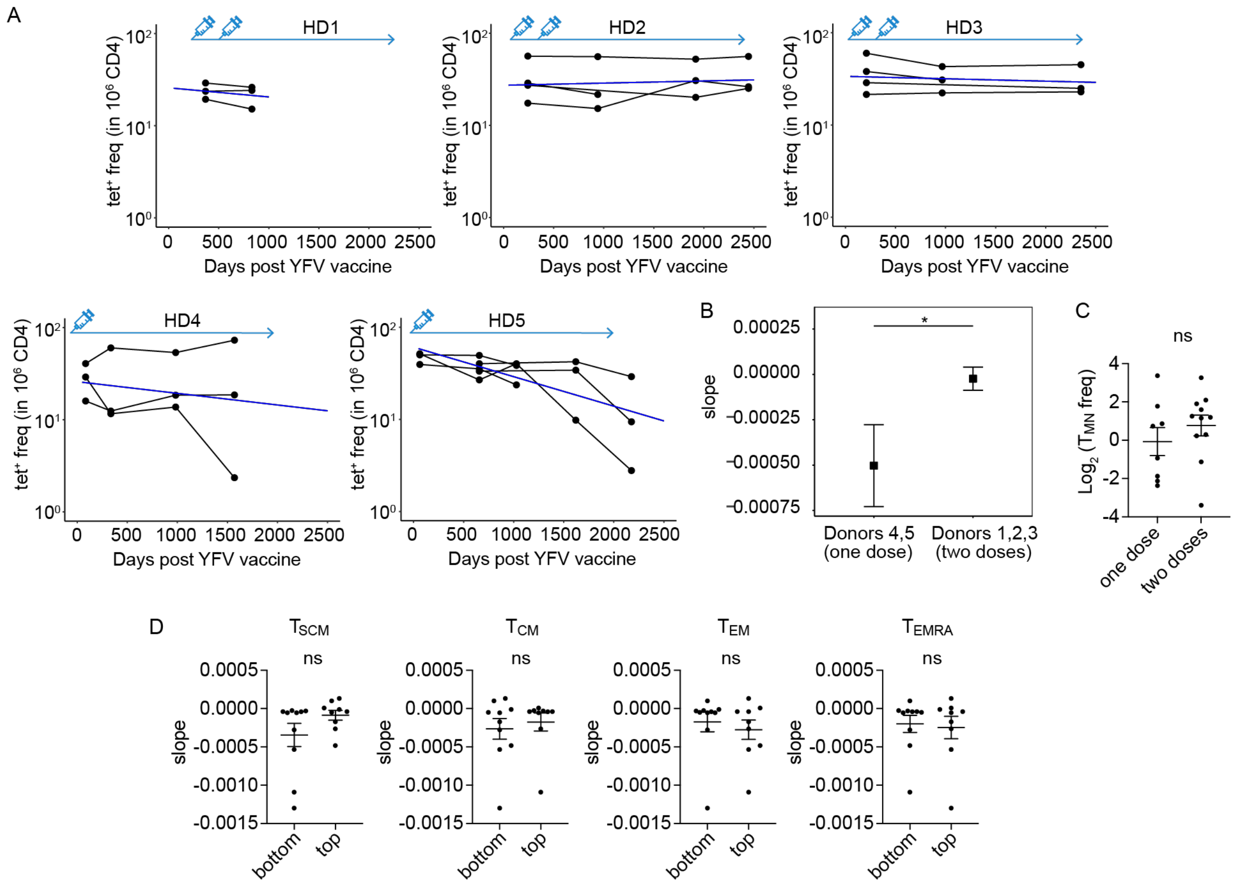

Figure S5: Longitudinal dynamics of YFV-specific populations. (A) The frequency of tetramer⁺ populations by donor. Filled circles represent individual tetramer⁺ populations. A line connects T cells labeled by the same tetramer across time points. Mixed effects exponential decay models were fitted to the longitudinal frequencies of individual tetramer-labeled populations for each donor. Blue lines represent the estimated decay. (B) Longitudinal dynamics of tetramer⁺ populations were combined for donors who received one YFV dose (donors 4 and 5) and two doses (donors 1, 2, 3). A mixed-effects exponential decay model was employed to estimate the corresponding population slopes for the two groups. (C) The plot summarizes T_{MN} frequency in donors who received one (donors 4, 5) or two doses (donors 1, 2, 3) of the YFV vaccine. (D) Plots summarize the estimated slopes of individual tetramer⁺ populations, divided into top and bottom halves by the averaged frequency of cells expressing the indicated phenotypes. (B) Wald test was used. (C) Mann-Whitney test was used. (D) Welch's t-test was used.

Table S1: Donor characteristics

ID	Sex	Age at the time of YFV vaccination	Vaccine dates	Sample collection dates
HD1	M	37	8/25/16	8/28/17
HD2	F	32	9/12/16	5/12/17
HD3	M	64	1/4/17	8/2/17
HD4	M	25	5/22/17	4/23/18
HD5	F	50	4/21/17	2/7/19
HD6	M	53	3/6/17	10/24/19
HD7	M	27	3/6/17	2/23/21

Table S2: List of YFV peptides

Peptide	YFV Protein	Sequence
YF108	NS5	VIKILTYPWDRIEEVTR
YF23	NS3	ESATILMTATPPGTS
YF25	NS3	KGPLRISASSAAQRR
YF38	RNA Polymerase	EEFIAKVRSHAAIGA
YF42	RNA Polymerase	ACLSKAYANMWSLMY
YF44	NS5	IHLVIHRIRTLIGQE
YF45	NS3	GEVIGLYGNGILVGD
YF50	Protein E	TIRVLALGNQEGSLKTA
YF51	Protein E	TDKMFFVKNPTDTGHGT
YF53	NS3	GLYGNGILVGDNSFVSA
YF54	NS3	LPSIRAANVMAASLRKA
YF57	NS5	TLGEVWKRELNLLDKRQ
YF69	NS3	WILADKRPTAWFLPSIR
YF80	Protein E	TGHGTVVMQVKVSKGAP
YF91	NS5	PPAGTRKIMKVVNRWLF
YF93	Protein E	MGAVLIWVGINTRNMTM

Table S3: phenotypic markers

Phenotype	CD45RO and CCR7 staining	CD95, CXCR3, CD49d, CD11a staining
Naive	CD45RO-CCR7+	not available
T_{CM}	CD45RO+CCR7+	
T_{EM}	CD45RO+CCR7-	
T_{EMRA}	CD45RO-CCR7-	
T_{SCM}	CD45RO-CCR7+	positive for one of the following: CD95, CXCR3, CD49d, CD11a
T_{MN}	CD45RO-CCR7+	negative for all of the following: CD95, CXCR3, CD49d, CD11a

Table S4: YFV-specific $CD4^+$ T cells 7months or longer after vaccination

Donor	specificity	Phenotype	TCRb	TCRa-TCRb	clone size
HD3	1501-YF91	TCM	CASASVAGGTYEQYF	CALSEGDQGGKLIF-CASASVAGGTYEQYF	6
HD3	1501-YF91	TCM	CASASVAGGTYEQYF	CALSEGDQGGKLIF-CASASVAGGTYEQYF	6
HD3	1501-YF91	TCM	CASASVAGGTYEQYF	CALSEGDQGGKLIF-CASASVAGGTYEQYF	6
HD3	1501-YF91	TCM	CASASVAGGTYEQYF	CALSEGDQGGKLIF-CASASVAGGTYEQYF	6
HD2	0407-YF80	TCM	CASEGGGSGANVLTF	CASEGGGSGANVLTF	3
HD2	0407-YF80	TCM	CASGTGSSGANVLTF	CASGTGSSGANVLTF	9
HD2	0407-YF80	TCM	CASGTGSSGANVLTF	CASGTGSSGANVLTF	9
HD2	0407-YF80	TCM	CASGTGSSGANVLTF	CASGTGSSGANVLTF	9
HD2	1501-YF45	TCM	CASHEGWTVGNTIYF	CIVRENSGNTGKLIF-CASHEGWTVGNTIYF	1
HD2	0407-YF80	TCM	CASIEGGEGDTQYF	CASIEGGEGDTQYF	1
HD2	0407-YF80	TCM	CASIGGGEGNEQFF	CASIGGGEGNEQFF	5
HD2	0407-YF80	TCM	CASIGGGEGNEQFF	CASIGGGEGNEQFF	5
HD2	0407-YF80	TCM	CASIGGGEGNEQFF	CASIGGGEGNEQFF	5
HD2	0407-YF80	TCM	CASIGGGEGNEQFF	CASIGGGEGNEQFF	5
HD2	1501-YF45	TCM	CASIKIGVLGYGYTF	CVVSFLW_GYNKLIF-CASIKIGVLGYGYTF	12
HD2	1501-YF45	TCM	CASIKIGVLGYGYTF	CVVSFLW_GYNKLIF-CASIKIGVLGYGYTF	12
HD3	1501-YF91	TCM	CASKHRPDSYEQYF	CASKHRPDSYEQYF	2
HD2	0407-YF80	TCM	CASLTSGEGATEAFF	CASLTSGEGATEAFF	1
HD2	0407-YF80	TCM	CASPKSSGSTDTQYF	CVVSSRHTDKLIF-CASPKSSGSTDTQYF	14
HD2	0407-YF80	TCM	CASPKSSGSTDTQYF	CASPKSSGSTDTQYF	14
HD2	0407-YF80	TCM	CASPKSSGSTDTQYF	CASPKSSGSTDTQYF	14
HD2	1501-YF45	TCM	CASQTGASVTYEQYF	CIVRVAAGNTGKLIF-CASQTGASVTYEQYF	9
HD2	1501-YF45	TCM	CASQTGASVTYEQYF	CIVRVAAGNTGKLIF-CASQTGASVTYEQYF	9
HD2	1501-YF45	TCM	CASQTGASVTYEQYF	CIVRVAAGNTGKLIF-CASQTGASVTYEQYF	9
HD3	1501-YF45	TCM	CASRDLYGYTF	CIVRVAAEAAGNKLTF-CASRDLYGYTF	3
HD3	1501-YF45	TCM	CASRDLYGYTF	CIVRVAAEAAGNKLTF-CASRDLYGYTF	3
HD2	0407-YF80	TCM	CASRVTDNEQFF	CVVSSRHTDKLIF-CASRVTDNEQFF	1
HD2	0407-YF80	TCM	CASRWDGNSPLHF	CASRWDGNSPLHF	6
HD2	0407-YF80	TCM	CASRWDGNSPLHF	CASRWDGNSPLHF	6
HD2	0407-YF80	TCM	CASRWDGNSPLHF	CALITQGGSEKLVF-CASRWDGNSPLHF;CVVSSRHTDKLIF-CASRWDGNSPLHF	6
HD2	0407-YF80	TCM	CASRWDGNSPLHF	CASRWDGNSPLHF	6
HD3	1501-YF91	TCM	CASSEDSWRGGSTDTQYF	CVVSEVQGYGGSQGNLIF-CASSEDSWRGGSTDTQYF	1
HD2	1501-YF45	TCM	CASSEGHIPMNTEAFF	CIVRVAAGQSGYALNF-CASSEGHIPMNTEAFF	5
HD3	1501-YF45	TCM	CASSFGTVVDTEAFF	CIVRVAADYKLSF-CASSFGTVVDTEAFF	1
HD3	1501-YF45	TCM	CASSFPRGQNINQPQHF	CIVRVGAQGAQKLVF-CASSFPRGQNINQPQHF	1
HD3	1501-YF91	TCM	CASSFQTGGIVTDTQYF	CIVRVRGGNNDMRF-CASSFQTGGIVTDTQYF	1
HD2	1501-YF45	TCM	CASSGKMTSFSYEQYF	CIVRVTNQAGTALIF-CASSGKMTSFSYEQYF	1
HD3	1501-YF91	TCM	CASSGSIELSGYTF	CAVPRVEWYGGATNKLIF-CASSGSIELSGYTF	1

HD2	1501-YF45	TCM	CASSKTSGLQSYNEQFF	CILRPNYGGSQGNLIF-CASSKTSGLQSYNEQFF;CILRPNYGGSQGNLIF-CASSKTSGLQSYNEQFF	2
HD2	1501-YF45	TCM	CASSLAGVGPGGYEQFF	CARMSGGFKTIF-CASSLAGVGPGGYEQFF	2
HD2	1501-YF45	TCM	CASSLAVTVRSSNYGYTF	CIVRVQTGANNLFF-CASSLAVTVRSSNYGYTF	3
HD3	1501-YF45	TCM	CASSLEAGLSTDTQYF	CVVIPNW_ANNLFF-CASSLEAGLSTDTQYF	4
HD3	1501-YF45	TCM	CASSLEAGLSTDTQYF	CASSLEAGLSTDTQYF	4
HD3	1501-YF45	TCM	CASSLGASGGAAGEQFF	CALSDRDTGNQFYF-CASSLGASGGAAGEQFF	1
HD3	1501-YF45	TCM	CASSLGDQVSNQPQHF	CAAGT**_AGNMLTF-CASSLGDQVSNQPQHF	1
HD2	1501-YF45	TCM	CASSLGFSMTDRGYTF	CIVRPSAGNTGKLIF-CASSLGFSMTDRGYTF	3
HD2	1501-YF45	TCM	CASSLGLSVANEQFF	CAFMRGAGANNLFF-CASSLGLSVANEQFF	1
HD2	0407-YF80	TCM	CASSLGSAGANVLTF	CASSLGSAGANVLTF	3
HD2	1501-YF45	TCM	CASSLGSLAGSYNEQFF	CIVRVRAGNTPLVF-CASSLGSLAGSYNEQFF	4
HD3	1501-YF45	TCM	CASSLQGPLSYEQYF	CIVRVVTDYKLSF-CASSLQGPLSYEQYF	1
HD3	1501-YF45	TCM	CASSMTVQGAIGANVLTF	CAGAGGTSYGKLTF-CASSMTVQGAIGANVLTF	5
HD2	1501-YF45	TCM	CASSPGGLSTEAFF	CASSPGGLSTEAFF	4
HD2	1501-YF45	TCM	CASSPGGLSTEAFF	CAVGAQGRGFQKLVF-CASSPGGLSTEAFF	4
HD2	1501-YF45	TCM	CASSPGQTLVTEAFF	CIVRALSGNTGKLIF-CASSPGQTLVTEAFF	1
HD3	0407-YF54	TCM	CASSPGTGDGYTF	CAGEKL_GNKLTF-CASSPGTGDGYTF	1
HD3	1501-YF45	TCM	CASSPQGPLINEQFF	CIVRNNAGNMLTF-CASSPQGPLINEQFF	14
HD3	1501-YF45	TCM	CASSPQGPLINEQFF	CIVRNNAGNMLTF-CASSPQGPLINEQFF	14
HD3	1501-YF45	TCM	CASSPQGPLINEQFF	CIVRNNAGNMLTF-CASSPQGPLINEQFF	14
HD3	1501-YF45	TCM	CASSPQGPLINEQFF	CIVRNNAGNMLTF-CASSPQGPLINEQFF	14
HD3	1501-YF45	TCM	CASSPQGPLINEQFF	CIVRNNAGNMLTF-CASSPQGPLINEQFF	14
HD3	1501-YF45	TCM	CASSPQGPLINEQFF	CIVRNNAGNMLTF-CASSPQGPLINEQFF	14
HD3	1501-YF45	TCM	CASSPQGPLINEQFF	CIVRNNAGNMLTF-CASSPQGPLINEQFF	14
HD3	1501-YF45	TCM	CASSPQGPLINEQFF	CIVRNNAGNMLTF-CASSPQGPLINEQFF	14
HD3	1501-YF45	TCM	CASSPQGPLINEQFF	CIVRNNAGNMLTF-CASSPQGPLINEQFF	14
HD3	0407-YF54	TCM	CASSPQGQRPYEQYV	CASSPQGQRPYEQYV	1
HD2	1501-YF45	TCM	CASSPTGLGDYGYTF	CIALPAGGTSYGKLTF-CASSPTGLGDYGYTF	15
HD2	1501-YF45	TCM	CASSPTGLGDYGYTF	CIALPAGGTSYGKLTF-CASSPTGLGDYGYTF	15
HD2	1501-YF45	TCM	CASSPTGLGDYGYTF	CIALPAGGTSYGKLTF-CASSPTGLGDYGYTF	15
HD2	1501-YF45	TCM	CASSPTGLGDYGYTF	CIALPAGGTSYGKLTF-CASSPTGLGDYGYTF	15
HD2	1501-YF45	TCM	CASSPTGLGDYGYTF	CIALPAGGTSYGKLTF-CASSPTGLGDYGYTF	15
HD2	1501-YF45	TCM	CASSPTGLGDYGYTF	CIALPAGGTSYGKLTF-CASSPTGLGDYGYTF	15
HD3	0407-YF54	TCM	CASSPTSGRGYEQYF	CALIGDDMRF-CASSPTSGRGYEQYF	2
HD3	1501-YF91	TCM	CASSQDLAGGSYNSPLHF	CALSEGDQGGKLIF-CASSQDLAGGSYNSPLHF	1
HD3	1501-YF91	TCM	CASSQDLGFENSPLHF	CAVGAR_TYKYIF-CASSQDLGFENSPLHF	4

