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Investigating the effects of T cell avidity distributions on acute vs. chronic viral infection dynamics

The generation of lymphocyte receptor diversity is a key feature of adaptive immunity. In addition to somatic recombination, diversification of the T cell repertoire is significantly enhanced by terminal deoxynucleotidyl transferase, or TdT. However, TdT-knockout studies have shown that lack of TdT does not abrogate T cell immunity in response to acute stimulation by bacterial or viral antigen, and so the specific advantage that this added TdT-dependent variability brings forth remains unclear. We propose that TdT may alter properties of the binding-avidity distribution of protective T cells, and that lack of TdT can impair the immune response against a chronic viral pathogen. In this work, we study the response of a population of T cells that together confer a continuum of T-cell avidities. By constructing and analyzing a system of integro-differential equations, we can not only consider the temporal evolution of key population sizes (namely effector T-cell levels and viral loads), but also track the evolution and infer the role of the distribution of T cell avidities over time. We observe that TdT could offer an advantage over TdT-deficient T cells in a chronic viral context, by either decreasing the average binding avidity, or broadening the range of observable T cells avidities.