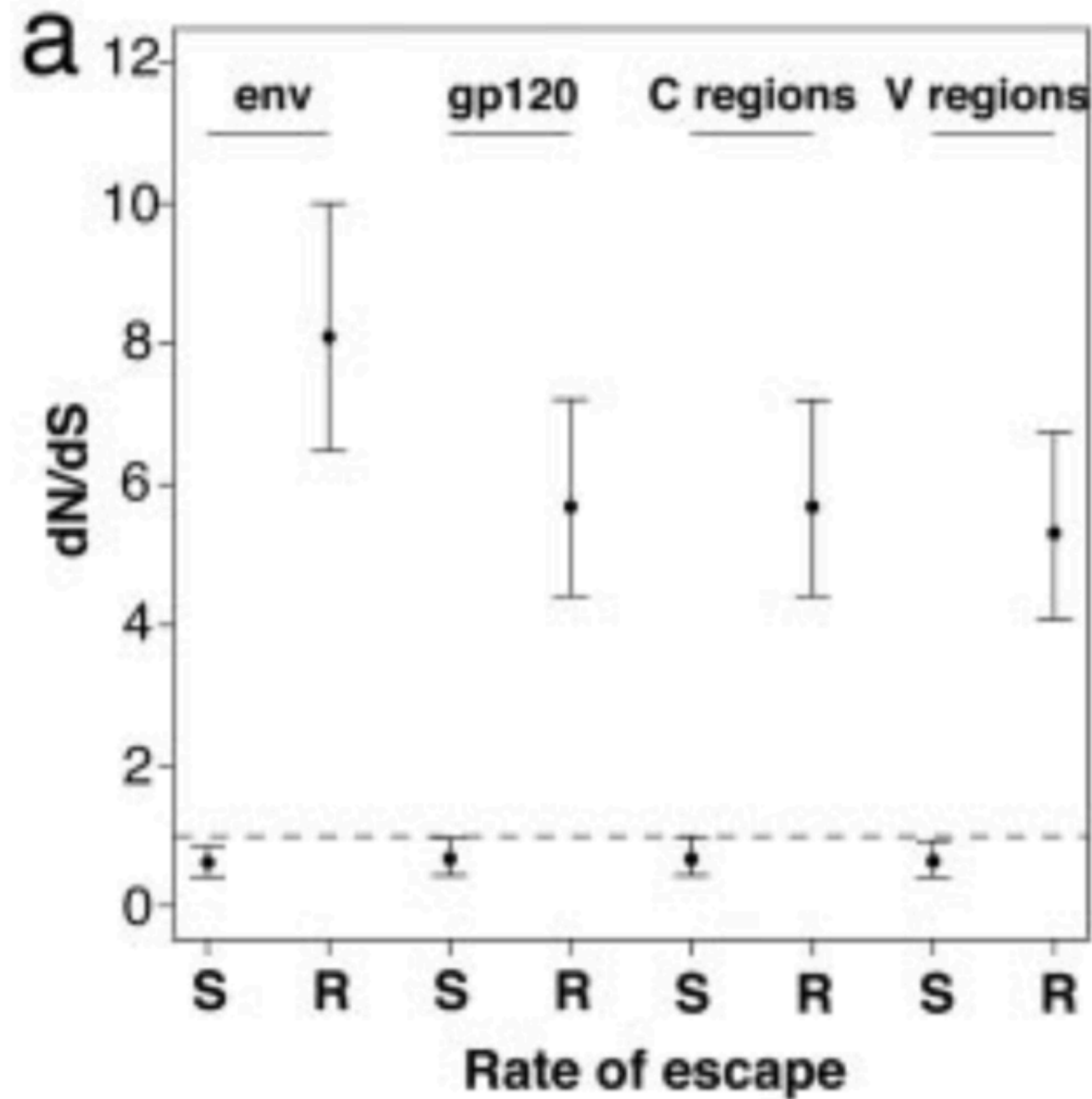


Mean gene-wide dN/dS estimates

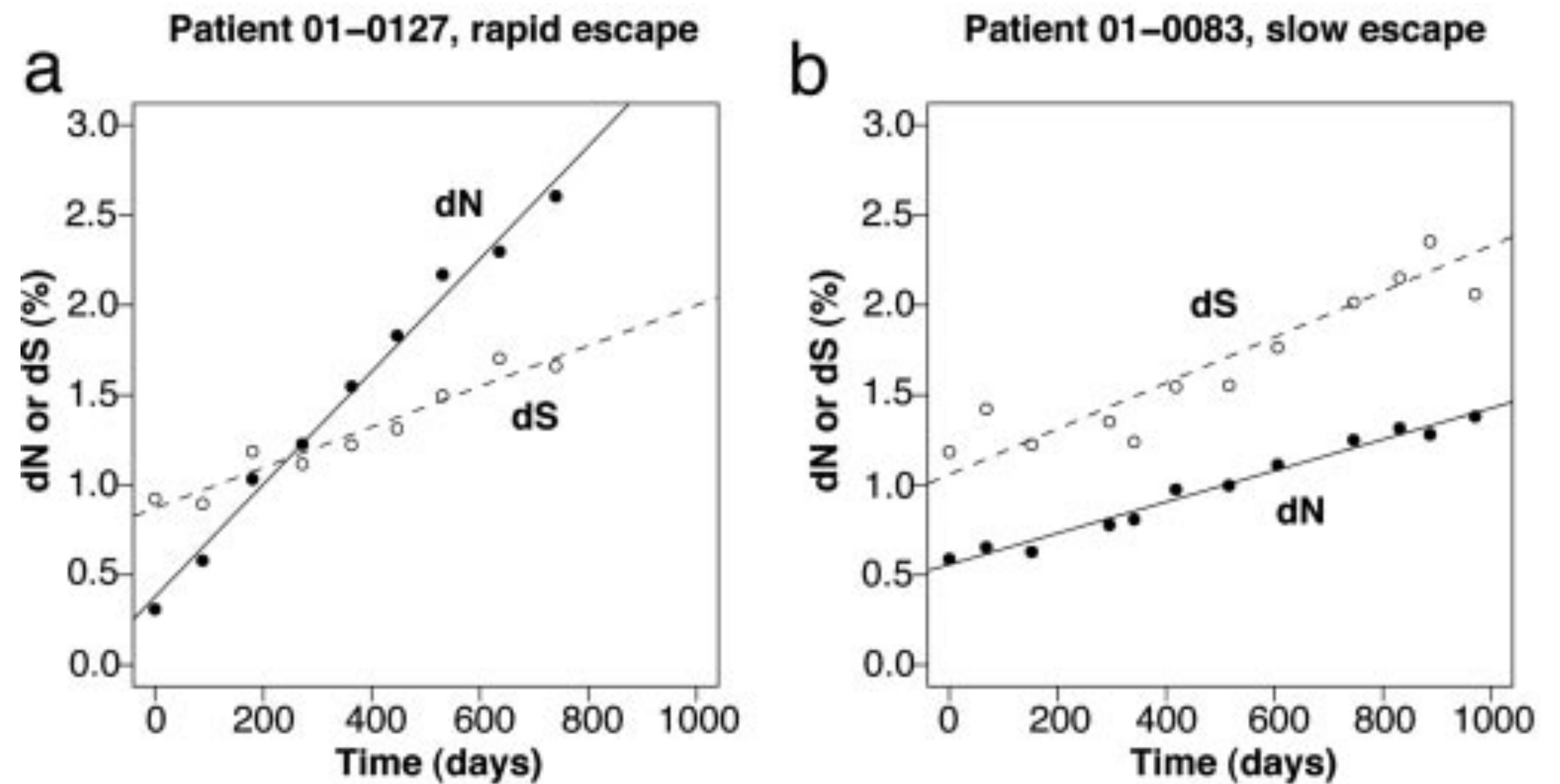
- Are not the way to go, **except** when you have very small (2-3 sequence) datasets
- **For example:**
 - The humoral arm of the immune system mounts a potent defense against viral infections
 - Existing successful vaccines are based on raising a neutralizing antibody (nAb) response to the pathogen
 - No simple host genetic basis (epitopes) of the specificity of neutralizing antibody responses is known
 - Need to measure these responses

An example of mean dN/dS utility

The extent of immune selection pressure drives intra-host evolution in HIV-1



Slow (S) and Rapid (R)



Neutralizing antibody responses drive the evolution of human immunodeficiency virus type 1 envelope during recent HIV infection

Simon D. W. Frost[†], Terri Wrin[†], Davey M. Smith^{*5}, Sergei L. Kosakovsky Pond^{*}, Yang Liu[†], Ellen Paxinos[†], Colombe Chappey[†], Justin Galovich[†], Jeff Beauchaine[†], Christos J. Petropoulos[†], Susan J. Little^{*}, and Douglas D. Richman^{*5}