HD3	1501-YF91	TCM	CASSQDLGFENSPLHF	CAVGAR_TYKYIF-CASSQDLGFENSPLHF	4
HD3	1501-YF91	TCM	CASSQDLGFENSPLHF	CASSQDLGFENSPLHF	4
HD3	1501-YF91	TCM	CASSQDVGGEIGNSPLHF	CAGVGMNRDDKIIF-CASSQDVGGEIGNSPLHF	4
HD3	1501-YF91	TCM	CASSQDVGGEIGNSPLHF	CAGVGMNRDDKIIF-CASSQDVGGEIGNSPLHF	4
HD3	1501-YF45	TCM	CASSQGGLNTEAFF	CASSQGGLNTEAFF	1
HD3	0407-YF54	TCM	CASSQIGTSGSFSYNEQFF	CAVNDRDDKIIF-CASSQIGTSGSFSYNEQFF	1
HD2	1501-YF45	TCM	CASSQQQGLNTEAFF	CALGGFKTIF-CASSQQQGLNTEAFF	7
HD3	1501-YF45	TCM	CASSRDRGPYEQYF	CAENTNTGGFKTIF-CASSRDRGPYEQYF	1
HD3	1501-YF45	TCM	CASSRNGGPFSEQYF	CASSRNGGPFSEQYF	1
HD2	1501-YF45	TCM	CASSSGASTPGYEQYF	CIVRSAGNMLTF-CASSSGASTPGYEQYF	5
HD2	1501-YF45	TCM	CASSSGASTPGYEQYF	CIVRSAGNMLTF-CASSSGASTPGYEQYF;CIVRSAGNMLTF-CASSSGASTPGYEQYF	5
HD2	1501-YF45	TCM	CASSSGEVLGEQYF	CIVRPSAGGGNKLTF-CASSSGEVLGEQYF	1
HD2	1501-YF45	TCM	CASSSGGLNTEAFF	CASSSGGLNTEAFF	2
HD3	1501-YF45	TCM	CASSSGLAIEQYF	CIVRVGNYGQNFVF-CASSSGLAIEQYF	3
HD2	1501-YF45	TCM	CASSSGSNTVNTEAFF	CIVRYSGGSNYKLTF-CASSSGSNTVNTEAFF	1
HD2	1501-YF45	TCM	CASSSMGLAGGLTGELFF	CAGRTNTGNQFYF-CASSSMGLAGGLTGELFF	12
HD2	1501-YF45	TCM	CASSSMGLAGGLTGELFF	CAGRTNTGNQFYF-CASSSMGLAGGLTGELFF	12
HD2	1501-YF45	TCM	CASSSMGLAGGLTGELFF	CAGRTNTGNQFYF-CASSSMGLAGGLTGELFF	12
HD2	1501-YF45	TCM	CASSSMGLAGGLTGELFF	CAGRTNTGNQFYF-CASSSMGLAGGLTGELFF	12
HD2	1501-YF45	TCM	CASSSMGLAGGLTGELFF	CAGRTNTGNQFYF-CASSSMGLAGGLTGELFF	12
HD2	1501-YF45	TCM	CASSSMGLAGGLTGELFF	CAGRTNTGNQFYF-CASSSMGLAGGLTGELFF;CALVNRDNARLMF-CASSSMGLAGGLTGELFF	12
HD3	1501-YF45	TCM	CASSSPGLNTEAFF	CALCTGGGNKLTF-CASSSPGLNTEAFF	2
HD3	1501-YF45	TCM	CASSSPGLNTEAFF	CALCTGGGNKLTF-CASSSPGLNTEAFF	2
HD3	1501-YF45	TCM	CASSSSGGIYNEQFF	CIVKVQTGANNLFF-CASSSSGGIYNEQFF	4
HD3	1501-YF45	TCM	CASSSSGGIYNEQFF	CIVKVQTGANNLFF-CASSSSGGIYNEQFF	4
HD3	1501-YF45	TCM	CASSSSGGIYNEQFF	CASSSSGGIYNEQFF	4
HD3	1501-YF91	TCM	CASSSSTYEQYF	CAGTDRGSTLGRLYF-CASSSSTYEQYF;CAGAPGGR_GADGLTF-CASSSSTYEQYF	1
HD2	1501-YF45	TCM	CASSSTTDGYTF	CASSSTTDGYTF	7
HD2	1501-YF45	TCM	CASSSTTDGYTF	CASSSTTDGYTF	7
HD2	1501-YF45	TCM	CASSSTTDGYTF	CASSSTTDGYTF	7
HD2	1501-YF45	TCM	CASSSTTDGYTF	CAVGAQGGFGNVLHC-CASSSTTDGYTF	7
HD2	1501-YF45	TCM	CASSTGGLTTEAFF	CASSTGGLTTEAFF	3
HD2	1501-YF45	TCM	CASSTGGLTTEAFF	CASSTGGLTTEAFF	3
HD3	1501-YF45	TCM	CASSTQGLITEAFF	CASSTQGLITEAFF	8
HD3	1501-YF45	TCM	CASSTQGLITEAFF	CAENNNNARLMF-CASSTQGLITEAFF	8
HD3	1501-YF45	TCM	CASSTQGLITEAFF	CASSTQGLITEAFF	8
HD3	1501-YF45	TCM	CASSTQGLITEAFF	CASSTQGLITEAFF	8

HD2	1501-YF45	TCM	CASSVGMGSTDTQYF	CAVQAWDKIIF-CASSVGMGSTDTQYF	7
HD3	1501-YF91	TCM	CASSVIDNEQFF	CLVGDIDNAGNMLTF-CASSVIDNEQFF	1
HD2	1501-YF45	TCM	CASSWTGALGEQYF	CIVRPLSGNTPLVF-CASSWTGALGEQYF	1
HD3	1501-YF91	TCM	CASSYEAGSSSGANVLTF	CAVRVTGGFKTIF-CASSYEAGSSSGANVLTF	1
HD3	1501-YF45	TCM	CASSYPGTANTEAFF	CIAKATGTASKLTF-CASSYPGTANTEAFF	1
HD2	0407-YF80	TCM	CASSYRDRAFSRRGTEAFF	CASSYRDRAFSRRGTEAFF	1
HD3	1501-YF91	TCM	CASSYRPDTEAFF	CIPTL_YALNF-CASSYRPDTEAFF	1
HD3	1501-YF45	TCM	CASTKSGGVYNEQFF	CIVRVQTGANNLFF-CASTKSGGVYNEQFF	2
HD2	1501-YF45	TCM	CASTLSGGVYNEQFF	CIVRVASAGNNRKLIW-CASTLSGGVYNEQFF	1
HD2	1501-YF45	TCM	CASTSSGGIYNEQFF	CIVRVQTGANNLFF-CASTSSGGIYNEQFF	8
HD2	1501-YF45	TCM	CASTSSGGIYNEQFF	CIVRVQTGANNLFF-CASTSSGGIYNEQFF	8
HD2	1501-YF45	TCM	CASTSSGGIYNEQFF	CIVRVQTGANNLFF-CASTSSGGIYNEQFF	8
HD2	1501-YF45	TCM	CASTSSGGIYNEQFF	CIVRVQTGANNLFF-CASTSSGGIYNEQFF	8
HD2	1501-YF45	TCM	CATSDFPVVGVNYGYTF	CALVSNSGYALNF-CATSDFPVVGVNYGYTF	1
HD3	0407-YF54	TCM	CATSREVSRGQYF	CATSREVSRGQYF	1
HD3	1501-YF91	TCM	CAVFTVEAGRDEAFF	CAFVPFGGAQKLVF-CAVFTVEAGRDEAFF	2
HD2	1501-YF45	TCM	CSAGVRVEGEQFF	CAERTSGGYQKVTF-CSAGVRVEGEQFF	2
HD2	1501-YF45	TCM	CSAISGSVYNEQFF	CIVRVPVVNNNDMRF-CSAISGSVYNEQFF	1
HD2	1501-YF45	TCM	CSAKFTTGRKETQYF	CAFISDGGQKLLF-CSAKFTTGRKETQYF	1
HD3	1501-YF45	TCM	CSAKMRVGGELFF	CSAKMRVGGELFF	3
HD2	1501-YF45	TCM	CSAKMTSGASYEQYF	CATDAYTDKLIF-CSAKMTSGASYEQYF	1
HD3	1501-YF45	TCM	CSALVRTGDQQPQHF	CAAGGRGGNTGKLIF-CSALVRTGDQQPQHF	1
HD2	1501-YF45	TCM	CSANPRTGYNQPQHF	CAVRDRGGFGNVLHC-CSANPRTGYNQPQHF	3
HD2	1501-YF45	TCM	CSANPRTGYNQPQHF	CAVRDRGGFGNVLHC-CSANPRTGYNQPQHF	3
HD2	1501-YF45	TCM	CSANPRTGYNQPQHF	CAVRDRGGFGNVLHC-CSANPRTGYNQPQHF	3
HD3	1501-YF45	TCM	CSANVRVEGEQYF	CAAIRGTYKYIF-CSANVRVEGEQYF	1
HD2	1501-YF45	TCM	CSAQMRTGGSGNTIYF	CLVETGNTGKLIF-CSAQMRTGGSGNTIYF	1
HD2	1501-YF45	TCM	CSARAITARYEQYF	CSARAITARYEQYF	2
HD2	1501-YF45	TCM	CSARAITARYEQYF	CSARAITARYEQYF	2
HD2	1501-YF45	TCM	CSARALTTVAEAFF	CIVPPGGGADGLTF-CSARALTTVAEAFF	1
HD3	1501-YF45	TCM	CSARATSGGASEQYF	CSARATSGGASEQYF	13
HD3	1501-YF45	TCM	CSARATSGGASEQYF	CSARATSGGASEQYF	13
HD3	1501-YF45	TCM	CSARATSGGASEQYF	CSARATSGGASEQYF	13
HD3	1501-YF45	TCM	CSARATSGGASEQYF	CSARATSGGASEQYF	13
HD3	1501-YF45	TCM	CSARATSGGASEQYF	CAASGAL_GYNKLIF-CSARATSGGASEQYF	13
HD3	1501-YF45	TCM	CSARATSGGASEQYF	CSARATSGGASEQYF	13
HD3	0407-YF54	TCM	CSARDEGAKNIQYF	CSARDEGAKNIQYF	1
HD3	0407-YF54	TCM	CSARDWQGQRNTEAFF	CAVNGYGNKLVF-CSARDWQGQRNTEAFF	3
HD3	0407-YF54	TCM	CSAREIQGARNTEAFF	CAVNGGDDKIIF-CSAREIQGARNTEAFF	7
HD3	0407-YF54	TCM	CSAREIQGARNTEAFF	CAVNGGDDKIIF-CSAREIQGARNTEAFF	7
HD3	0407-YF54	TCM	CSAREIQGARNTEAFF	CAVNGGDDKIIF-CSAREIQGARNTEAFF	7

HD3	0407-YF54	TCM	CSAREIQGARNTEAFF	CAVNGGDDKIIF-CSAREIQGARNTEAFF	7
HD3	0407-YF54	TCM	CSARGLQRRNTEAFF	CAVNDRDDKIIF-CSARGLQRRNTEAFF	3
HD3	1501-YF91	TCM	CSARGRIANYGYTF	CAAPLSGSARQLTF-CSARGRIANYGYTF	7
HD3	1501-YF45	TCM	CSARILTGEDSPLHF	CSARILTGEDSPLHF	2
HD3	1501-YF45	TCM	CSARILTSNNSPLHF	CATDARTTDSWGKLQF-CSARILTSNNSPLHF	1
HD2	1501-YF45	TCM	CSARLLVNGEQFF	CALTFSASKIIF-CSARLLVNGEQFF	1
HD2	1501-YF45	TCM	CSARLSGSIGEQFF	CSARLSGSIGEQFF	3
HD2	1501-YF45	TCM	CSARPPTLGQTNTEAFF	CIVRLPISGNTPLVF-CSARPPTLGQTNTEAFF	1
HD2	1501-YF45	TCM	CSARRGEASYEQYF	CAGHPRGYALNF-CSARRGEASYEQYF	1
HD2	1501-YF45	TCM	CSARRTSILNEQYF	CAAP*TAQGGKLIF-CSARRTSILNEQYF;CALDSRDAGKSTF-CSARRTSILNEQYF	1
HD2	1501-YF45	TCM	CSARSRTGWGTEAFF	CAGSSYGQNFVF-CSARSRTGWGTEAFF	2
HD3	0407-YF54	TCM	CSARVADRGTTRNTEAFF	CSARVADRGTTRNTEAFF	3
HD3	0407-YF54	TCM	CSARVADRGTTRNTEAFF	CAVNRGDDKIIF-CSARVADRGTTRNTEAFF	3
HD3	1501-YF45	TCM	CSARVGSVIGNTIYF	CAAFAYSGAGSYQLTF-CSARVGSVIGNTIYF	1
HD3	1501-YF45	TCM	CSARVIAGAYEQYF	CAASGAGGTSYGKLTF-CSARVIAGAYEQYF	1
HD2	1501-YF45	TCM	CSARVLAGGPYVEQYF	CVVSEGNAGNMLTF-CSARVLAGGPYVEQYF	1
HD2	1501-YF45	TCM	CSARVLSGGPQETQYF	CAGRPYNFNKFYF-CSARVLSGGPQETQYF	1
HD2	1501-YF45	TCM	CSARVLTGNNQPQHF	CALNYRKTF-CSARVLTGNNQPQHF	2
HD2	1501-YF45	TCM	CSARVLTISSYTF	CAAHNDMRF-CSARVLTISSYTF	1
HD2	1501-YF45	TCM	CSARVLVAGELFF	CAVDAGGTSYGKLTF-CSARVLVAGELFF	1
HD3	1501-YF45	TCM	CSARVSGFNEQFF	CAENTPQAGTALIF-CSARVSGFNEQFF	1
HD2	1501-YF45	TCM	CSARVTAINTGELFF	CIARNTGFQKLVF-CSARVTAINTGELFF	1
HD3	0407-YF54	TCM	CSARVVQGRRNTEAFF	CAVNNRDDKIIF-CSARVVQGRRNTEAFF	16
HD3	1501-YF45	TCM	CSARVVTGSDQPQHF	CIVRSINNAGNMLTF-CSARVVTGSDQPQHF	1
HD3	1501-YF45	TCM	CSARVVVGDTQYF	CALDNAGGTSYGKLTF-CSARVVVGDTQYF	1
HD2	1501-YF45	TCM	CSASAGSLGQPQHF	CAENKNQGGKLIF-CSASAGSLGQPQHF	1
HD2	1501-YF45	TCM	CSASFTSGGWTDTQYF	CAVVYMEYGNKLVF-CSASFTSGGWTDTQYF	1
HD2	1501-YF45	TCM	CSASLVTGGTGELFF	CLVGGNTNAGKSTF-CSASLVTGGTGELFF;CLVGGNTNAGKSTF-CSASLVTGGTGELFF	1
HD2	1501-YF45	TCM	CSASPLTGDEETQYF	WGLPGQ_RALTF-CSASPLTGDEETQYF	1
HD2	1501-YF45	TCM	CSASQGAVGNTIYF	CAENRNAGNMLTF-CSASQGAVGNTIYF	3
HD2	1501-YF45	TCM	CSASQGAVGNTIYF	CAENRNAGNMLTF-CSASQGAVGNTIYF	3
HD2	1501-YF45	TCM	CSASQGAVGNTIYF	CAV**ML_NNRKLIW-CSASQGAVGNTIYF	3
HD2	1501-YF45	TCM	CSASRGYTGELFF	CANAGGTSYGKLTF-CSASRGYTGELFF	1
HD2	1501-YF45	TCM	CSASSGTVSGNTIYF	CAENKAAGNKLTF-CSASSGTVSGNTIYF	2
HD2	1501-YF45	TCM	CSASSGTVSGNTIYF	CAENKAAGNKLTF-CSASSGTVSGNTIYF	2
HD2	1501-YF45	TCM	CSASTGSLGQPQHF	CAENRNQGGKLIF-CSASTGSLGQPQHF	1
HD2	1501-YF45	TCM	CSASVLAGGYNEQFF	CALNYGANNLFF-CSASVLAGGYNEQFF	1
HD3	1501-YF45	TCM	CSASVVTNQPQHF	CAYRSSDYKLSF-CSASVVTNQPQHF	1

HD3	1501-YF45	TCM	CSASYLTGSYNEQFF	CAGQGYNQGGKLIF-CSASYLTGSYNEQFF	55
HD3	1501-YF45	TCM	CSASYLTGSYNEQFF	CAGQGYNQGGKLIF-CSASYLTGSYNEQFF	55
HD3	1501-YF45	TCM	CSASYLTGSYNEQFF	CAGQGYNQGGKLIF-CSASYLTGSYNEQFF	55
HD3	1501-YF45	TCM	CSASYLTGSYNEQFF	CSASYLTGSYNEQFF	55
HD3	1501-YF45	TCM	CSASYLTGSYNEQFF	CAGQGYNQGGKLIF-CSASYLTGSYNEQFF	55
HD3	1501-YF45	TCM	CSASYLTGSYNEQFF	CAGQGYNQGGKLIF-CSASYLTGSYNEQFF	55
HD3	1501-YF45	TCM	CSASYLTGSYNEQFF	CAGQGYNQGGKLIF-CSASYLTGSYNEQFF	55
HD3	1501-YF45	TCM	CSASYLTGSYNEQFF	CAGQGYNQGGKLIF-CSASYLTGSYNEQFF	55
HD3	1501-YF45	TCM	CSASYLTGSYNEQFF	CAGQGYNQGGKLIF-CSASYLTGSYNEQFF	55
HD3	1501-YF45	TCM	CSASYLTGSYNEQFF	CAGQGYNQGGKLIF-CSASYLTGSYNEQFF	55
HD3	1501-YF45	TCM	CSASYLTGSYNEQFF	CAGQGYNQGGKLIF-CSASYLTGSYNEQFF	55
HD3	1501-YF45	TCM	CSASYLTGSYNEQFF	CAGQGYNQGGKLIF-CSASYLTGSYNEQFF	55
HD3	1501-YF45	TCM	CSASYLTGSYNEQFF	CAGQGYNQGGKLIF-CSASYLTGSYNEQFF	55
HD3	1501-YF45	TCM	CSASYLTGSYNEQFF	CAGQGYNQGGKLIF-CSASYLTGSYNEQFF	55
HD3	1501-YF45	TCM	CSASYLTGSYNEQFF	CAGQGYNQGGKLIF-CSASYLTGSYNEQFF	55
HD3	1501-YF45	TCM	CSASYLTGSYNEQFF	CAGQGYNQGGKLIF-CSASYLTGSYNEQFF	55
HD3	1501-YF45	TCM	CSASYLTGSYNEQFF	CAGQGYNQGGKLIF-CSASYLTGSYNEQFF	55
HD3	1501-YF45	TCM	CSASYLTGSYNEQFF	CAGQGYNQGGKLIF-CSASYLTGSYNEQFF	55
HD3	1501-YF45	TCM	CSASYLTGSYNEQFF	CAGQGYNQGGKLIF-CSASYLTGSYNEQFF	55
HD3	1501-YF45	TCM	CSASYLTGSYNEQFF	CSASYLTGSYNEQFF	55
HD3	1501-YF45	TCM	CSASYLTGSYNEQFF	CAGQGYNQGGKLIF-CSASYLTGSYNEQFF	55
HD3	1501-YF45	TCM	CSASYLTGSYNEQFF	CAGQGYNQGGKLIF-CSASYLTGSYNEQFF	55
HD3	1501-YF45	TCM	CSASYLTGSYNEQFF	CAGQGYNQGGKLIF-CSASYLTGSYNEQFF	55
HD3	1501-YF45	TCM	CSASYLTGSYNEQFF	CAGQGYNQGGKLIF-CSASYLTGSYNEQFF	55
HD3	1501-YF45	TCM	CSASYLTGSYNEQFF	CAGQGYNQGGKLIF-CSASYLTGSYNEQFF	55
HD2	1501-YF45	TCM	CSATQMSVGELFF	CAENRAAGNKLTF-CSATQMSVGELFF	1
HD3	1501-YF45	TCM	CSATTGSNSGNTIYF	CAENGNAGNMLTF-CSATTGSNSGNTIYF	1
HD3	1501-YF91	TCM	CSAWDRANYGYTF	CIVRVERDDKIIF-CSAWDRANYGYTF	4
HD3	1501-YF91	TCM	CSAWDRANYGYTF	CIVRVERDDKIIF-CSAWDRANYGYTF	4
HD2	1501-YF45	TCM	CSVAGLYNEQFF	CIVRVLAGANNLFF-CSVAGLYNEQFF	1
HD2	0407-YF80	TCM	CSVEGTSGRGEQFF	CSVEGTSGRGEQFF	19
HD2	0407-YF80	TCM	CSVEGTSGRGEQFF	CSVEGTSGRGEQFF	19
HD2	1501-YF45	TCM	CSVEGTSGRGEQFF	CIVRPSAGNTGKLIF-CSVEGTSGRGEQFF	19
HD3	1501-YF91	TCM	CSVEGTSGRGEQFF	CALSEGDQGGKLIF-CSVEGTSGRGEQFF	19
HD3	1501-YF91	TCM	CSVEGTSGRGEQFF	CSVEGTSGRGEQFF	19
HD3	1501-YF91	TCM	CSVEGTSGRGEQFF	CSVEGTSGRGEQFF	19
HD3	1501-YF45	TCM	CSVEGTSGRGEQFF	CSVEGTSGRGEQFF	19
HD3	1501-YF45	TCM	CSVEGTSGRGEQFF	CSVEGTSGRGEQFF	19
HD3	1501-YF45	TCM	CSVEVRVGGTEAFF	CIIHGSSNTGKLIF-CSVEVRVGGTEAFF	1
HD2	1501-YF45	TCM	CSVGDRVGTGELFF	CIAIGGATNKLIF-CSVGDRVGTGELFF	1
HD2	1501-YF45	TCM	CSVNYRTGMNTEAFF	CIVGSGNTGKLIF-CSVNYRTGMNTEAFF	1
HD2	0407-YF80	TCM	CVVEGQTEAFF	CVVEGQTEAFF	1
HD3	1501-YF45	TEM	CASDLRDR_VRYYGYTF	CIVKVQTGANNLFF-CASDLRDR_VRYYGYTF	1
HD2	0407-YF80	TEM	CASEGGGSGANVLTF	CASEGGGSGANVLTF	3
HD2	0407-YF80	TEM	CASEGGGSGANVLTF	CASEGGGSGANVLTF	3

