Supporting Information

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SI Materials and Methods

Here we compare a self-boosting vaccine, which offers endogenous boosting throughout a host's lifetime, with an alternative scheme of simply increasing the frequency of a "conventional" boosting program, one requiring repeated visits to a healthcare professional. For our purposes, a key distinction is that with the latter, challenges in maintaining vaccination coverage can result in a gradual reduction, through time, in the number of people in a given cohort who return to the clinic to receive their booster dose.

In particular, we compare dynamical behavior in the context of "natural boosting," shown in Figs. 3 and 4 in the main text. A simple way of capturing conventional boosting in this framework is to assume a constant per capita "dropout" rate ε, at which vaccinated individuals discontinue boosting. In the structure shown in Fig. 3*A*, this amounts to a transition of rate ε, from S_v to S, I_v to I, etc. If σ_1 is now interpreted as the frequency of visiting a clinic for a booster shot, then $1/\varepsilon$ may be seen as the mean age at which individuals stop returning to the clinic altogether. (Behavior may in reality be more sporadic, with individuals resuming a booster schedule after several years' absence. In our simple framework, however, we expect this effectively to lower ε.) For a given vaccination coverage, then, an "endogenously boosting" vaccination scheme would be recovered by allowing $\varepsilon \to 0$.

Fig. S1 shows results corresponding to Fig. 4 in the main text, for different values of ε: Note that Fig. S1 is limited to the range $0 < \sigma_1 < 2$ (i.e., boosting happening on average less than twice a year), a conservatively wide range for what might be achievable with conventional booster schedules. Fig. S1*D* shows once again the "rescue" effect of a self-boosting vaccine, mitigating epidemic cycles with increasing σ_1. With a conventional boosting program, however, and for the *B. pertussis*-like parameters adopted here, this rescue effect is highly sensitive to $\varepsilon > 0$ (see Fig. S1 *A*–*C*). Even a dropout rate of $\varepsilon = 0.01$ (i.e., mean dropout age of 100) is sufficient to reinstate epidemic cycles.

Although for a highly idealized model, these results illustrate the changing dynamics that could in theory arise from even marginal departures from lifelong boosting.

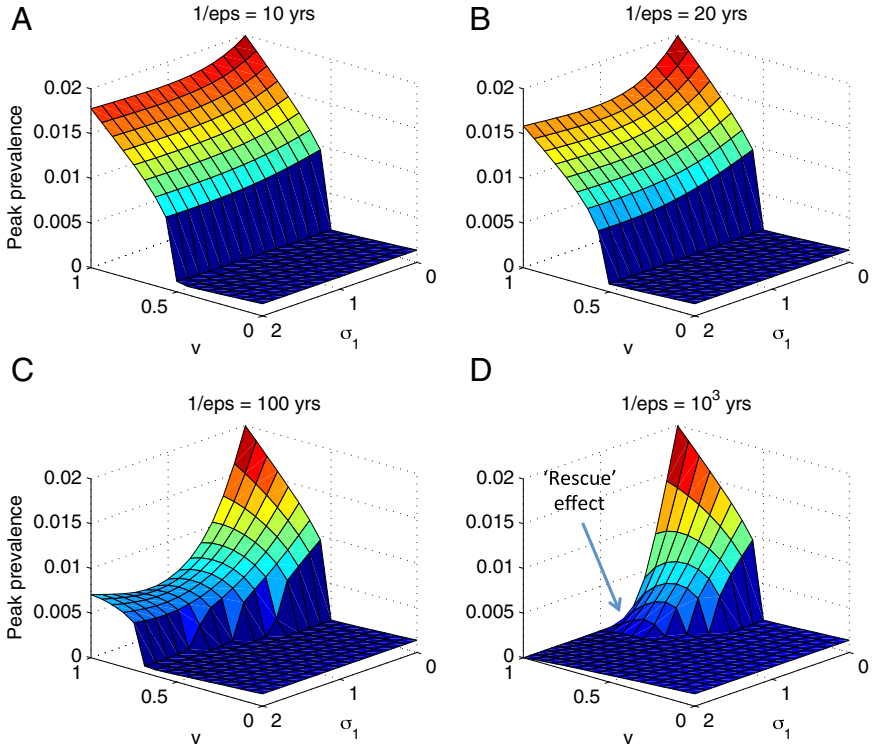

Fig. S1. Results corresponding to Fig. 4 in the main text, but in the case of a "conventional" boosting program, in which individuals stop receiving booster doses at an average of $1/\varepsilon$ y of age. Panels *A*–*D* show results for decreasing values of epsilon (equivalently, increasingly comprehensive follow-up of individuals for repeat vaccination). Panel *D* shows essentially the case of zero 'dropout' rate, recovering Fig. 4. Note that these figures are shown rotated, with respect to Fig. 4, to better illustrate the surfaces. For the parameters considered here, conventional boosting can, to some extent, mitigate the epidemic peaks. However, eliminating these peaks altogether requires a near-complete follow-up of all vaccinated individuals, throughout their lifetimes (panel *D*).