Supplementary Material

To simplify the fitting of the model, we have normalized variables in the model equations (1-3) as follows:

$$\bar{x}(t) = \frac{x(t)}{x(0)}, \quad \bar{y}(t) = \frac{y(t)}{y(0)} = \frac{y(t)}{\beta C}, \quad \bar{z}(t) = \frac{z(t)}{z(0)}$$

Here C is certain average immune cell density found within the tumor, and β is the free parameter that models deviation of this cell density from the average. Therefore, equations (1-3) in new variables then become

$$\begin{aligned}
\frac{d\bar{x}}{dt} &= (p_1 - s_1 e^{-\lambda t})\bar{x} - \frac{\delta' \beta \bar{x}\bar{y}}{1 + (\bar{x}/a')^q} \\
\frac{d\bar{y}}{dt} &= r'\bar{x}\bar{y}(1 - \bar{y}\beta/1000) - (v + f s_1 e^{-\lambda t})\bar{y} \\
\frac{d\bar{z}}{dt} &= (p' + s' e^{-\lambda t})\bar{x} - u\bar{z}
\end{aligned}$$

with redefined parameters

$$\delta' = \delta C, \quad a' = a x(0), \quad r' = r x(0), \quad p' = p x(0)/z(0), \quad s' = s x(0)/z(0)$$

Here we assumed that $K = 1000C$, which implies that the immune cell response can at most increase 1000 fold from the average.

It is to be noticed that the above system of differential equations has the same structure as the original (1-3). However, some of the free parameters are now redefined and β is introduced. In the main text we imply that the redefined parameters keep the same notation.