HD2	0407-YF80	TEM	CASGTGSSGANVLTF	CASGTGSSGANVLTF	9
HD2	0407-YF80	TEM	CASGTGSSGANVLTF	CASGTGSSGANVLTF	9
HD2	0407-YF80	TEM	CASGTGSSGANVLTF	CVVSSRHTDKLIF-CASGTGSSGANVLTF;CALITQGGSEKLVF-CASGTGSSGANVLTF	9
HD2	0407-YF80	TEM	CASGTGSSGANVLTF	CASGTGSSGANVLTF	9
HD2	0407-YF80	TEM	CASGTGSSGANVLTF	CASGTGSSGANVLTF	9
HD2	0407-YF80	TEM	CASGTGSSGANVLTF	CASGTGSSGANVLTF	9
HD2	1501-YF45	TEM	CASHPGTSIAGELFF	CAVGSSGNTGKLIF-CASHPGTSIAGELFF	1
HD2	0407-YF80	TEM	CASIGGGEGNEQFF	CASIGGGEGNEQFF	5
HD2	1501-YF45	TEM	CASIKIGVLGYGYTF	CVVSFLW_GYNKLIF-CASIKIGVLGYGYTF	12
HD2	1501-YF45	TEM	CASIKIGVLGYGYTF	CASIKIGVLGYGYTF	12
HD2	1501-YF45	TEM	CASIKIGVLGYGYTF	CASIKIGVLGYGYTF	12
HD2	1501-YF45	TEM	CASIKIGVLGYGYTF	CVVSFLW_GYNKLIF-CASIKIGVLGYGYTF	12
HD2	1501-YF45	TEM	CASIKIGVLGYGYTF	CVVSFLW_GYNKLIF-CASIKIGVLGYGYTF	12
HD3	1501-YF91	TEM	CASKHRPDSYEQYF	CAASEEMDSSYKLIF-CASKHRPDSYEQYF	2
HD2	1501-YF45	TEM	CASKMDSWTNTEAFF	CAYRSAGTGNQFYF-CASKMDSWTNTEAFF	1
HD2	0407-YF80	TEM	CASPKSSGSTDTQYF	CASPKSSGSTDTQYF	14
HD2	0407-YF80	TEM	CASPKSSGSTDTQYF	CASPKSSGSTDTQYF	14
HD2	0407-YF80	TEM	CASPKSSGSTDTQYF	CALITQGGSEKLVF-CASPKSSGSTDTQYF	14
HD2	0407-YF80	TEM	CASPKSSGSTDTQYF	CASPKSSGSTDTQYF	14
HD2	0407-YF80	TEM	CASPKSSGSTDTQYF	CASPKSSGSTDTQYF	14
HD2	0407-YF80	TEM	CASPKSSGSTDTQYF	CASPKSSGSTDTQYF	14
HD2	0407-YF80	TEM	CASPKSSGSTDTQYF	CASPKSSGSTDTQYF	14
HD2	0407-YF80	TEM	CASPKSSGSTDTQYF	CASPKSSGSTDTQYF	14
HD2	0407-YF80	TEM	CASPKSSGSTDTQYF	CASPKSSGSTDTQYF	14
HD2	0407-YF80	TEM	CASPKSSGSTDTQYF	CASPKSSGSTDTQYF	14
HD2	0407-YF80	TEM	CASPKSSGSTDTQYF	CASPKSSGSTDTQYF	14
HD2	1501-YF45	TEM	CASQTGASVTYEQYF	CIVRVAAGNTGKLIF-CASQTGASVTYEQYF	9
HD3	1501-YF45	TEM	CASRDLYGYTF	CIVRVAAEAAGNKLTF-CASRDLYGYTF	3
HD2	0407-YF80	TEM	CASRWDGNSPLHF	CASRWDGNSPLHF	6
HD2	1501-YF45	TEM	CASSEGHIPMNTEAFF	CIVRVAAGQSGYALNF-CASSEGHIPMNTEAFF	5
HD2	1501-YF45	TEM	CASSEGHIPMNTEAFF	CIVRVAAGQSGYALNF-CASSEGHIPMNTEAFF	5
HD2	1501-YF45	TEM	CASSEGHIPMNTEAFF	CIVRVAAGQSGYALNF-CASSEGHIPMNTEAFF	5
HD2	1501-YF45	TEM	CASSEGHIPMNTEAFF	CIVRVAAGQSGYALNF-CASSEGHIPMNTEAFF	5
HD3	0407-YF54	TEM	CASSFGTGVDEAFF	CAGRNGGSQGNLIF-CASSFGTGVDEAFF	1
HD2	0407-YF80	TEM	CASSFSSGTAGPPLHF	CASSFSSGTAGPPLHF	1
HD2	1501-YF45	TEM	CASSKGSTSGSYNEQFF	CIVRVVAGNEKLTF-CASSKGSTSGSYNEQFF	1
HD3	0407-YF54	TEM	CASSLAGGFYEQYF	CAVREDDKIIF-CASSLAGGFYEQYF	1
HD2	1501-YF45	TEM	CASSLAGTVNTEAFF	CIVKGTGTASKLTF-CASSLAGTVNTEAFF	2
HD2	1501-YF45	TEM	CASSLAGVGPGGYEQFF	CAPPDQAGTALIF-CASSLAGVGPGGYEQFF	2
HD2	1501-YF45	TEM	CASSLAVTVRSSNYGYTF	CIVRVQTGANNLFF-CASSLAVTVRSSNYGYTF	3

HD2	1501-YF45	TEM	CASSLEPVRDTEAFF	CAGSAINSGGSNYKLTF-CASSLEPVRDTEAFF	1
HD2	1501-YF45	TEM	CASSLGFSMTDRGYTF	CIVRPSAGNTGKLIF-CASSLGFSMTDRGYTF	3
HD2	1501-YF45	TEM	CASSLGFSMTDRGYTF	CIVRPSAGNTGKLIF-CASSLGFSMTDRGYTF;CAENNGQLGDKIIF-CASSLGFSMTDRGYTF	3
HD2	1501-YF45	TEM	CASSLGFVAGKELFF	CIVSALSGNTGKLIF-CASSLGFVAGKELFF	2
HD2	1501-YF45	TEM	CASSLGFVAGKELFF	CIVSALSGNTGKLIF-CASSLGFVAGKELFF	2
HD2	1501-YF45	TEM	CASSLGGTVNTEAFF	CIGKHTGTASKLTF-CASSLGGTVNTEAFF	1
HD2	1501-YF45	TEM	CASSLGPGLAGETQYF	CIVTPLSGYALNF-CASSLGPGLAGETQYF	1
HD2	0407-YF80	TEM	CASSLGSAGANVLTF	CAVERQGSGNTGKLIF-CASSLGSAGANVLTF	3
HD2	0407-YF80	TEM	CASSLGSAGANVLTF	CALITQGGSEKLVF-CASSLGSAGANVLTF;CAPDNYGQNFVF-CASSLGSAGANVLTF	3
HD2	1501-YF45	TEM	CASSLGSLAGSYNEQFF	CIVRVRAGNTPLVF-CASSLGSLAGSYNEQFF	4
HD2	1501-YF45	TEM	CASSLGSLAGSYNEQFF	CIVRVRAGNTPLVF-CASSLGSLAGSYNEQFF	4
HD2	1501-YF45	TEM	CASSLGTSYRAPYEQYF	CIGWSSGDKLTF-CASSLGTSYRAPYEQYF	1
HD2	0407-YF80	TEM	CASSLNPLGPWT_GD*GTNEKLFF	CVVSSRHTDKLIF-CASSLNPLGPWT_GD*GTNEKLFF	1
HD2	0407-YF80	TEM	CASSLNTGVKQPQHF	CASSLNTGVKQPQHF	2
HD2	0407-YF80	TEM	CASSLNTGVKQPQHF	CASSLNTGVKQPQHF	2
HD2	1501-YF45	TEM	CASSLQM*A_RTTDTQYF	CAGSGGSYIPTF-CASSLQM*A_RTTDTQYF	1
HD2	1501-YF45	TEM	CASSLSRQGAREQFF	CAMREGPYNFNKFYF-CASSLSRQGAREQFF	3
HD2	1501-YF45	TEM	CASSLSRQGAREQFF	CAMREGPYNFNKFYF-CASSLSRQGAREQFF	3
HD2	1501-YF45	TEM	CASSLTAGRGAGGANVLTF	CIVSRAGSYQLTF-CASSLTAGRGAGGANVLTF;CAFIMYSGGGADGLTF-CASSLTAGRGAGGANVLTF	2
HD2	1501-YF45	TEM	CASSLTAGRGAGGANVLTF	CIVSRAGSYQLTF-CASSLTAGRGAGGANVLTF	2
HD2	1501-YF45	TEM	CASSLTQGRNSPLHF	CADGSGNTGKLIF-CASSLTQGRNSPLHF	1
HD3	1501-YF45	TEM	CASSLVQLNTEAFF	CIVRVYAGNMLTF-CASSLVQLNTEAFF	2
HD3	1501-YF45	TEM	CASSMTVQGAIGANVLTF	CAGAGGTSYGKLTF-CASSMTVQGAIGANVLTF	5
HD3	0407-YF54	TEM	CASSNGA_NTGELFF	CAVNNGGNKLVF-CASSNGA_NTGELFF	2
HD3	1501-YF45	TEM	CASSNLRGSEQYF	CALSEGPNNAGNMLTF-CASSNLRGSEQYF	1
HD2	1501-YF45	TEM	CASSPGGLSTEAFF	CAVQQE_TPLVF-CASSPGGLSTEAFF	4
HD2	1501-YF45	TEM	CASSPGGLSTEAFF	CAVQQE_TPLVF-CASSPGGLSTEAFF	4
HD3	1501-YF45	TEM	CASSPQGPLINEQFF	CIVRNNAGNMLTF-CASSPQGPLINEQFF	14
HD3	0407-YF54	TEM	CASSPQGPSYEQYF	CAVSGRTGAGSYQLTF-CASSPQGPSYEQYF	1
HD3	0407-YF54	TEM	CASSPSLGDTQYF	CAFMKPFPGGTSYGKLTF-CASSPSLGDTQYF	1
HD2	1501-YF45	TEM	CASSPSRPGGPLSYEQYF	CATVDNQGGKLIF-CASSPSRPGGPLSYEQYF	3
HD2	1501-YF45	TEM	CASSPTGLGDYGYTF	CIALPAGGTSYGKLTF-CASSPTGLGDYGYTF	15
HD2	1501-YF45	TEM	CASSPTGLGDYGYTF	CIALPAGGTSYGKLTF-CASSPTGLGDYGYTF	15

HD2	1501-YF45	TEM	CASSPTGLGDYGYTF	CIALPAGGTSYGKLTF-CASSPTGLGDYGYTF	15
HD3	0407-YF54	TEM	CASSPTSGRGYEQYF	CALIGDDMRF-CASSPTSGRGYEQYF	2
HD2	1501-YF45	TEM	CASSQERLTYTGELFF	CIVRVGAGSARQLTF-CASSQERLTYTGELFF	1
HD2	1501-YF45	TEM	CASSQQQGLNTEAFF	CALGGFKTIF-CASSQQQGLNTEAFF;CALGGFKTIF-CASSQQQGLNTEAFF	7
HD2	1501-YF45	TEM	CASSQQQGLNTEAFF	CALGGFKTIF-CASSQQQGLNTEAFF;CALGGFKTIF-CASSQQQGLNTEAFF	7
HD2	1501-YF45	TEM	CASSQQQGLNTEAFF	CALGGFKTIF-CASSQQQGLNTEAFF;CALGGFKTIF-CASSQQQGLNTEAFF	7
HD2	1501-YF45	TEM	CASSQQQGLNTEAFF	CALGGFKTIF-CASSQQQGLNTEAFF	7
HD2	1501-YF45	TEM	CASSQQQGLNTEAFF	CALGGFKTIF-CASSQQQGLNTEAFF	7
HD2	1501-YF45	TEM	CASSQRQGINTEAFF	CVVSVGKFSDGQKLLF-CASSQRQGINTEAFF;CIVRSAGNMLTF-CASSQRQGINTEAFF	3
HD2	1501-YF45	TEM	CASSQRQGINTEAFF	CVVSVGKFSDGQKLLF-CASSQRQGINTEAFF	3
HD3	0407-YF54	TEM	CASSQSIDRNNYGYTF	CASSQSIDRNNYGYTF	1
HD2	1501-YF45	TEM	CASSQSRQSAYEQYF	CAMREGPYNFNKFYF-CASSQSRQSAYEQYF	1
HD2	1501-YF45	TEM	CASSSGASTPGYEQYF	CIVRSAGNMLTF-CASSSGASTPGYEQYF	5
HD2	1501-YF45	TEM	CASSSGGLNTEAFF	CAVGRQGGGADGLTF-CASSSGGLNTEAFF	2
HD2	1501-YF45	TEM	CASSSGGSVSNEQFF	CIVRPSSGNTGKLIF-CASSSGGSVSNEQFF	1
HD2	1501-YF45	TEM	CASSSMGLAGGLTGELFF	CAGRTNTGNQFYF-CASSSMGLAGGLTGELFF;CALVNRDNARLMF-CASSSMGLAGGLTGELFF	12
HD2	1501-YF45	TEM	CASSSMGLAGGLTGELFF	CAGRTNTGNQFYF-CASSSMGLAGGLTGELFF;CALVNRDNARLMF-CASSSMGLAGGLTGELFF	12
HD2	1501-YF45	TEM	CASSSMGLAGGLTGELFF	CAGRTNTGNQFYF-CASSSMGLAGGLTGELFF;CAGRTNTGNQFYF-CASSSMGLAGGLTGELFF	12
HD2	1501-YF45	TEM	CASSSMGLAGGLTGELFF	CAGRTNTGNQFYF-CASSSMGLAGGLTGELFF	12
HD2	1501-YF45	TEM	CASSSMGLAGGLTGELFF	CAGRTNTGNQFYF-CASSSMGLAGGLTGELFF;CALVNRDNARLMF-CASSSMGLAGGLTGELFF	12
HD3	1501-YF91	TEM	CASSSQNYGYTF	CIVTFRR_GADGLTF-CASSSQNYGYTF	1
HD3	1501-YF45	TEM	CASSSRQGLNTEAFF	CIPPLA_DDKIIF-CASSSRQGLNTEAFF	1
HD2	1501-YF45	TEM	CASSSTTDGYTF	CASSSTTDGYTF	7
HD2	1501-YF45	TEM	CASSSTTDGYTF	CASSSTTDGYTF	7
HD2	1501-YF45	TEM	CASSTGGLTTEAFF	CAVGAQGGGADGLTF-CASSTGGLTTEAFF	3
HD2	1501-YF45	TEM	CASSTGSTTPNNEQFF	CILKTSGSRLTF-CASSTGSTTPNNEQFF	2
HD2	1501-YF45	TEM	CASSTLLAGAPPTDTQYF	CAVSHRSGYSTLTF-CASSTLLAGAPPTDTQYF	2
HD3	1501-YF45	TEM	CASSTQGLITEAFF	CASSTQGLITEAFF	8
HD3	1501-YF45	TEM	CASSTQGLITEAFF	CASSTQGLITEAFF	8
HD3	1501-YF45	TEM	CASSTQGLITEAFF	CASSTQGLITEAFF	8
HD2	1501-YF45	TEM	CASSVAGSVNTEAFF	CAMSPTGGTSYGKLTF-CASSVAGSVNTEAFF	1

HD2	1501-YF45	TEM	CASSVAGTVNTEAFF	CIVKNTGTASKLTF-CASSVAGTVNTEAFF	2
HD2	1501-YF45	TEM	CASSVAGTVNTEAFF	CIVKNTGTASKLTF-CASSVAGTVNTEAFF	2
HD2	1501-YF45	TEM	CASSVGMGSTDTQYF	CAVQAWDKIIF-CASSVGMGSTDTQYF	7
HD2	1501-YF45	TEM	CASSVGMGSTDTQYF	CAVQAWDKIIF-CASSVGMGSTDTQYF	7
HD2	1501-YF45	TEM	CASSVGMGSTDTQYF	CAVQAWDKIIF-CASSVGMGSTDTQYF	7
HD2	1501-YF45	TEM	CASSVGMGSTDTQYF	CAVQAWDKIIF-CASSVGMGSTDTQYF	7
HD2	1501-YF45	TEM	CASSVGMGSTDTQYF	CAVQAWDKIIF-CASSVGMGSTDTQYF	7
HD3	1501-YF45	TEM	CASSVGSVSGGTGELFF	CAMSHTGFQKLVF-CASSVGSVSGGTGELFF	2
HD2	1501-YF45	TEM	CASSYEAG_ANNEQFF	CAVRGTSYGKLTF-CASSYEAG_ANNEQFF	1
HD3	1501-YF91	TEM	CASSYGMWYGYTF	CALSEPGGGSEKLVF-CASSYGMWYGYTF	1
HD2	1501-YF45	TEM	CASSYSTGGAAKNIQYF	CAGPGDSSYKLIF-CASSYSTGGAAKNIQYF	2
HD2	1501-YF45	TEM	CASSYSTGGAAKNIQYF	CAGPGDSSYKLIF-CASSYSTGGAAKNIQYF	2
HD2	1501-YF45	TEM	CASTSSGGIYNEQFF	CIVRVQTGANNLFF-CASTSSGGIYNEQFF	8
HD2	1501-YF45	TEM	CASTSSGGIYNEQFF	CIVRVQTGANNLFF-CASTSSGGIYNEQFF	8
HD2	1501-YF45	TEM	CASTSSGGIYNEQFF	CIVRVQTGANNLFF-CASTSSGGIYNEQFF	8
HD2	1501-YF45	TEM	CASTSSGGIYNEQFF	CIVRVQTGANNLFF-CASTSSGGIYNEQFF	8
HD2	0407-YF80	TEM	CATNHGGSGANVLTF	CATNHGGSGANVLTF	1
HD2	0407-YF80	TEM	CATSSDRVREKLFF	CATSSDRVREKLFF	1
HD2	1501-YF45	TEM	CSAGVRVEGEQFF	CAERTSGGYQKVTF-CSAGVRVEGEQFF;CAERTSGGYQKVTF-CSAGVRVEGEQFF	2
HD2	1501-YF45	TEM	CSAHQGNGYTF	CAASHGFQKLVF-CSAHQGNGYTF;CIALPAGGTSYGKLTF-CSAHQGNGYTF	3
HD2	1501-YF45	TEM	CSAHQGNGYTF	CAASHGFQKLVF-CSAHQGNGYTF	3
HD2	1501-YF45	TEM	CSAIQGVVWDTQYF	CILKAPISGNTPLVF-CSAIQGVVWDTQYF	1
HD2	1501-YF45	TEM	CSAPARTGTTEQYF	CAAPSGNTGKLIF-CSAPARTGTTEQYF	1
HD2	1501-YF45	TEM	CSAPVGSLGQPQHF	CAENRAAGNKLTF-CSAPVGSLGQPQHF	1
HD3	1501-YF45	TEM	CSAPVIVGGEQYF	CAACSNDYKLSF-CSAPVIVGGEQYF	1
HD2	1501-YF45	TEM	CSARAPAFAYNEQFF	CIVRVEGGNNRKLIW-CSARAPAFAYNEQFF	1
HD3	1501-YF45	TEM	CSARATSGGASEQYF	CSARATSGGASEQYF	13
HD2	1501-YF45	TEM	CSARAVTGDNSPLHF	CAMTGSARQLTF-CSARAVTGDNSPLHF;CAMTGSARQLTF-CSARAVTGDNSPLHF	1
HD2	1501-YF45	TEM	CSARAVVGGYEQYF	CAYRSRYPYNTDKLIF-CSARAVVGGYEQYF;CAGGLTQGGSEKLVF-CSARAVVGGYEQYF	2
HD2	1501-YF45	TEM	CSARDDGEQFF	CIVRVAGRSINTDKLIF-CSARDDGEQFF	1
HD2	1501-YF45	TEM	CSARDLGQSYGYTF	CIVRGPVGGNKLTF-CSARDLGQSYGYTF	1
HD3	0407-YF54	TEM	CSARDLQGARNTEAFF	CSARDLQGARNTEAFF	1
HD3	0407-YF54	TEM	CSARDRQGRNTEAFF	CAVTLNNNDMRF-CSARDRQGRNTEAFF	1
HD3	0407-YF54	TEM	CSARDVQGRRNTEAFF	CAVNMGDDKIIF-CSARDVQGRRNTEAFF	1
HD3	0407-YF54	TEM	CSARDWQGARNTEAFF	CAVNSNFNKFYF-CSARDWQGARNTEAFF	4
HD3	0407-YF54	TEM	CSARDWQGARNTEAFF	CAVNSNFNKFYF-CSARDWQGARNTEAFF	4
HD3	0407-YF54	TEM	CSARDWQGQRNTEAFF	CAVNGYGNKLVF-CSARDWQGQRNTEAFF	3
HD3	0407-YF54	TEM	CSAREIQGARNTEAFF	CAVNGGDDKIIF-CSAREIQGARNTEAFF	7

HD3	0407-YF54	TEM	CSAREIQGARNTEAFF	CAVNGGDDKIIF-CSAREIQGARNTEAFF	7
HD3	0407-YF54	TEM	CSARGLQRRNTEAFF	CAVNDRDDKIIF-CSARGLQRRNTEAFF	3
HD3	0407-YF54	TEM	CSARGLQRRNTEAFF	CAVNDRDDKIIF-CSARGLQRRNTEAFF	3
HD3	1501-YF91	TEM	CSARGRIANYGYTF	CAAPLSGSARQLTF-CSARGRIANYGYTF	7
HD3	1501-YF91	TEM	CSARGRIANYGYTF	CAAPLSGSARQLTF-CSARGRIANYGYTF	7
HD3	0407-YF54	TEM	CSARGTGGAKSYTF	CSARGTGGAKSYTF	1
HD3	1501-YF45	TEM	CSARILTGEDSPLHF	CSARILTGEDSPLHF	2
HD2	1501-YF45	TEM	CSARISNLNQETQYF	CAVRDGSAYNTDKLIF-CSARISNLNQETQYF	2
HD3	1501-YF45	TEM	CSARLLSSYNSPLHF	CATVNAGGTSYGKLTF-CSARLLSSYNSPLHF	1
HD2	1501-YF45	TEM	CSARLSGSIGEQFF	CSARLSGSIGEQFF	3
HD2	1501-YF45	TEM	CSARPRTGGEQYF	CAMSVTNPFHNAGNMLTF-CSARPRTGGEQYF	1
HD2	1501-YF45	TEM	CSARTLAGGPGETQYF	CALSVIQGAQKLVF-CSARTLAGGPGETQYF	1
HD2	1501-YF45	TEM	CSARTRVGGEQYF	CAVLIGGATNKLIF-CSARTRVGGEQYF;CAFPPRDDKIIF-CSARTRVGGEQYF	2
HD2	1501-YF45	TEM	CSARTRVGGEQYF	CAVLIGGATNKLIF-CSARTRVGGEQYF	2
HD3	0407-YF54	TEM	CSARVADRGTTRNTEAFF	CAVNRGDDKIIF-CSARVADRGTTRNTEAFF	3
HD3	1501-YF45	TEM	CSARVGSLPGNTIYF	CSARVGSLPGNTIYF	1
HD2	1501-YF45	TEM	CSARVITGGGEQYF	CAVSDRNGNKLVF-CSARVITGGGEQYF	1
HD2	1501-YF45	TEM	CSARVLTGNNQPQHF	CALNYRKTF-CSARVLTGNNQPQHF;CAENGSGNTGKLIF-CSARVLTGNNQPQHF	2
HD2	1501-YF45	TEM	CSARVLTYNSPLHF	CAGEPYNTDKLIF-CSARVLTYNSPLHF	1
HD3	1501-YF45	TEM	CSARVLVGQETQYF	CALTYSGYSTLTF-CSARVLVGQETQYF	1
HD3	1501-YF45	TEM	CSARVRVEGEQYF	CGADGNTGNQFYF-CSARVRVEGEQYF	1
HD3	1501-YF45	TEM	CSARVRVQGTQYF	CARDSSGGSNYKLTF-CSARVRVQGTQYF	1
HD3	0407-YF54	TEM	CSARVVQGRRNTEAFF	CAVNNRDDKIIF-CSARVVQGRRNTEAFF	16
HD3	0407-YF54	TEM	CSARVVQGRRNTEAFF	CAVNNRDDKIIF-CSARVVQGRRNTEAFF	16
HD3	0407-YF54	TEM	CSARVVQGRRNTEAFF	CAVNNRDDKIIF-CSARVVQGRRNTEAFF	16
HD3	0407-YF54	TEM	CSARVVQGRRNTEAFF	CAVNNRDDKIIF-CSARVVQGRRNTEAFF	16
HD3	0407-YF54	TEM	CSARVVQGRRNTEAFF	CAVNNRDDKIIF-CSARVVQGRRNTEAFF	16
HD3	0407-YF54	TEM	CSARVVQGRRNTEAFF	CAVNNRDDKIIF-CSARVVQGRRNTEAFF	16
HD3	0407-YF54	TEM	CSARVVQGRRNTEAFF	CAVNNRDDKIIF-CSARVVQGRRNTEAFF	16
HD3	0407-YF54	TEM	CSARVVQGRRNTEAFF	CAVNNRDDKIIF-CSARVVQGRRNTEAFF	16
HD3	0407-YF54	TEM	CSARVVQGRRNTEAFF	CAVNNRDDKIIF-CSARVVQGRRNTEAFF	16
HD3	0407-YF54	TEM	CSARVVQGRRNTEAFF	CSARVVQGRRNTEAFF	16
HD3	0407-YF54	TEM	CSARVVQGRRNTEAFF	CAVNNRDDKIIF-CSARVVQGRRNTEAFF	16
HD2	1501-YF45	TEM	CSARVVSGSGIQYF	CAVVREETSGSRLTF-CSARVVSGSGIQYF	1
HD2	1501-YF45	TEM	CSARVYVGSEQFF	CSARVYVGSEQFF	1
HD2	1501-YF45	TEM	CSASARVGGELFF	CAASRPDSWGKLQF-CSASARVGGELFF	3
HD2	1501-YF45	TEM	CSASARVGGELFF	CAVLLRL_ATNKLIF-CSASARVGGELFF	3
HD2	1501-YF45	TEM	CSASAVVGNIQYF	CAPSETDKLIF-CSASAVVGNIQYF	1
HD2	1501-YF45	TEM	CSASPLSGGANYEQYF	CAVKNAGGTSYGKLTF-CSASPLSGGANYEQYF;CAVKNAGGTSYGKLTF-CSASPLSGGANYEQYF	1

HD2	1501-YF45	TEM	CSASPRVEGEQYF	CIVRGNQFYF-CSASPRVEGEQYF	2
HD2	1501-YF45	TEM	CSASQGTASGNTIYF	CAENMAAGNKLTF-CSASQGTASGNTIYF	1
HD2	1501-YF45	TEM	CSASVRTGDNQPQHF	CAGRFQGAQKLVF-CSASVRTGDNQPQHF	1
HD3	1501-YF45	TEM	CSASYLTGSYNEQFF	CAGQGYNQGGKLIF-CSASYLTGSYNEQFF	55
HD3	1501-YF45	TEM	CSASYLTGSYNEQFF	CAGQGYNQGGKLIF-CSASYLTGSYNEQFF	55
HD3	1501-YF45	TEM	CSASYLTGSYNEQFF	CAGQGYNQGGKLIF-CSASYLTGSYNEQFF	55
HD3	1501-YF45	TEM	CSASYLTGSYNEQFF	CAGQGYNQGGKLIF-CSASYLTGSYNEQFF	55
HD3	1501-YF45	TEM	CSASYLTGSYNEQFF	CAGQGYNQGGKLIF-CSASYLTGSYNEQFF	55
HD3	1501-YF45	TEM	CSASYLTGSYNEQFF	CAGQGYNQGGKLIF-CSASYLTGSYNEQFF	55
HD3	1501-YF45	TEM	CSASYLTGSYNEQFF	CAGQGYNQGGKLIF-CSASYLTGSYNEQFF	55
HD3	1501-YF45	TEM	CSASYLTGSYNEQFF	CAGQGYNQGGKLIF-CSASYLTGSYNEQFF	55
HD3	1501-YF45	TEM	CSASYLTGSYNEQFF	CAGQGYNQGGKLIF-CSASYLTGSYNEQFF	55
HD3	1501-YF45	TEM	CSASYLTGSYNEQFF	CAGQGYNQGGKLIF-CSASYLTGSYNEQFF	55
HD2	1501-YF45	TEM	CSASYMTGVGTQYF	CATGYLMGGATNKLIF-CSASYMTGVGTQYF	2
HD2	1501-YF45	TEM	CSASYMTGVGTQYF	CATGYLMGGATNKLIF-CSASYMTGVGTQYF	2
HD2	1501-YF45	TEM	CSATIRTGAGVEQYF	CALSEAYGSGNTGKLIF-CSATIRTGAGVEQYF	1
HD2	1501-YF45	TEM	CSATLRTGANTEAFF	CIVPGTYKYIF-CSATLRTGANTEAFF	1
HD2	1501-YF45	TEM	CSAYQRVAGELFF	CAFNGLGDSWGKLQF-CSAYQRVAGELFF	1
HD2	1501-YF45	TEM	CSGKAVSGSNQPQHF	CALSGYMGGSEKLVF-CSGKAVSGSNQPQHF	1
HD2	1501-YF45	TEM	CSVEDRAGGTEAFF	CAVRVYSSASKIIF-CSVEDRAGGTEAFF	1
HD3	1501-YF45	TEM	CSVEGTSGRGEQFF	CAGQGYNQGGKLIF-CSVEGTSGRGEQFF	19
HD3	1501-YF45	TEM	CSVEGTSGRGEQFF	CSVEGTSGRGEQFF	19
HD3	1501-YF45	TEM	CSVEGTSGRGEQFF	CSVEGTSGRGEQFF	19
HD3	1501-YF45	TEM	CSVEGTSGRGEQFF	CSVEGTSGRGEQFF	19
HD3	1501-YF45	TEM	CSVEGTSGRGEQFF	CSVEGTSGRGEQFF	19
HD3	1501-YF45	TEM	CSVEGTSGRGEQFF	CALTLNSGNTPLVF-CSVEGTSGRGEQFF	19
HD3	1501-YF45	TEM	CSVEGTSGRGEQFF	CAGQGYNQGGKLIF-CSVEGTSGRGEQFF	19
HD3	1501-YF45	TEM	CSVEGTSGRGEQFF	CSVEGTSGRGEQFF	19
HD3	1501-YF45	TEM	CSVEGTSGRGEQFF	CSVEGTSGRGEQFF	19
HD2	1501-YF45	TEM	CSVGNRVGSRELFF	CIVRVPSPSAGNMLTF-CSVGNRVGSRELFF	1
HD3	1501-YF45	TEM	CSVRTGQVTGELFF	CAGQEGIQ_GGADGLTF-CSVRTGQVTGELFF	3
HD2	1501-YF45	TEM	CSVSDRVGSDTIYF	CLVGAGNTGKLIF-CSVSDRVGSDTIYF	1
HD3	1501-YF91	Naïve	CASASVAGGTYEQYF	CALSEGDQGGKLIF-CASASVAGGTYEQYF	6
HD3	1501-YF91	Naive	CASASVAGGTYEQYF	CALSEGDQGGKLIF-CASASVAGGTYEQYF	6
HD2	1501-YF45	Naive	CASQTGASVTYEQYF	CIVRVAAGNTGKLIF-CASQTGASVTYEQYF	9
HD2	1501-YF45	Naive	CASQTGASVTYEQYF	CIVRVAAGNTGKLIF-CASQTGASVTYEQYF	9
HD2	1501-YF45	Naive	CASQTGASVTYEQYF	CIVRVAAGNTGKLIF-CASQTGASVTYEQYF	9
HD3	1501-YF91	Naive	CASRPEDEPQHF	CALSEGDQGGKLIF-CASRPEDEPQHF	1
HD2	0407-YF80	Naive	CASRWDGNSPLHF	CASRWDGNSPLHF	6
HD3	0407-YF54	Naive	CASSFLAGANEQFF	CAVNNRDDKIIF-CASSFLAGANEQFF	1
HD3	1501-YF91	Naive	CASSLDFNSPLHF	CASSLDFNSPLHF	1
HD3	0407-YF54	Naive	CASSLLGQTEAFF	CASSLLGQTEAFF	1

HD3	1501-YF91	Naive	CASSLSAGGRDEQFF	CAESQGGYQKVTF-CASSLSAGGRDEQFF	2
HD2	1501-YF45	Naive	CASSLSRQGAREQFF	CAMREGPYNFNKFYF-CASSLSRQGAREQFF	3
HD3	1501-YF45	Naive	CASSMTVQGAIGANVLTF	CAGAGGTSYGKLTF-CASSMTVQGAIGANVLTF	5
HD3	1501-YF91	Naive	CASSPFLGAVDTQYF	CAFMIDNARLMF-CASSPFLGAVDTQYF	1
HD2	1501-YF45	Naive	CASSPLSGGAYKTQYF	CALRGGGADGLTF-CASSPLSGGAYKTQYF	1
HD3	1501-YF45	Naive	CASSPQGPLINEQFF	CIVRNNAGNMLTF-CASSPQGPLINEQFF	14
HD2	1501-YF45	Naive	CASSPSRPGGPLSYEQYF	CASSPSRPGGPLSYEQYF	3
HD2	1501-YF45	Naive	CASSPSRPGGPLSYEQYF	CATVDNQGGKLIF-CASSPSRPGGPLSYEQYF	3
HD2	1501-YF45	Naive	CASSPTGLGDYGYTF	CIALPAGGTSYGKLTF-CASSPTGLGDYGYTF	15
HD2	1501-YF45	Naive	CASSPTGLGDYGYTF	CIALPAGGTSYGKLTF-CASSPTGLGDYGYTF	15
HD2	1501-YF45	Naive	CASSPTGLGDYGYTF	CIALPAGGTSYGKLTF-CASSPTGLGDYGYTF;CIALPAGGTSYGKLTF-CASSPTGLGDYGYTF	15
HD3	1501-YF91	Naive	CASSQDLGFENSPLHF	CAVGAR_TYKYIF-CASSQDLGFENSPLHF	4
HD3	1501-YF91	Naive	CASSQDRSGGSYNSPLHF	CAVGNQFYF-CASSQDRSGGSYNSPLHF;CAVVTGNQFYF-CASSQDRSGGSYNSPLHF	1
HD3	1501-YF91	Naive	CASSQDVGGEIGNSPLHF	CASSQDVGGEIGNSPLHF	4
HD3	1501-YF91	Naive	CASSQDVGGEIGNSPLHF	CALSEGDQGGKLIF-CASSQDVGGEIGNSPLHF;CAQIGFGNVLHC-CASSQDVGGEIGNSPLHF	4
HD3	1501-YF91	Naive	CASSQEGGGYEQYF	CASSQEGGGYEQYF	1
HD3	1501-YF91	Naive	CASSQGTGGVVVEKLFF	CAQIGFGNVLHC-CASSQGTGGVVVEKLFF	1
HD2	1501-YF45	Naive	CASSQRQGINTEAFF	CVVSVGKFSDGQKLLF-CASSQRQGINTEAFF	3
HD3	1501-YF91	Naive	CASSSDRGGSNQPQHF	CALSDMDSSYKLIF-CASSSDRGGSNQPQHF	1
HD2	0407-YF80	Naive	CASSSGGATNEKLFF	CASSSGGATNEKLFF	1
HD3	1501-YF45	Naive	CASSSGLAIEQYF	CIVRVGNYGQNFVF-CASSSGLAIEQYF	3
HD3	1501-YF45	Naive	CASSVGSVSGGTGELFF	CAMSHTGFQKLVF-CASSVGSVSGGTGELFF	2
HD3	1501-YF91	Naive	CATSVRETQYF	CVTGQGGANNLFF-CATSVRETQYF	1
HD3	1501-YF91	Naive	CAVFTVEAGRDEAFF	CAFVPFGGAQKLVF-CAVFTVEAGRDEAFF	2
HD3	1501-YF45	Naive	CAWSLRQAAAPLHF	CALIGDDMRF-CAWSLRQAAAPLHF;CALSEGANTGGFKTIF-CAWSLRQAAAPLHF	1
HD3	1501-YF45	Naive	CSAKMRVGGELFF	CSAKMRVGGELFF	3
HD2	1501-YF45	Naive	CSANRGAVSNQPQHF	CIVRNSGNTPLVF-CSANRGAVSNQPQHF	1
HD2	1501-YF45	Naive	CSANVATNSPLHF	CGADMGGAGTASKLTF-CSANVATNSPLHF	1
HD3	1501-YF45	Naive	CSARATSGGASEQYF	CIVRNNAGNMLTF-CSARATSGGASEQYF	13
HD3	1501-YF45	Naive	CSARATSGGASEQYF	CAASGAL_GYNKLIF-CSARATSGGASEQYF	13
HD3	0407-YF54	Naive	CSARDWQGARNTEAFF	CAVNSNFNKFYF-CSARDWQGARNTEAFF	4
HD3	0407-YF54	Naive	CSARDWQGARNTEAFF	CAVNSNFNKFYF-CSARDWQGARNTEAFF	4
HD3	0407-YF54	Naive	CSARDWQGQRNTEAFF	CAVNGYGNKLVF-CSARDWQGQRNTEAFF	3
HD3	0407-YF54	Naive	CSAREIQGARNTEAFF	CAVNGGDDKIIF-CSAREIQGARNTEAFF	7

HD3	1501-YF91	Naive	CSARGRIANYGYTF	CAAPLSGSARQLTF-CSARGRIANYGYTF	7
HD3	1501-YF91	Naive	CSARGRIANYGYTF	CAAPLSGSARQLTF-CSARGRIANYGYTF	7
HD3	1501-YF91	Naive	CSARGRIANYGYTF	CAAPLSGSARQLTF-CSARGRIANYGYTF	7
HD3	1501-YF91	Naive	CSARGRIANYGYTF	CAAPLSGSARQLTF-CSARGRIANYGYTF;CAASFNAGNNRKLIW-CSARGRIANYGYTF	7
HD3	0407-YF54	Naive	CSARHLQGNRNTEAFF	CAVEGQGGGYNKLIF-CSARHLQGNRNTEAFF	2
HD3	1501-YF45	Naive	CSARVGSLADTQYF	CAVHSGNTPLVF-CSARVGSLADTQYF	1
HD3	0407-YF54	Naive	CSARVVQGRRNTEAFF	CAVNNRDDKIIF-CSARVVQGRRNTEAFF	16
HD3	0407-YF54	Naive	CSARVVQGRRNTEAFF	CAVNNRDDKIIF-CSARVVQGRRNTEAFF	16
HD2	1501-YF45	Naive	CSASARVGGELFF	CAVLLRL_ATNKLIF-CSASARVGGELFF	3
HD2	1501-YF45	Naive	CSASPRVEGEQYF	CIVRGNQFYF-CSASPRVEGEQYF	2
HD3	1501-YF45	Naive	CSASYLTGSYNEQFF	CAGQGYNQGGKLIF-CSASYLTGSYNEQFF	55
HD3	1501-YF45	Naive	CSASYLTGSYNEQFF	CAGQGYNQGGKLIF-CSASYLTGSYNEQFF	55
HD3	1501-YF45	Naive	CSASYLTGSYNEQFF	CAGQGYNQGGKLIF-CSASYLTGSYNEQFF	55
HD3	1501-YF45	Naive	CSASYLTGSYNEQFF	CAGQGYNQGGKLIF-CSASYLTGSYNEQFF	55
HD3	1501-YF91	Naive	CSAWDRANYGYTF	CIVRVERDDKIIF-CSAWDRANYGYTF	4
HD3	1501-YF91	Naive	CSAWDRANYGYTF	CIVRVERDDKIIF-CSAWDRANYGYTF	4
HD2	1501-YF45	TEMRA	CASIKIGVLGYGYTF	CASIKIGVLGYGYTF	12
HD2	1501-YF45	TEMRA	CASIKIGVLGYGYTF	CVVSFLW_GYNKLIF-CASIKIGVLGYGYTF	12
HD3	1501-YF45	TEMRA	CASSHRGLEQPQHF	CASSHRGLEQPQHF	1
HD3	0407-YF54	TEMRA	CASSIGTARVEKLFF	CASSIGTARVEKLFF	1
HD3	1501-YF91	TEMRA	CASSLSAGGRDEQFF	CASSLSAGGRDEQFF	2
HD2	1501-YF45	TEMRA	CASSLSALSGNTIYF	CAASAISNSGGSNYKLTF-CASSLSALSGNTIYF;CAMREGPYNFNKFYF-CASSLSALSGNTIYF	1
HD3	0407-YF54	TEMRA	CASSNGA_NTGELFF	CAVNNGGNKLVF-CASSNGA_NTGELFF	2
HD2	1501-YF45	TEMRA	CASSPGTSVADTQYF	CAFRNTGNQFYF-CASSPGTSVADTQYF;CAAPIKAAGNKLTF-CASSPGTSVADTQYF	1
HD3	1501-YF45	TEMRA	CASSPQGPLINEQFF	CIVRNNAGNMLTF-CASSPQGPLINEQFF	14
HD3	1501-YF45	TEMRA	CASSPQGPLINEQFF	CIVRNNAGNMLTF-CASSPQGPLINEQFF	14
HD2	1501-YF45	TEMRA	CASSPTGLGDYGYTF	CIALPAGGTSYGKLTF-CASSPTGLGDYGYTF	15
HD2	1501-YF45	TEMRA	CASSPTGLGDYGYTF	CIALPAGGTSYGKLTF-CASSPTGLGDYGYTF	15
HD2	1501-YF45	TEMRA	CASSPTGLGDYGYTF	CIALPAGGTSYGKLTF-CASSPTGLGDYGYTF	15
HD2	1501-YF45	TEMRA	CASSSGASTPGYEQYF	CIVRSAGNMLTF-CASSSGASTPGYEQYF	5
HD3	1501-YF45	TEMRA	CASSSGLAIEQYF	CIVRVGNYGQNFVF-CASSSGLAIEQYF	3
HD3	1501-YF45	TEMRA	CASSSSGGIYNEQFF	CIVKVQTGANNLFF-CASSSSGGIYNEQFF	4
HD2	1501-YF45	TEMRA	CASSTGSTTPNNEQFF	CILKTSGSRLTF-CASSTGSTTPNNEQFF	2
HD2	1501-YF45	TEMRA	CASSTLLAGAPPTDTQYF	CAVSHRSGYSTLTF-CASSTLLAGAPPTDTQYF;CATDAIQ_DYKLSF-CASSTLLAGAPPTDTQYF	2
HD3	1501-YF45	TEMRA	CASSTQGLITEAFF	CASSTQGLITEAFF	8
HD2	1501-YF45	TEMRA	CASSVGMGSTDTQYF	CAVQAWDKIIF-CASSVGMGSTDTQYF	7
HD3	1501-YF45	TEMRA	CSARATSGGASEQYF	CSARATSGGASEQYF	13
HD3	1501-YF45	TEMRA	CSARATSGGASEQYF	CAASGAL_GYNKLIF-CSARATSGGASEQYF	13

HD2	1501-YF45	TEMRA	CSARAVVGGYEQYF	CAYRSRYPYNTDKLIF-CSARAVVGGYEQYF;CAGGLTQGGSEKLVF-CSARAVVGGYEQYF	2
HD3	0407-YF54	TEMRA	CSARDYQGDRNTEAFF	CAVPLRSNDYKLSF-CSARDYQGDRNTEAFF	1
HD2	1501-YF45	TEMRA	CSARESLAGAREQYF	CIVLRPPGNTPLVF-CSARESLAGAREQYF	1
HD3	0407-YF54	TEMRA	CSARHLQGNRNTEAFF	CAVEGQGGGYNKLIF-CSARHLQGNRNTEAFF	2
HD2	1501-YF45	TEMRA	CSARISNLNQETQYF	CAVRDGSAYNTDKLIF-CSARISNLNQETQYF	2
HD2	1501-YF45	TEMRA	CSARLSGSIGEQFF	CSARLSGSIGEQFF	3
HD2	1501-YF45	TEMRA	CSARMDSLNTGELFF	CILKAPISGNTPLVF-CSARMDSLNTGELFF	1
HD2	1501-YF45	TEMRA	CSARSRTGWGTEAFF	CAPDR_NQFYF-CSARSRTGWGTEAFF	2
HD3	1501-YF45	TEMRA	CSARVIVAGELFF	CSARVIVAGELFF	1
HD2	1501-YF45	TEMRA	CSARVLTNEKLFF	CAVYNDMRF-CSARVLTNEKLFF	1
HD3	1501-YF45	TEMRA	CSARVQTSGEQYF	CSARVQTSGEQYF	1
HD3	0407-YF54	TEMRA	CSARVVQGRRNTEAFF	CAVNNRDDKIIF-CSARVVQGRRNTEAFF	16
HD3	0407-YF54	TEMRA	CSARVVQGRRNTEAFF	CSARVVQGRRNTEAFF	16
HD3	1501-YF45	TEMRA	CSASIRTGDNQPQHF	CAASGRAQKLVF-CSASIRTGDNQPQHF	1
HD3	1501-YF45	TEMRA	CSASYLTGSYNEQFF	CSASYLTGSYNEQFF	55
HD3	1501-YF45	TEMRA	CSASYLTGSYNEQFF	CAGQGYNQGGKLIF-CSASYLTGSYNEQFF	55
HD3	1501-YF45	TEMRA	CSASYLTGSYNEQFF	CSASYLTGSYNEQFF	55
HD3	1501-YF45	TEMRA	CSASYLTGSYNEQFF	CAGQGYNQGGKLIF-CSASYLTGSYNEQFF	55
HD3	1501-YF45	TEMRA	CSASYLTGSYNEQFF	CAGQGYNQGGKLIF-CSASYLTGSYNEQFF	55
HD3	1501-YF45	TEMRA	CSASYLTGSYNEQFF	CAGQGYNQGGKLIF-CSASYLTGSYNEQFF	55
HD3	1501-YF45	TEMRA	CSASYLTGSYNEQFF	CAGQGYNQGGKLIF-CSASYLTGSYNEQFF	55
HD3	1501-YF45	TEMRA	CSASYLTGSYNEQFF	CAGQGYNQGGKLIF-CSASYLTGSYNEQFF	55
HD3	1501-YF45	TEMRA	CSASYLTGSYNEQFF	CAGQGYNQGGKLIF-CSASYLTGSYNEQFF	55
HD3	1501-YF45	TEMRA	CSASYLTGSYNEQFF	CSASYLTGSYNEQFF	55
HD3	1501-YF45	TEMRA	CSVEGTSGRGEQFF	CSVEGTSGRGEQFF	19
HD2	1501-YF45	TMN	CASIKIGVLGYGYTF	CVVSFLW_GYNKLIF-CASIKIGVLGYGYTF	12
HD2	1501-YF45	TMN	CASIKIGVLGYGYTF	CVVSFLW_GYNKLIF-CASIKIGVLGYGYTF	12
HD2	1501-YF45	TMN	CASSEQSLNNYNEQFF	CALSPFSGGYNKLIF-CASSEQSLNNYNEQFF	1
HD2	1501-YF45	TMN	CASSLAGTVNTEAFF	CIVKGTGTASKLTF-CASSLAGTVNTEAFF	2
HD2	1501-YF45	TMN	CASSLAVTVRSSNYGYTF	CIVRVQTGANNLFF-CASSLAVTVRSSNYGYTF	3
HD2	1501-YF45	TMN	CASSPRQGLNTEAFF	CAAKGLK_SGYALNF-CASSPRQGLNTEAFF	1
HD2	1501-YF45	TMN	CASSQQQGLNTEAFF	CALGGFKTIF-CASSQQQGLNTEAFF	7
HD2	1501-YF45	TMN	CASSSTTDGYTF	CAGEVLV_YNKLIF-CASSSTTDGYTF	7
HD2	1501-YF45	TMN	CSAHQGNGYTF	CAASHGFQKLVF-CSAHQGNGYTF	3
HD3	1501-YF45	TMN	CASIIGTP_SGNTIYF	CAMRGSGGGADGLTF-CASIIGTP_SGNTIYF	1
HD3	1501-YF45	TMN	CASSLVQLNTEAFF	CIVRVYAGNMLTF-CASSLVQLNTEAFF	2
HD3	1501-YF45	TMN	CASSMTVQGAIGANVLTF	CAGAGGTSYGKLTF-CASSMTVQGAIGANVLTF	5
HD3	1501-YF45	TMN	CASSPGSSTSSYNEQFF	CIVRPSSGNTPLVF-CASSPGSSTSSYNEQFF	1
HD3	1501-YF45	TMN	CASTKSGGVYNEQFF	CIVRVQTGANNLFF-CASTKSGGVYNEQFF	2

HD3	1501-YF45	TMN	CASTLSGGLYNEQFF	KGRDDKIIF-CASTLSGGLYNEQFF	1
HD3	1501-YF45	TMN	CSARATSGGASEQYF	CSARATSGGASEQYF	13
HD3	1501-YF45	TMN	CSASYLTGSYNEQFF	CAGQGYNQGGKLIF-CSASYLTGSYNEQFF	55
HD3	1501-YF45	TMN	CSASYLTGSYNEQFF	CAGQGYNQGGKLIF-CSASYLTGSYNEQFF	55
HD3	1501-YF45	TMN	CSASYLTGSYNEQFF	CAGQGYNQGGKLIF-CSASYLTGSYNEQFF	55
HD3	1501-YF45	TMN	CSVEGTSGRGEQFF	CSVEGTSGRGEQFF	19
HD3	1501-YF45	TMN	CSVRTGQVTGELFF	CAENNNNARLMF-CSVRTGQVTGELFF	3
HD2	1501-YF45	TSCM	CASIKIGVLGYGYTF	CVVSFLW_GYNKLIF-CASIKIGVLGYGYTF	12
HD2	1501-YF45	TSCM	CASQTGASVTYEQYF	CIVRVAAGNTGKLIF-CASQTGASVTYEQYF	9
HD2	1501-YF45	TSCM	CASQTGASVTYEQYF	CIVRVAAGNTGKLIF-CASQTGASVTYEQYF	9
HD2	1501-YF45	TSCM	CASSKTSGLQSYNEQFF	CILRPNYGGSQGNLIF-CASSKTSGLQSYNEQFF	2
HD3	1501-YF45	TSCM	CASSLALRDRGSIQPQHF	CVVSAVGGTYKYIF-CASSLALRDRGSIQPQHF	1
HD3	1501-YF45	TSCM	CASSLEAGLSTDTQYF	CASSLEAGLSTDTQYF	4
HD3	1501-YF45	TSCM	CASSLEAGLSTDTQYF	CASSLEAGLSTDTQYF	4
HD3	1501-YF45	TSCM	CASSLGFMNTEAFF	CIVRVVTNAGKSTF-CASSLGFMNTEAFF	1
HD2	1501-YF45	TSCM	CASSLGSLAGSYNEQFF	CIVRVRAGNTPLVF-CASSLGSLAGSYNEQFF	4
HD3	1501-YF45	TSCM	CASSLHGGTVSTEAFF	CIVREAGGFKTIF-CASSLHGGTVSTEAFF	1
HD3	1501-YF45	TSCM	CASSMTVQGAIGANVLTF	CAGAGGTSYGKLTF-CASSMTVQGAIGANVLTF	5
HD3	1501-YF45	TSCM	CASSPQGPLINEQFF	CIVRNNAGNMLTF-CASSPQGPLINEQFF	14
HD2	1501-YF45	TSCM	CASSSGASTPGYEQYF	CIVRSAGNMLTF-CASSSGASTPGYEQYF	5
HD2	1501-YF45	TSCM	CASSSMGLAGGLTGELFF	CAGRTNTGNQFYF-CASSSMGLAGGLTGELFF	12
HD3	1501-YF45	TSCM	CASTPTGTVGGTQYF	CIVRVGAGGTSYGKLTF-CASTPTGTVGGTQYF	1
HD3	1501-YF45	TSCM	CSAKMRVGGELFF	CALSEAGL_FGNEKLTF-CSAKMRVGGELFF	3
HD3	1501-YF45	TSCM	CSALDRVGGEQYF	CAVLPGR_GNKLTF-CSALDRVGGEQYF	1
HD3	1501-YF45	TSCM	CSARALSTGEQYF	CSARALSTGEQYF	2
HD3	1501-YF45	TSCM	CSARALSTGEQYF	CSARALSTGEQYF	2
HD3	1501-YF45	TSCM	CSARATSGGASEQYF	CSARATSGGASEQYF	13
HD3	1501-YF45	TSCM	CSARGQGVLGELFF	CLVGATGSARQLTF-CSARGQGVLGELFF	1
HD3	1501-YF45	TSCM	CSARLSDGTMRSEAFF	CAMVTSHGKLTF-CSARLSDGTMRSEAFF	1
HD2	1501-YF45	TSCM	CSARVPQQGLAHNEQFF	CIVRVANSGNTPLVF-CSARVPQQGLAHNEQFF	1
HD3	1501-YF45	TSCM	CSARVQTSGPQHF	CAVANDMRF-CSARVQTSGPQHF	1
HD3	1501-YF45	TSCM	CSARVVSNQPQHF	CIAGGNTDKLIF-CSARVVSNQPQHF	1
HD3	1501-YF45	TSCM	CSARYVTGNTGELFF	CIVGSSNTGKLIF-CSARYVTGNTGELFF	1
HD3	1501-YF45	TSCM	CSASYLTGSYNEQFF	CAGQGYNQGGKLIF-CSASYLTGSYNEQFF	55
HD3	1501-YF45	TSCM	CSASYLTGSYNEQFF	CSASYLTGSYNEQFF	55
HD3	1501-YF45	TSCM	CSASYLTGSYNEQFF	CAGQGYNQGGKLIF-CSASYLTGSYNEQFF	55
HD3	1501-YF45	TSCM	CSVRTGQVTGELFF	CAENNNNARLMF-CSVRTGQVTGELFF	3
HD2	1501-YF45	TSCM	CSVSDRVGWDTEAFF	CAGTLTF-CSVSDRVGWDTEAFF	1

Table S5: YF45 tetramer+ T cells before and 14 days after YFV vaccination

Donor	specificity	visit	TCRb	TCRa-TCRb	clone size
HD2	1501-YF45	d14 post	CASNHRLPYNSPLHF	CIVRSSNTGNQFYF-CASNHRLPYNSPLHF;CIVRSSNTGNQFYF-CASNHRLPYNSPLHF	1
HD3	1501-YF45	d14 post	CASSFGTPLGGELFF	CASSFGTPLGGELFF	1
HD3	1501-YF45	d14 post	CASSFLKPGQAHYGYTF	CASSFLKPGQAHYGYTF	1
HD3	1501-YF45	d14 post	CASSFPMNTEAFF	CASSFPMNTEAFF	1
HD3	1501-YF45	d14 post	CASSFPRGQNINQPQHF	CIVRVGAQGAQKLVF-CASSFPRGQNINQPQHF	3
HD3	1501-YF45	d14 post	CASSFPRGQNINQPQHF	CIVRVGAQGAQKLVF-CASSFPRGQNINQPQHF	3
HD3	1501-YF45	d14 post	CASSFPRGQNINQPQHF	CIVRVGAQGAQKLVF-CASSFPRGQNINQPQHF	3
HD2	1501-YF45	d14 post	CASSKTSGLQSYNEQFF	CILRPNYGGSQGNLIF-CASSKTSGLQSYNEQFF;CILRPNYGGSQGNLIF-CASSKTSGLQSYNEQFF	1
HD2	1501-YF45	d14 post	CASSLAGTVNTEAFF	CIVKGTGTASKLTF-CASSLAGTVNTEAFF;CIVKGTGTASKLTF-CASSLAGTVNTEAFF	1
HD3	1501-YF45	d14 post	CASSLAQQGNTEAFF	CIVRVGASNTGKLIF-CASSLAQQGNTEAFF	5
HD3	1501-YF45	d14 post	CASSLAQQGNTEAFF	CIVRVGASNTGKLIF-CASSLAQQGNTEAFF	5
HD3	1501-YF45	d14 post	CASSLAQQGNTEAFF	CIGGRK_QGNLIF-CASSLAQQGNTEAFF;CIVRVGASNTGKLIF-CASSLAQQGNTEAFF	5
HD3	1501-YF45	d14 post	CASSLAQQGNTEAFF	CIVRVGASNTGKLIF-CASSLAQQGNTEAFF	5
HD3	1501-YF45	d14 post	CASSLAQQGNTEAFF	CIVRVGASNTGKLIF-CASSLAQQGNTEAFF	5
HD2	1501-YF45	d14 post	CASSLAVTVRSSNYGYTF	CIVRVQTGANNLFF-CASSLAVTVRSSNYGYTF	4
HD2	1501-YF45	d14 post	CASSLAVTVRSSNYGYTF	CIVRVQTGANNLFF-CASSLAVTVRSSNYGYTF;FIVRVQTGANNLFF-CASSLAVTVRSSNYGYTF	4
HD2	1501-YF45	d14 post	CASSLAVTVRSSNYGYTF	CIVRVQTGANNLFF-CASSLAVTVRSSNYGYTF;CIVRVQTGANNLFF-CASSLAVTVRSSNYGYTF	4
HD2	1501-YF45	d14 post	CASSLAVTVRSSNYGYTF	CIVRVQTGANNLFF-CASSLAVTVRSSNYGYTF	4
HD3	1501-YF45	d14 post	CASSLDYNEQFF	CASSLDYNEQFF	1
HD3	1501-YF45	d14 post	CASSLEAGLSTDTQYF	CVVIPNW_ANNLFF-CASSLEAGLSTDTQYF	1
HD3	1501-YF45	d14 post	CASSLEWRGAQMRPFF	CAVRLMNYGGSQGNLIF-CASSLEWRGAQMRPFF	1
HD3	1501-YF45	d14 post	CASSLGFMNTEAFF	CIVRVVTNAGKSTF-CASSLGFMNTEAFF	2
HD3	1501-YF45	d14 post	CASSLGFMNTEAFF	CIVRVVTNAGKSTF-CASSLGFMNTEAFF	2
HD2	1501-YF45	d14 post	CASSLGFSMTDRGYTF	CIVRPSAGNTGKLIF-CASSLGFSMTDRGYTF;CAENNGQLGDKIIF-CASSLGFSMTDRGYTF	1
HD3	1501-YF45	d14 post	CASSLGGIESGYTF	CAMREGNNFNKFYF-CASSLGGIESGYTF	1
HD3	1501-YF45	d14 post	CASSLGKTTSGNTIYF	CAMREVNNARLMF-CASSLGKTTSGNTIYF	1
HD3	1501-YF45	d14 post	CASSLGQVLFTDTQYF	CIVRPLGGAQKLVF-CASSLGQVLFTDTQYF	1
HD2	1501-YF45	d14 post	CASSLGSLAGSYNEQFF	CIVRVRAGNTPLVF-CASSLGSLAGSYNEQFF	4
HD2	1501-YF45	d14 post	CASSLGSLAGSYNEQFF	CIVRVRAGNTPLVF-CASSLGSLAGSYNEQFF	4
HD2	1501-YF45	d14 post	CASSLGSLAGSYNEQFF	CIVRVRAGNTPLVF-CASSLGSLAGSYNEQFF;CIALPAGGTSYGKLTF-CASSLGSLAGSYNEQFF	4
HD2	1501-YF45	d14 post	CASSLGSLAGSYNEQFF	CIVRVRAGNTPLVF-CASSLGSLAGSYNEQFF	4
HD3	1501-YF45	d14 post	CASSLGSVPPGNTIYF	CIVRVSGGGGADGLTF-CASSLGSVPPGNTIYF	1
HD3	1501-YF45	d14 post	CASSLHGGTVSTEAFF	CIVREAGGFKTIF-CASSLHGGTVSTEAFF	1

HD3	1501-YF45	d14 post	CASSLNPLAGGLTGELFF	CIVKAGTALIF-CASSLNPLAGGLTGELFF	1
HD2	1501-YF45	d14 post	CASSLQPGQVSYEQYF	CIVRVGYGGQNFVF-CASSLQPGQVSYEQYF	1
HD2	1501-YF45	d14 post	CASSLTQGRNSPLHF	CADGSGNTGKLIF-CASSLTQGRNSPLHF	1
HD3	1501-YF45	d14 post	CASSLVQLNTEAFF	CIVRVYAGNMLTF-CASSLVQLNTEAFF	2
HD3	1501-YF45	d14 post	CASSLVQLNTEAFF	CIVRVYAGNMLTF-CASSLVQLNTEAFF	2
HD3	1501-YF45	d14 post	CASSMTVQGAIGANVLTF	CAGAGGTSYGKLTF-CASSMTVQGAIGANVLTF	3
HD3	1501-YF45	d14 post	CASSMTVQGAIGANVLTF	CAGAGGTSYGKLTF-CASSMTVQGAIGANVLTF	3
HD3	1501-YF45	d14 post	CASSMTVQGAIGANVLTF	CAGAGGTSYGKLTF-CASSMTVQGAIGANVLTF	3
HD3	1501-YF45	d14 post	CASSPEGPTYF	CIVRVAAISGGYNKLIF-CASSPEGPTYF	1
HD3	1501-YF45	d14 post	CASSPNLWVPHEQFF	CIVRVAGDTGRRALTF-CASSPNLWVPHEQFF	1
HD3	1501-YF45	d14 post	CASSPPGQVNTEAFF	CIGKNTGTASKLTF-CASSPPGQVNTEAFF	3
HD3	1501-YF45	d14 post	CASSPPGQVNTEAFF	CIGKNTGTASKLTF-CASSPPGQVNTEAFF	3
HD3	1501-YF45	d14 post	CASSPPGQVNTEAFF	CIGKNTGTASKLTF-CASSPPGQVNTEAFF	3
HD3	1501-YF45	d14 post	CASSPQDSLGVYNEQFF	CASSPQDSLGVYNEQFF	2
HD3	1501-YF45	d14 post	CASSPQDSLGVYNEQFF	CAENRPGV_SSASKIIF-CASSPQDSLGVYNEQFF	2
HD3	1501-YF45	d14 post	CASSPQGPLINEQFF	CIVRNNAGNMLTF-CASSPQGPLINEQFF	26
HD3	1501-YF45	d14 post	CASSPQGPLINEQFF	CIVRNNAGNMLTF-CASSPQGPLINEQFF	26
HD3	1501-YF45	d14 post	CASSPQGPLINEQFF	CIVRNNAGNMLTF-CASSPQGPLINEQFF	26
HD3	1501-YF45	d14 post	CASSPQGPLINEQFF	CIVRNNAGNMLTF-CASSPQGPLINEQFF;CIVRNNAGNMLTF-CASSPQGPLINEQFF	26
HD3	1501-YF45	d14 post	CASSPQGPLINEQFF	CIVRNNAGNMLTF-CASSPQGPLINEQFF	26
HD3	1501-YF45	d14 post	CASSPQGPLINEQFF	CIVRNNAGNMLTF-CASSPQGPLINEQFF;CIVRNNAGNMLTF-CASSPQGPLINEQFF	26
HD3	1501-YF45	d14 post	CASSPQGPLINEQFF	CIVRNNAGNMLTF-CASSPQGPLINEQFF	26
HD3	1501-YF45	d14 post	CASSPQGPLINEQFF	CIVRNNAGNMLTF-CASSPQGPLINEQFF	26
HD3	1501-YF45	d14 post	CASSPQGPLINEQFF	CIVRNNAGNMLTF-CASSPQGPLINEQFF	26
HD3	1501-YF45	d14 post	CASSPQGPLINEQFF	CIVRNNAGNMLTF-CASSPQGPLINEQFF	26
HD3	1501-YF45	d14 post	CASSPQGPLINEQFF	CIVRNNAGNMLTF-CASSPQGPLINEQFF	26
HD3	1501-YF45	d14 post	CASSPQGPLINEQFF	CIVRNNAGNMLTF-CASSPQGPLINEQFF	26
HD3	1501-YF45	d14 post	CASSPQGPLINEQFF	CIVRNNAGNMLTF-CASSPQGPLINEQFF	26
HD3	1501-YF45	d14 post	CASSPQGPLINEQFF	CIVRNNAGNMLTF-CASSPQGPLINEQFF	26
HD3	1501-YF45	d14 post	CASSPQGPLINEQFF	CIVRNNAGNMLTF-CASSPQGPLINEQFF	26
HD3	1501-YF45	d14 post	CASSPQGPLINEQFF	CIVRNNAGNMLTF-CASSPQGPLINEQFF	26
HD3	1501-YF45	d14 post	CASSPQGPLINEQFF	CIVRNNAGNMLTF-CASSPQGPLINEQFF	26
HD3	1501-YF45	d14 post	CASSPQGPLINEQFF	CIVRNNAGNMLTF-CASSPQGPLINEQFF	26
HD3	1501-YF45	d14 post	CASSPQGPLINEQFF	CIVRNNAGNMLTF-CASSPQGPLINEQFF	26
HD3	1501-YF45	d14 post	CASSPQGPLINEQFF	CIVRNNAGNMLTF-CASSPQGPLINEQFF	26
HD3	1501-YF45	d14 post	CASSPQGPLINEQFF	CIVRNNAGNMLTF-CASSPQGPLINEQFF	26
HD3	1501-YF45	d14 post	CASSPQGPLINEQFF	CIVRNNAGNMLTF-CASSPQGPLINEQFF	26
HD3	1501-YF45	d14 post	CASSPQGPLINEQFF	CIVRNNAGNMLTF-CASSPQGPLINEQFF	26
HD3	1501-YF45	d14 post	CASSPQGPLINEQFF	CIVRNNAGNMLTF-CASSPQGPLINEQFF	26
HD3	1501-YF45	d14 post	CASSPQGPLINEQFF	CIVRNNAGNMLTF-CASSPQGPLINEQFF	26

HD2	1501-YF45	d14 post	CASSPTGLGDYGYTF	CIALPAGGTSYGKLTF-CASSPTGLGDYGYTF;CIVRVQTGANNLFF-CASSPTGLGDYGYTF	6
HD2	1501-YF45	d14 post	CASSPTGLGDYGYTF	CIALPAGGTSYGKLTF-CASSPTGLGDYGYTF;CIALPAGGTSYGKLTF-CASSPTGLGDYGYTF	6
HD2	1501-YF45	d14 post	CASSPTGLGDYGYTF	CIALPAGGTSYGKLTF-CASSPTGLGDYGYTF;CIALPAGGTSYGKLTF-CASSPTGLGDYGYTF	6
HD2	1501-YF45	d14 post	CASSPTGLGDYGYTF	CIALPAGGTSYGKLTF-CASSPTGLGDYGYTF;CIALPAGGTSYGKLTF-CASSPTGLGDYGYTF	6
HD2	1501-YF45	d14 post	CASSPTGLGDYGYTF	CIALPAGGTSYGKLTF-CASSPTGLGDYGYTF	6
HD2	1501-YF45	d14 post	CASSPTGLGDYGYTF	CIALPAGGTSYGKLTF-CASSPTGLGDYGYTF	6
HD3	1501-YF45	d14 post	CASSPYWTVTDSPLHF	CIVRSNTDKLIF-CASSPYWTVTDSPLHF;CIWHE_LFYF-CASSPYWTVTDSPLHF	2
HD3	1501-YF45	d14 post	CASSPYWTVTDSPLHF	CIVRSNTDKLIF-CASSPYWTVTDSPLHF	2
HD2	1501-YF45	d14 post	CASSQARQGTPEAFF	GFGNVLHC-CASSQARQGTPEAFF;CAMREGPFSGGYNKLIF-CASSQARQGTPEAFF	1
HD3	1501-YF45	d14 post	CASSQGGLNTEAFF	CASSQGGLNTEAFF	1
HD2	1501-YF45	d14 post	CASSQNVGIVYEQYF	CALSRNSGNTPLVF-CASSQNVGIVYEQYF	1
HD2	1501-YF45	d14 post	CASSQRQGINTEAFF	CVVSVGKFSDGQKLLF-CASSQRQGINTEAFF	3
HD2	1501-YF45	d14 post	CASSQRQGINTEAFF	CVVSVGKFSDGQKLLF-CASSQRQGINTEAFF;CIVRSAGNMLTF-CASSQRQGINTEAFF	3
HD2	1501-YF45	d14 post	CASSQRQGINTEAFF	CVVSVGKFSDGQKLLF-CASSQRQGINTEAFF	3
HD3	1501-YF45	d14 post	CASSQSGGVYNEQFF	CIVKVQTGANNLFF-CASSQSGGVYNEQFF	1
HD3	1501-YF45	d14 post	CASSRWTGPLGQETQYF	CAPGR_DKIIF-CASSRWTGPLGQETQYF	1
HD2	1501-YF45	d14 post	CASSSGASTPGYEQYF	CIVRSAGNMLTF-CASSSGASTPGYEQYF;CIVRGAGNMLTF-CASSSGASTPGYEQYF	2
HD2	1501-YF45	d14 post	CASSSGASTPGYEQYF	CIVRSAGNMLTF-CASSSGASTPGYEQYF	2
HD2	1501-YF45	d14 post	CASSSGEIPRSYEQYF	CIVRVAGSARQLTF-CASSSGEIPRSYEQYF	2
HD2	1501-YF45	d14 post	CASSSGEIPRSYEQYF	CASSSGEIPRSYEQYF	2
HD3	1501-YF45	d14 post	CASSSGLAIEQYF	CIVRVGNYGQNFVF-CASSSGLAIEQYF	3
HD3	1501-YF45	d14 post	CASSSGLAIEQYF	CIVRVGNYGQNFVF-CASSSGLAIEQYF	3
HD3	1501-YF45	d14 post	CASSSGLAIEQYF	CIVRVGNYGQNFVF-CASSSGLAIEQYF	3
HD3	1501-YF45	d14 post	CASSSPGLNTEAFF	CALCTGGGNKLTF-CASSSPGLNTEAFF	3
HD3	1501-YF45	d14 post	CASSSPGLNTEAFF	CALCTGGGNKLTF-CASSSPGLNTEAFF	3
HD3	1501-YF45	d14 post	CASSSPGLNTEAFF	CALCTGGGNKLTF-CASSSPGLNTEAFF	3
HD3	1501-YF45	d14 post	CASSSRQGLNTEAFF	CIPPLA_DDKIIF-CASSSRQGLNTEAFF	1
HD3	1501-YF45	d14 post	CASSSSGGIYNEQFF	CIVKVQTGANNLFF-CASSSSGGIYNEQFF	2
HD3	1501-YF45	d14 post	CASSSSGGIYNEQFF	CIVKVQTGANNLFF-CASSSSGGIYNEQFF	2
HD2	1501-YF45	d14 post	CASSSTTDGYTF	CASSSTTDGYTF	4
HD2	1501-YF45	d14 post	CASSSTTDGYTF	CASSSTTDGYTF	4
HD2	1501-YF45	d14 post	CASSSTTDGYTF	CASSSTTDGYTF	4
HD2	1501-YF45	d14 post	CASSSTTDGYTF	CASSSTTDGYTF	4
HD3	1501-YF45	d14 post	CASSSVPGPNTEAFF	CALLNYGGQNFVF-CASSSVPGPNTEAFF	2
HD3	1501-YF45	d14 post	CASSSVPGPNTEAFF	CASSSVPGPNTEAFF	2
HD2	1501-YF45	d14 post	CASSTGGLTTEAFF	CASSTGGLTTEAFF	3

HD2	1501-YF45	d14 post	CASSTGGLTTEAFF	CASSTGGLTTEAFF	3
HD2	1501-YF45	d14 post	CASSTGGLTTEAFF	CASSTGGLTTEAFF	3
HD2	1501-YF45	d14 post	CASSTGSTTPNNEQFF	CILKTSGSRLTF-CASSTGSTTPNNEQFF;CILKTSGSRLTF-CASSTGSTTPNNEQFF	3
HD2	1501-YF45	d14 post	CASSTGSTTPNNEQFF	CILKTSGSRLTF-CASSTGSTTPNNEQFF;CILKTSGSRLTF-CASSTGSTTPNNEQFF	3
HD2	1501-YF45	d14 post	CASSTGSTTPNNEQFF	CILKTSGSRLTF-CASSTGSTTPNNEQFF;CILKTSGSRLTF-CASSTGSTTPNNEQFF	3
HD3	1501-YF45	d14 post	CASSTQGLITEAFF	CASSTQGLITEAFF	4
HD3	1501-YF45	d14 post	CASSTQGLITEAFF	CASSTQGLITEAFF	4
HD3	1501-YF45	d14 post	CASSTQGLITEAFF	CAPSTGGGNKLTF-CASSTQGLITEAFF	4
HD3	1501-YF45	d14 post	CASSTQGLITEAFF	CASSTQGLITEAFF	4
HD2	1501-YF45	d14 post	CASSVAGTVNTEAFF	CIVKNTGTASKLTF-CASSVAGTVNTEAFF	1
HD3	1501-YF45	d14 post	CASSVGIGSTDTQYF	CAVQAWVTGGGNKLTF-CASSVGIGSTDTQYF	1
HD3	1501-YF45	d14 post	CASSVGSVSGGTGELFF	CAMSHTGFQKLVF-CASSVGSVSGGTGELFF;CIVKAGTALIF-CASSVGSVSGGTGELFF	1
HD3	1501-YF45	d14 post	CASTAGPLDTEAFF	CASTAGPLDTEAFF	1
HD3	1501-YF45	d14 post	CASTKSGGVYNEQFF	CIVRVQTGANNLFF-CASTKSGGVYNEQFF;CIVRVQTGANNLFF-CASTKSGGVYNEQFF	2
HD3	1501-YF45	d14 post	CASTKSGGVYNEQFF	CIVRVQTGANNLFF-CASTKSGGVYNEQFF	2
HD3	1501-YF45	d14 post	CASTLSGGLYNEQFF	KGRDDKIIF-CASTLSGGLYNEQFF;CIVRPQTGANNLFF-CASTLSGGLYNEQFF	1
HD2	1501-YF45	d14 post	CASTSSGGIYNEQFF	CIVRVQTGANNLFF-CASTSSGGIYNEQFF	2
HD2	1501-YF45	d14 post	CASTSSGGIYNEQFF	CIVRVQTGANNLFF-CASTSSGGIYNEQFF	2
HD2	1501-YF45	d14 post	CATGPKRGLSDTQYF	CATGPKRGLSDTQYF	1
HD2	1501-YF45	d14 post	CATSDFPVVGVNYGYTF	CALVSNSGYALNF-CATSDFPVVGVNYGYTF	1
HD2	1501-YF45	d14 post	CSAGGRVGTGELFF	CIVRVGNNNDMRF-CSAGGRVGTGELFF;CIVRVGNNNDMRF-CSAGGRVGTGELFF	1
HD2	1501-YF45	d14 post	CSAIAGPAYNEQFF	CIVRSTGNKLTF-CSAIAGPAYNEQFF	3
HD2	1501-YF45	d14 post	CSAIAGPAYNEQFF	CIVRSTGNKLTF-CSAIAGPAYNEQFF;CIVRSTGNKLTF-CSAIAGPAYNEQFF	3
HD2	1501-YF45	d14 post	CSAIAGPAYNEQFF	CIVRSTGNKLTF-CSAIAGPAYNEQFF	3
HD2	1501-YF45	d14 post	CSANPRVEGTQYF	CAIPSQFYF-CSANPRVEGTQYF	1
HD3	1501-YF45	d14 post	CSANVRVEGEQYF	CAAIRGTYKYIF-CSANVRVEGEQYF	1
HD2	1501-YF45	d14 post	CSAQPHITSEQYF	TTRPGYSTLTF-CSAQPHITSEQYF	2
HD2	1501-YF45	d14 post	CSAQPHITSEQYF	TTRPGYSTLTF-CSAQPHITSEQYF	2
HD2	1501-YF45	d14 post	CSARAITARYEQYF	CSARAITARYEQYF	1
HD3	1501-YF45	d14 post	CSARALSTGEQYF	CSARALSTGEQYF	7
HD3	1501-YF45	d14 post	CSARALSTGEQYF	CSARALSTGEQYF	7
HD3	1501-YF45	d14 post	CSARALSTGEQYF	CSARALSTGEQYF	7
HD3	1501-YF45	d14 post	CSARALSTGEQYF	CSARALSTGEQYF	7
HD3	1501-YF45	d14 post	CSARALSTGEQYF	CSARALSTGEQYF	7
HD3	1501-YF45	d14 post	CSARALSTGEQYF	CSARALSTGEQYF	7
HD3	1501-YF45	d14 post	CSARALSTGEQYF	CSARALSTGEQYF	7

HD3	1501-YF45	d14 post	CSARARVGGEAFF	CAVEPQLNNAGGTSYGKLTF-CSARARVGGEAFF	1
HD2	1501-YF45	d14 post	CSARAVSGGSTDTQYF	CVVSAWYSSASKIIF-CSARAVSGGSTDTQYF	1
HD2	1501-YF45	d14 post	CSARAVTGDNSPLHF	CAMTGSARQLTF-CSARAVTGDNSPLHF;CAMTGSARQLTF-CSARAVTGDNSPLHF	4
HD2	1501-YF45	d14 post	CSARAVTGDNSPLHF	CAMTGSARQLTF-CSARAVTGDNSPLHF;CAMTGSARQLTF-CSARAVTGDNSPLHF	4
HD2	1501-YF45	d14 post	CSARAVTGDNSPLHF	CAMTGSARQLTF-CSARAVTGDNSPLHF;CAMTGSARQLTF-CSARAVTGDNSPLHF	4
HD2	1501-YF45	d14 post	CSARAVTGDNSPLHF	CAMTGSARQLTF-CSARAVTGDNSPLHF;CAMTGSARQLTF-CSARAVTGDNSPLHF	4
HD2	1501-YF45	d14 post	CSARAVVGGYEQYF	CAYRSRYPYNTDKLIF-CSARAVVGGYEQYF;CAGGLTQGGSEKLVF-CSARAVVGGYEQYF	1
HD3	1501-YF45	d14 post	CSARGQGVLGELFF	CLVGATGSARQLTF-CSARGQGVLGELFF;CLVGATGSARQLTF-CSARGQGVLGELFF	2
HD3	1501-YF45	d14 post	CSARGQGVLGELFF	CLVGATGSARQLTF-CSARGQGVLGELFF	2
HD3	1501-YF45	d14 post	CSARGRVGGEQYF	CAAPGHSNYQLIW-CSARGRVGGEQYF	1
HD3	1501-YF45	d14 post	CSARLGNTNNEQFF	CIVRATGNQFYF-CSARLGNTNNEQFF	4
HD3	1501-YF45	d14 post	CSARLGNTNNEQFF	CIVRATGNQFYF-CSARLGNTNNEQFF	4
HD3	1501-YF45	d14 post	CSARLGNTNNEQFF	CIVRATGNQFYF-CSARLGNTNNEQFF	4
HD3	1501-YF45	d14 post	CSARLGNTNNEQFF	CIVRATGNQFYF-CSARLGNTNNEQFF	4
HD3	1501-YF45	d14 post	CSARLRTGWDSPLHF	CAQGGRNNYGQNFVF-CSARLRTGWDSPLHF;CLVGATGSARQLTF-CSARLRTGWDSPLHF	2
HD3	1501-YF45	d14 post	CSARLRTGWDSPLHF	CAQGGRNNYGQNFVF-CSARLRTGWDSPLHF	2
HD2	1501-YF45	d14 post	CSARLSGSIGEQFF	CSARLSGSIGEQFF	1
HD2	1501-YF45	d14 post	CSARPGSIETQYF	CSARPGSIETQYF	1
HD2	1501-YF45	d14 post	CSARPPTLGQTNTEAFF	CIVRLPISGNTPLVF-CSARPPTLGQTNTEAFF	1
HD2	1501-YF45	d14 post	CSARPRTGGEQYF	CALIRNSGNTPLVF-CSARPRTGGEQYF;CAMSVTNPFHNAGNMLTF-CSARPRTGGEQYF	2
HD2	1501-YF45	d14 post	CSARPRTGGEQYF	CALIRNSGNTPLVF-CSARPRTGGEQYF;CAMSVTNPFHNAGNMLTF-CSARPRTGGEQYF	2
HD2	1501-YF45	d14 post	CSARQGSLNTQYF	CIVRVLAGGTSYGKLTF-CSARQGSLNTQYF	1
HD3	1501-YF45	d14 post	CSARQGVVNEQFF	CIVRATGNQFYF-CSARQGVVNEQFF;CIVRATGNQFYF-CSARQGVVNEQFF	1
HD2	1501-YF45	d14 post	CSARRTSILNEQYF	CALDSRDAGKSTF-CSARRTSILNEQYF	1
HD2	1501-YF45	d14 post	CSARTISGGSTDTQYF	CVVSSYYSSASKIIF-CSARTISGGSTDTQYF;CIVRSTGNKLTF-CSARTISGGSTDTQYF	1
HD3	1501-YF45	d14 post	CSARTRVGNSPLHF	CAVDNTNAGKSTF-CSARTRVGNSPLHF	1
HD3	1501-YF45	d14 post	CSARVLAGGPGEQYF	CSARVLAGGPGEQYF	1
HD2	1501-YF45	d14 post	CSARVLSSYNSPLHF	CAVSVSYLDGGTSYGKLTF-CSARVLSSYNSPLHF;CAVSVSYLDGGTSYGKLTF-CSARVLSSYNSPLHF	1
HD3	1501-YF45	d14 post	CSARVLTVGEQYF	CPHP-CSARVLTVGEQYF	1
HD3	1501-YF45	d14 post	CSARVLVGNTIYF	CASYRDDKIIF-CSARVLVGNTIYF	1

HD3	1501-YF45	d14 post	CSARVVVGDTQYF	CALDNAGGTSYGKLTF-CSARVVVGDTQYF	3
HD3	1501-YF45	d14 post	CSASGGSNSGNTIYF	CAENRNAGNMLTF-CSASGGSNSGNTIYF	1
HD3	1501-YF45	d14 post	CSASLRTGQNQPQHF	CASGSSNTGKLIF-CSASLRTGQNQPQHF	6
HD3	1501-YF45	d14 post	CSASLRTGQNQPQHF	CASGSSNTGKLIF-CSASLRTGQNQPQHF	6
HD3	1501-YF45	d14 post	CSASLRTGQNQPQHF	CAESVGLH_NAGKSTF-CSASLRTGQNQPQHF	6
HD3	1501-YF45	d14 post	CSASLRTGQNQPQHF	CAESVGLH_NAGKSTF-CSASLRTGQNQPQHF	6
HD3	1501-YF45	d14 post	CSASLRTGQNQPQHF	CASGSSNTGKLIF-CSASLRTGQNQPQHF	6
HD3	1501-YF45	d14 post	CSASLRTGQNQPQHF	CASGSSNTGKLIF-CSASLRTGQNQPQHF	6
HD2	1501-YF45	d14 post	CSASPLTGDEETQYF	CAVRGRLGGGYNKLIF-CSASPLTGDEETQYF	1
HD2	1501-YF45	d14 post	CSASPRVYGEQYF	CIVRVGSWNAGNMLTF-CSASPRVYGEQYF;CIVRVQTGANNLFF-CSASPRVYGEQYF	1
HD3	1501-YF45	d14 post	CSASQRTGSSGNTIYF	CILGSSNTGKLIF-CSASQRTGSSGNTIYF;CILGSSNTGKLIF-CSASQRTGSSGNTIYF	2
HD2	1501-YF45	d14 post	CSASVVTGTFGEQYF	CAGTNNDMRF-CSASVVTGTFGEQYF;CAGTNNDMRF-CSASVVTGTFGEQYF	1
HD2	1501-YF45	d14 post	CSASWTSFGEQYF	CIVLTSGTYKYIF-CSASWTSFGEQYF	1
HD3	1501-YF45	d14 post	CSASYLTGSYNEQFF	CAGQGYNQGGKLIF-CSASYLTGSYNEQFF	30
HD3	1501-YF45	d14 post	CSASYLTGSYNEQFF	CAGQGYNQGGKLIF-CSASYLTGSYNEQFF	30
HD3	1501-YF45	d14 post	CSASYLTGSYNEQFF	CAGQGYNQGGKLIF-CSASYLTGSYNEQFF	30
HD3	1501-YF45	d14 post	CSASYLTGSYNEQFF	CAGQGYNQGGKLIF-CSASYLTGSYNEQFF	30
HD3	1501-YF45	d14 post	CSASYLTGSYNEQFF	CAGQGYNQGGKLIF-CSASYLTGSYNEQFF	30
HD3	1501-YF45	d14 post	CSASYLTGSYNEQFF	CAGQGYNQGGKLIF-CSASYLTGSYNEQFF	30
HD3	1501-YF45	d14 post	CSASYLTGSYNEQFF	CAGQGYNQGGKLIF-CSASYLTGSYNEQFF	30
HD3	1501-YF45	d14 post	CSASYLTGSYNEQFF	CAGQGYNQGGKLIF-CSASYLTGSYNEQFF	30
HD3	1501-YF45	d14 post	CSASYLTGSYNEQFF	CAGQGYNQGGKLIF-CSASYLTGSYNEQFF	30
HD3	1501-YF45	d14 post	CSASYLTGSYNEQFF	CAGQGYNQGGKLIF-CSASYLTGSYNEQFF	30
HD3	1501-YF45	d14 post	CSASYLTGSYNEQFF	CAGQGYNQGGKLIF-CSASYLTGSYNEQFF	30
HD3	1501-YF45	d14 post	CSASYLTGSYNEQFF	CAGQGYNQGGKLIF-CSASYLTGSYNEQFF	30
HD3	1501-YF45	d14 post	CSASYLTGSYNEQFF	CAGQGYNQGGKLIF-CSASYLTGSYNEQFF	30
HD3	1501-YF45	d14 post	CSASYLTGSYNEQFF	CAGQGYNQGGKLIF-CSASYLTGSYNEQFF	30
HD3	1501-YF45	d14 post	CSASYLTGSYNEQFF	CAGQGYNQGGKLIF-CSASYLTGSYNEQFF	30
HD3	1501-YF45	d14 post	CSASYLTGSYNEQFF	CAGQGYNQGGKLIF-CSASYLTGSYNEQFF	30
HD3	1501-YF45	d14 post	CSASYLTGSYNEQFF	CAGQGYNQGGKLIF-CSASYLTGSYNEQFF	30
HD3	1501-YF45	d14 post	CSASYLTGSYNEQFF	CAGQGYNQGGKLIF-CSASYLTGSYNEQFF	30
HD3	1501-YF45	d14 post	CSASYLTGSYNEQFF	CAGQGYNQGGKLIF-CSASYLTGSYNEQFF	30
HD3	1501-YF45	d14 post	CSASYLTGSYNEQFF	CAGQGYNQGGKLIF-CSASYLTGSYNEQFF	30
HD3	1501-YF45	d14 post	CSASYLTGSYNEQFF	CAGQGYNQGGKLIF-CSASYLTGSYNEQFF	30
HD3	1501-YF45	d14 post	CSASYLTGSYNEQFF	CAGQGYNQGGKLIF-CSASYLTGSYNEQFF	30
HD3	1501-YF45	d14 post	CSASYLTGSYNEQFF	CAGQGYNQGGKLIF-CSASYLTGSYNEQFF	30
HD3	1501-YF45	d14 post	CSASYLTGSYNEQFF	CAGQGYNQGGKLIF-CSASYLTGSYNEQFF	30
HD3	1501-YF45	d14 post	CSASYLTGSYNEQFF	CAGQGYNQGGKLIF-CSASYLTGSYNEQFF	30
HD3	1501-YF45	d14 post	CSASYLTGSYNEQFF	CAGQGYNQGGKLIF-CSASYLTGSYNEQFF	30
HD3	1501-YF45	d14 post	CSASYLTGSYNEQFF	CAGQGYNQGGKLIF-CSASYLTGSYNEQFF	30
HD3	1501-YF45	d14 post	CSASYLTGSYNEQFF	CAGQGYNQGGKLIF-CSASYLTGSYNEQFF	30
HD3	1501-YF45	d14 post	CSASYLTGSYNEQFF	CAGQGYNQGGKLIF-CSASYLTGSYNEQFF	30

HD3	1501-YF45	d14 post	CSASYLTGSYNEQFF	CAGQGYNQGGKLIF-CSASYLTGSYNEQFF	30
HD3	1501-YF45	d14 post	CSATLRTLGEQFF	CSATLRTLGEQFF	1
HD3	1501-YF45	d14 post	CSATSLVTSRTGIQQYF	CATDPYSSNTGKLIF-CSATSLVTSRTGIQQYF	1
HD3	1501-YF45	d14 post	CSATTLSGGGRETQYF	CALSDGGYQKVTF-CSATTLSGGGRETQYF	2
HD3	1501-YF45	d14 post	CSATTLSGGGRETQYF	CALSDGGYQKVTF-CSATTLSGGGRETQYF	2
HD2	1501-YF45	d14 post	CSATVRTGGEQYF	CSATVRTGGEQYF	1
HD3	1501-YF45	d14 post	CSAVVGSVMRSPLHF	CALTPLNSGGSNYKLTF-CSAVVGSVMRSPLHF	1
HD3	1501-YF45	d14 post	CSTLDRVGGGELFF	CLVGLPGSSNTGKLIF-CSTLDRVGGGELFF	1
HD3	1501-YF45	d14 post	CSVADRVGTGELFF	CIVPGSTPLVF-CSVADRVGTGELFF	1
HD2	1501-YF45	d14 post	CSVAWRVGTGELFF	CIVSSGNTGKLIF-CSVAWRVGTGELFF	1
HD3	1501-YF45	d14 post	CSVGARVNTGELFF	CIAFSGNTPLVF-CSVGARVNTGELFF;CIAFSVNTPLVF-CSVGARVNTGELFF	1
HD3	1501-YF45	d14 post	CSVGNRWARVVGSGNTIYF	CIVRVSHKAAGNKLTF-CSVGNRWARVVGSGNTIYF	1
HD3	1501-YF45	d14 post	CSVGQASNTGELFF	CIVRVAVNAGNMLTF-CSVGQASNTGELFF	1
HD3	1501-YF45	d14 post	CSVLHRVGGTEAFF	CAGPVGSSNTGKLIF-CSVLHRVGGTEAFF	1
HD3	1501-YF45	d14 post	CSVQIGRVGGEQFF	CIVRPLNTGNQFYF-CSVQIGRVGGEQFF;SMVLGANSKLTF-CSVQIGRVGGEQFF	1
HD3	1501-YF45	d14 post	CSVRRGNGQGDTEAFF	CALFSSNTGKLIF-CSVRRGNGQGDTEAFF	1
HD3	1501-YF45	d14 post	CSVRTGQVTGELFF	CSVRTGQVTGELFF	1
HD2	1501-YF45	d14 post	CSVSDRVGSDTIYF	CLVGAGNTGKLIF-CSVSDRVGSDTIYF;GFQKLVF-CSVSDRVGSDTIYF	1
HD2	1501-YF45	d14 post	CSVSGLAGGGEQFF	CIALKAAGNKLTF-CSVSGLAGGGEQFF;CIVRVQTGANNLFF-CSVSGLAGGGEQFF	1
HD2	1501-YF45	d14 post	CSVVVRTGGNQPQHF	CALSGNNNARLMF-CSVVVRTGGNQPQHF;CALSGNNNARLMF-CSVVVRTGGNQPQHF	1
HD3	1501-YF45	pre-vac	CASGFLAPGQTSGNTIYF	CASGFLAPGQTSGNTIYF	1
HD2	1501-YF45	pre-vac	CASRDRFRTDTQYF	CAASVAGTYKYIF-CASRDRFRTDTQYF	1
HD2	1501-YF45	pre-vac	CASREGPGPRNKNYGYTF	CASREGPGPRNKNYGYTF	1
HD2	1501-YF45	pre-vac	CASRKGTGTNEKLFF	CIVISGAGGTSYGKLTF-CASRKGTGTNEKLFF	1
HD3	1501-YF45	pre-vac	CASRPRQTEQFF	CILSQGGSQGNLIF-CASRPRQTEQFF;CILSQGGSQGNLIF-CASRPRQTEQFF	1
HD2	1501-YF45	pre-vac	CASSASGTSLYEQYF	CASSASGTSLYEQYF	1
HD2	1501-YF45	pre-vac	CASSEQPLDYGYTF	CIVRVAGSGGYQKVTF-CASSEQPLDYGYTF	1
HD2	1501-YF45	pre-vac	CASSFTTDTQYF	CFTFSGGYQKVTF-CASSFTTDTQYF	1
HD2	1501-YF45	pre-vac	CASSGRLAPNEQFF	CAMTSTGFQKLVF-CASSGRLAPNEQFF;CAMTSTGFQKLVF-CASSGRLAPNEQFF	1
HD2	1501-YF45	pre-vac	CASSLASAQETQYF	CAMRGNQAGTALIF-CASSLASAQETQYF	1
HD2	1501-YF45	pre-vac	CASSLDVVTDTQYF	CASSLDVVTDTQYF	1
HD2	1501-YF45	pre-vac	CASSLERAPWEKLFF	CASSLERAPWEKLFF	1
HD3	1501-YF45	pre-vac	CASSLGASGGAAGEQFF	CAVRDAYGGSQGNLIF-CASSLGASGGAAGEQFF	1
HD2	1501-YF45	pre-vac	CASSLGVDEQYF	CAASASYNTDKLIF-CASSLGVDEQYF	1
HD2	1501-YF45	pre-vac	CASSMWARWPNTEAFF	CILRAVLLGNNNDMRF-CASSMWARWPNTEAFF;CILRAVLLGNNNDMRF-CASSMWARWPNTEAFF	1

HD2	1501-YF45	pre-vac	CASSPFLGPGVQPQHF	CIVRGLAAQKLVF-CASSPFLGPGVQPQHF;CIVRGLAAQKLVF-CASSPFLGPGVQPQHF	1
HD2	1501-YF45	pre-vac	CASSPGGYRQETQYF	CAFMKRGNNARLMF-CASSPGGYRQETQYF	1
HD2	1501-YF45	pre-vac	CASSPGLAGSGTGELFF	CASSPGLAGSGTGELFF	1
HD2	1501-YF45	pre-vac	CASSPVLHTQYF	CAYRSAGAQKLVF-CASSPVLHTQYF;CAYRSAGAQKLVF-CASSPVLHTQYF	1
HD2	1501-YF45	pre-vac	CASSPVVLANQETQYF	CAVGRSGGSYIPTF-CASSPVVLANQETQYF;CAVGRSGGSYIPTF-CASSPVVLANQETQYF	1
HD2	1501-YF45	pre-vac	CASSQDKLRGGETQYF	CAVISNAGGTSYGKLTF-CASSQDKLRGGETQYF	1
HD2	1501-YF45	pre-vac	CASSQVPGGSEQYF	CIVRVAGIGGNTPLVF-CASSQVPGGSEQYF;CIVRVAGIGGNTPLVF-CASSQVPGGSEQYF	1
HD3	1501-YF45	pre-vac	CASSQVTQLSTEAFF	CIVRVGYNARLMF-CASSQVTQLSTEAFF	1
HD2	1501-YF45	pre-vac	CASSRAVQPGQGATNEKLFF	CAASLMDSNYQLIW-CASSRAVQPGQGATNEKLFF	1
HD3	1501-YF45	pre-vac	CASSRDLIGTEAFF	CIVRVYTGNQFYF-CASSRDLIGTEAFF	1
HD2	1501-YF45	pre-vac	CASSRTGWYEQYF	CALAVTTGNQFYF-CASSRTGWYEQYF	1
HD2	1501-YF45	pre-vac	CASSTFGQGSTGNTEAFF	CASSTFGQGSTGNTEAFF	1
HD3	1501-YF45	pre-vac	CASSVQGLNTEAFF	CAPQMDSSYKLIF-CASSVQGLNTEAFF	1
HD2	1501-YF45	pre-vac	CASSYKENYGYTF	CAMSPNYGNNRLAF-CASSYKENYGYTF	1
HD3	1501-YF45	pre-vac	CASTPSRTGGYNEQFF	CAERRGSGGSNYKLTF-CASTPSRTGGYNEQFF	1
HD2	1501-YF45	pre-vac	CASWGNYGYTF	CIVRVAVLSGANNLFF-CASWGNYGYTF;CIVRVSVLSGANNLFF-CASWGNYGYTF	1
HD3	1501-YF45	pre-vac	CATRLAGGLQGYNEQFF	CAFLMDSNYQLIW-CATRLAGGLQGYNEQFF	1
HD2	1501-YF45	pre-vac	CATSEGPFRRNIQYF	CVVLKPDNFNKFYF-CATSEGPFRRNIQYF	1
HD2	1501-YF45	pre-vac	CATVGTGGDVRGDEAFF	CATVGTGGDVRGDEAFF	1
HD2	1501-YF45	pre-vac	CSAALLGTGGGGYTF	CIVRGLNAGNMLTF-CSAALLGTGGGGYTF;CIVRGLAAQKLVF-CSAALLGTGGGGYTF	1
HD2	1501-YF45	pre-vac	CSAAPGDSYNEQFF	CAVRVPSWGKLQF-CSAAPGDSYNEQFF	1
HD3	1501-YF45	pre-vac	CSAGGRPGEQYF	CSAGGRPGEQYF	1
HD3	1501-YF45	pre-vac	CSAGQRTNTGELFF	CIVMSGNTPLVF-CSAGQRTNTGELFF	1
HD2	1501-YF45	pre-vac	CSAIVLVSGEQYF	CVVSDFKDKLSF-CSAIVLVSGEQYF;CVVSDFKDKLSF-CSAIVLVSGEQYF	1
HD2	1501-YF45	pre-vac	CSAKMLTGNQPQHF	CAFGDSNYQLIW-CSAKMLTGNQPQHF	1
HD2	1501-YF45	pre-vac	CSAKVLAAFQETQYF	CVVSGGYSGNTGKLIF-CSAKVLAAFQETQYF;CVVSGGYSGNTGKLIF-CSAKVLAAFQETQYF	1
HD3	1501-YF45	pre-vac	CSALVRTGDQQPQHF	CAAGGRGGNTGKLIF-CSALVRTGDQQPQHF	1
HD2	1501-YF45	pre-vac	CSAPILAGQGQKLFF	CILGRDDKIIF-CSAPILAGQGQKLFF;CILGRDDKIIF-CSAPILAGQGQKLFF	1
HD3	1501-YF45	pre-vac	CSAPPLSGGQETQYF	CAVRPYDSWGKLQF-CSAPPLSGGQETQYF;CAVGPYDSWGKLQF-CSAPPLSGGQETQYF	1
HD3	1501-YF45	pre-vac	CSAPTRVEGPQHF	CVVSSPNSGYALNF-CSAPTRVEGPQHF;CVVSSPNSGYALNF-CSAPTRVEGPQHF	1
HD2	1501-YF45	pre-vac	CSAPVIAGRADTQYF	CSAPVIAGRADTQYF	1
HD2	1501-YF45	pre-vac	CSARAGTGAFEQYF	CAVYDYKLSF-CSARAGTGAFEQYF	1

HD2	1501-YF45	pre-vac	CSARAIAFGGEQYF	CAGPNSNSGYALNF-CSARAIAFGGEQYF	1
HD3	1501-YF45	pre-vac	CSARALTVYNSPLHF	CAASAGGGAGGTSYGKLTF-CSARALTVYNSPLHF;CAASAGGGAGGTSYGRLTF-CSARALTVYNSPLHF	1
HD2	1501-YF45	pre-vac	CSARASRIGTDTQYF	CAGLNTGGFKTIF-CSARASRIGTDTQYF;CAGLNTGGFKTIF-CSARASRIGTDTQYF	1
HD2	1501-YF45	pre-vac	CSARDLGLAEETQYF	CALGGSQGNLIF-CSARDLGLAEETQYF;CAVYDYKLSF-CSARDLGLAEETQYF	1
HD2	1501-YF45	pre-vac	CSARDLTILTDTQYF	CIVRVEANAGGTSYGKLTF-CSARDLTILTDTQYF	1
HD2	1501-YF45	pre-vac	CSARGVVGRNSPLHF	CALSAAGGTSYGKLTF-CSARGVVGRNSPLHF	1
HD2	1501-YF45	pre-vac	CSARILAGGPYNEQFF	CAVRSYNTDKLIF-CSARILAGGPYNEQFF	1
HD2	1501-YF45	pre-vac	CSARLRVSSETQYF	CAYRSGYRDDKIIF-CSARLRVSSETQYF	1
HD2	1501-YF45	pre-vac	CSARPLTNSPLHF	CVVSDSGNQFYF-CSARPLTNSPLHF;CVVSDSGNQFYF-CSARPLTNSPLHF	1
HD2	1501-YF45	pre-vac	CSARPLTTMKTQYF	CSARPLTTMKTQYF	1
HD2	1501-YF45	pre-vac	CSARRAVISYEQYF	CIVRPPTGNQFYF-CSARRAVISYEQYF;CAFRKASGTYKYIF-CSARRAVISYEQYF	1
HD2	1501-YF45	pre-vac	CSARSRVGGAQHF	CAGSVYNTDKLIF-CSARSRVGGAQHF	1
HD2	1501-YF45	pre-vac	CSARTGSIYNSPLHF	CALKAAGNKLTF-CSARTGSIYNSPLHF	1
HD2	1501-YF45	pre-vac	CSARVGANYGYTF	CAPRDSGGYQKVTF-CSARVGANYGYTF	1
HD2	1501-YF45	pre-vac	CSARVGSIMDTQYF	CAVRPRSGNTPLVF-CSARVGSIMDTQYF	1
HD3	1501-YF45	pre-vac	CSARVGSIQETQYF	CAVRGAGGTSYGKLTF-CSARVGSIQETQYF	1
HD2	1501-YF45	pre-vac	CSARVGSISTLHF	CAYRTGNTGKLIF-CSARVGSISTLHF	1
HD2	1501-YF45	pre-vac	CSARVGSLLAQYF	CAVRSPGGGADGLTF-CSARVGSLLAQYF	1
HD3	1501-YF45	pre-vac	CSARVGSLLETQYF	CAYRAGNQFYF-CSARVGSLLETQYF	1
HD2	1501-YF45	pre-vac	CSARVGSLNTIYF	CAVNQAGTALIF-CSARVGSLNTIYF;CAVNQAGTALIF-CSARVGSLNTIYF	1
HD2	1501-YF45	pre-vac	CSARVGSLPDTQYF	CAGRPNAGGTSYGKLTF-CSARVGSLPDTQYF	1
HD2	1501-YF45	pre-vac	CSARVGSLQETQYF	CAVPSGSARQLTF-CSARVGSLQETQYF	3
HD2	1501-YF45	pre-vac	CSARVGSLQETQYF	CSARVGSLQETQYF	3
HD3	1501-YF45	pre-vac	CSARVGSLQETQYF	CAVQGTGGFKTIF-CSARVGSLQETQYF	3
HD2	1501-YF45	pre-vac	CSARVGSLTAQYF	CAGPGGGADGLTF-CSARVGSLTAQYF	1
HD2	1501-YF45	pre-vac	CSARVGSLTDTQYF	CAVRGLSGGSNYKLTF-CSARVGSLTDTQYF;CAVRGLSGGSNYKLTF-CSARVGSLTDTQYF	2
HD2	1501-YF45	pre-vac	CSARVGSLTDTQYF	CVVTNSNSGYALNF-CSARVGSLTDTQYF;CVVTNSNSGYALNF-CSARVGSLTDTQYF	2
HD2	1501-YF45	pre-vac	CSARVGSLVETQYF	CVVRANSNSGYALNF-CSARVGSLVETQYF;CVVRANSNSGYALNF-CSARVGSLVETQYF	1
HD3	1501-YF45	pre-vac	CSARVGSVQPHEQYF	CSARVGSVQPHEQYF	1
HD3	1501-YF45	pre-vac	CSARVGSVVGNTIYF	CAVLNRDDKIIF-CSARVGSVVGNTIYF	1
HD2	1501-YF45	pre-vac	CSARVGTNYGYTF	CALPQGAQKLVF-CSARVGTNYGYTF;CALPQGAQKLVF-CSARVGTNYGYTF	1
HD3	1501-YF45	pre-vac	CSARVIAGAYEQYF	CAASGAGGTSYGKLTF-CSARVIAGAYEQYF	1
HD3	1501-YF45	pre-vac	CSARVLAGASGETQYF	CAVEEAAGNKLTF-CSARVLAGASGETQYF	1
HD2	1501-YF45	pre-vac	CSARVLAGGPGETQYF	CAVKGYNTDKLIF-CSARVLAGGPGETQYF	1

HD3	1501-YF45	pre-vac	CSARVLAGGPRDTQYF	CALSAPRAQKLVF-CSARVLAGGPRDTQYF	1
HD2	1501-YF45	pre-vac	CSARVLAGHPGETQYF	CSARVLAGHPGETQYF	1
HD2	1501-YF45	pre-vac	CSARVLAGRADTQYF	CAAFFSDGQKLLF-CSARVLAGRADTQYF;CAAFFSDGQKLLF-CSARVLAGRADTQYF	1
HD2	1501-YF45	pre-vac	CSARVLAGRPQETQYF	CAVSERTGGTSYGKLTF-CSARVLAGRPQETQYF;CAVSERTGGTSYGKLTF-CSARVLAGRPQETQYF	1
HD2	1501-YF45	pre-vac	CSARVLAGVGEQFF	CAVKDNYGQNFVF-CSARVLAGVGEQFF	1
HD2	1501-YF45	pre-vac	CSARVLAGVSTDTQYF	CAVRASTDSWGKLQF-CSARVLAGVSTDTQYF;CAVFWW_YNKLIF-CSARVLAGVSTDTQYF	1
HD2	1501-YF45	pre-vac	CSARVLIGQETQYF	CAAINTNAGKSTF-CSARVLIGQETQYF;CAINTLAGGTSYGKLTF-CSARVLIGQETQYF	1
HD2	1501-YF45	pre-vac	CSARVLPSTDTQYF	CAVEDPLTTDSWGKLQF-CSARVLPSTDTQYF	1
HD2	1501-YF45	pre-vac	CSARVLSGGVRETQYF	CSARVLSGGVRETQYF	1
HD3	1501-YF45	pre-vac	CSARVLTGGNSPLHF	CAGSPQGGSEKLVF-CSARVLTGGNSPLHF	1
HD2	1501-YF45	pre-vac	CSARVLTGNQPQHF	CAAMDSNYQLIW-CSARVLTGNQPQHF	1
HD2	1501-YF45	pre-vac	CSARVLVGYEQYF	CAVAQGGSEKLVF-CSARVLVGYEQYF	1
HD3	1501-YF45	pre-vac	CSARVRADYNSPLHF	CAVIDYNQGGKLIF-CSARVRADYNSPLHF;CAHGRGSQGNLIF-CSARVRADYNSPLHF	1
HD3	1501-YF45	pre-vac	CSARVRTDLGSPLHF	CIALNAGGTSYGKLTF-CSARVRTDLGSPLHF	1
HD3	1501-YF45	pre-vac	CSARVRVRGTQYF	CGADYDNDMRF-CSARVRVRGTQYF;CGADYDNDMRF-CSARVRVRGTQYF	1
HD3	1501-YF45	pre-vac	CSARVVAWNSPLHF	CAMAGNRDDKIIF-CSARVVAWNSPLHF;LGPDSWGKLQF-CSARVVAWNSPLHF	1
HD2	1501-YF45	pre-vac	CSARVVINSPLHF	CAVSVAGGADGLTF-CSARVVINSPLHF;CAVSVAGGADGLTF-CSARVVINSPLHF	1
HD3	1501-YF45	pre-vac	CSARVVTGDNSPLHF	CAGPYAGGTSYGKLTF-CSARVVTGDNSPLHF	1
HD3	1501-YF45	pre-vac	CSARVVTGDSPLHF	CAVGTGGTSYGKLTF-CSARVVTGDSPLHF	1
HD2	1501-YF45	pre-vac	CSARVVTGIGQPQHF	CSARVVTGIGQPQHF	1
HD3	1501-YF45	pre-vac	CSARVVTGSDQPQHF	CALILLLDSNYQLIW-CSARVVTGSDQPQHF	1
HD2	1501-YF45	pre-vac	CSARVVVEGPQHF	CATDVNAGGTSYGKLTF-CSARVVVEGPQHF	1
HD3	1501-YF45	pre-vac	CSARVVVGDTQYF	CALDNAGGTSYGKLTF-CSARVVVGDTQYF	3
HD3	1501-YF45	pre-vac	CSARVVVGDTQYF	CALDNAGGTSYGKLTF-CSARVVVGDTQYF	3
HD2	1501-YF45	pre-vac	CSARVVVNQPQHF	CAASPLNAGGTSYGKLTF-CSARVVVNQPQHF	1
HD2	1501-YF45	pre-vac	CSASGVAGGEDGYTF	CAASSYYNDYKLSF-CSASGVAGGEDGYTF	1
HD2	1501-YF45	pre-vac	CSASLRVYGEQFF	CGAGGTSYGKLTF-CSASLRVYGEQFF;CGAGGTSYGKLTF-CSASLRVYGEQFF	1
HD2	1501-YF45	pre-vac	CSASPLVGNTQYF	CASNTGFQKLVF-CSASPLVGNTQYF	1
HD3	1501-YF45	pre-vac	CSASQRTGSSGNTIYF	CILGSSNTGKLIF-CSASQRTGSSGNTIYF;CILGSSNTGKLIF-CSASQRTGSSGNTIYF	2
HD2	1501-YF45	pre-vac	CSASVLQGAFEQYF	CAVGLDARLMF-CSASVLQGAFEQYF	1
HD3	1501-YF45	pre-vac	CSASVVTGDQPQHF	CAVLYSGAGSYQLTF-CSASVVTGDQPQHF	6
HD3	1501-YF45	pre-vac	CSASVVTGDQPQHF	CAVLYSGAGSYQLTF-CSASVVTGDQPQHF;CIVRA*YGNKLVF-CSASVVTGDQPQHF	6

HD3	1501-YF45	pre-vac	CSASVVTGDQPQHF	CSASVVTGDQPQHF	6
HD3	1501-YF45	pre-vac	CSASVVTGDQPQHF	CSASVVTGDQPQHF	6
HD3	1501-YF45	pre-vac	CSASVVTGDQPQHF	CAVLYSGAGSYQLTF-CSASVVTGDQPQHF	6
HD3	1501-YF45	pre-vac	CSASVVTGDQPQHF	CAVLYSGAGSYQLTF-CSASVVTGDQPQHF	6
HD3	1501-YF45	pre-vac	CSATTRVEGSQYF	CIVRVQGGVGNQFYF-CSATTRVEGSQYF	1
HD2	1501-YF45	pre-vac	CSAWVLVQGAQYF	CAVETPYNTDKLIF-CSAWVLVQGAQYF	1
HD2	1501-YF45	pre-vac	CSGLVVSARPDTQYF	CSGLVVSARPDTQYF	1
HD3	1501-YF45	pre-vac	CSPVGTGDEKLFF	CAVRAANQAGTALIF-CSPVGTGDEKLFF	1
HD3	1501-YF45	pre-vac	CSVEGTSGRGEQFF	CSVEGTSGRGEQFF	1
HD3	1501-YF45	pre-vac	CSVEMAVRSGEQYF	CIVRGGKLIF-CSVEMAVRSGEQYF	1
HD2	1501-YF45	pre-vac	CSVGMGTVTTYEQYF	CAASKRGSGNTGKLIF-CSVGMGTVTTYEQYF	1
HD2	1501-YF45	pre-vac	CSVPSGGDGYTF	CIVRVATYGQNFVF-CSVPSGGDGYTF	1
HD3	1501-YF45	pre-vac	CSVQHRVGGEQFF	CAVSSSNTGKLIF-CSVQHRVGGEQFF	1
HD2	1501-YF45	pre-vac	CSVTDRVGSYEQYF	CSVTDRVGSYEQYF	1
HD2	1501-YF45	pre-vac	CSVVFRVEGGYTF	CAVGGYYGGATNKLIF-CSVVFRVEGGYTF	1
HD3	1501-YF45	pre-vac	RSVEGTSGRGEQFF	RSVEGTSGRGEQFF	1

Table S6: Longitudinal follow-up visits

ID	Sex	Total YFV doses	Vaccine dates	Longitudinal visit dates				
HD1	M	2	8/25/2016, 9/8/2017	8/28/17	12/4/18			
HD2	F	2	9/12/2016, 5/26/2017	5/12/17	4/11/19	12/14/21	5/25/23	
HD3	M	2	1/4/2017, 8/11/2017	8/2/17	8/29/19	6/15/23		
HD4	M	1	5/22/17	8/14/17	4/23/18	1/30/20	9/8/21	
HD5	F	1	4/21/17	6/22/17	2/7/19	2/13/20	9/27/21	4/6/23