Jin et al., http://www.jgp.org/cgi/content/full/jgp.201210885/DC1

Computation validation studies

Adequacy of time steps to obtain steady-state solution.
Steady-state solutions were obtained by kinetic computations that were performed for sufficient time to ensure that percent inhibition was constant (example shown in Fig. S1). As explained in the main text, the kinetic solution to the convection–diffusion equations was based on the instantaneous coupled nature of crypt/villus fluid secretion, inhibitor diffusion, and inhibitor concentration at the crypt/villus surface. In addition to ensuing adequacy of computation time, we confirmed independence of steady-state percent inhibition on starting conditions (inhibitor concentration profiles).

Adequacy of mesh element density.

For all computations, adequacy of mesh element density was confirmed by showing insensitivity of percent inhibition to the number of mesh elements used in the computation (example shown in Fig. S2). The effect of mesh elements number from $O(10^2)$ to $\sim O(10^5)$ had no effect, which is expected because of very slow laminar flow ($R_e < 0.001$ in crypt, and $R_e < 0.1$ in villus).

Secretion rate (J_v°) calculation

diarrhea secretion rate = 4.5 ml/cm/h

crypt density = $12{,}500/\text{cm}^2$

lumen diameter = 5 cm

sinlge crypt/villus unit secretion rate

$$\sum J = \frac{4.5cm^3 \times 1/cm \times 1/3{,}600s}{\pi D_{lumen} \times 12{,}500} =$$

$$\frac{4.5/3{,}600}{\pi 5 \times 12{,}500} cm^3/s \approx 6.4 \times 10^{-9} cm^3/s \approx 4 \times 10^{-7} cm^3/\min$$

$$\sum J = 2\pi \times R_{villus} \times \frac{L_{villus}}{2} \times \left[(0.15+0.28) \times \frac{R_{crypt}}{R_{villus}} \times \frac{L_{crypt}}{L_{villus}}\right]$$

$$\times Jvo + 2\pi \times R_{crypt} \times \frac{L_{crypt}}{2}(0.6+1) \times Jvo$$

$$= \pi \times R_{crypt} \times (0.43 L_{crypt} + 1.6 L_{crypt}) \times Jvo$$

$$= \pi \times R_{crypt} \times 2.03 L_{crypt} \times Jvo$$

Secretion rate per unit area at the crypt surface

$$J_v^o = \frac{\sum J}{\pi \times R_{crypt} \times 2.03 \times L_{crypt}} = \frac{6.4 \times 10^{-9} cm^3/s}{\pi \times 50\mu m \times 2.03 \times 150\mu m}$$

$$J_v^o = 6.74 \times 10^{-5} cm/s = 7 \times 10^{-2}\ \mu L/cm^2/s$$

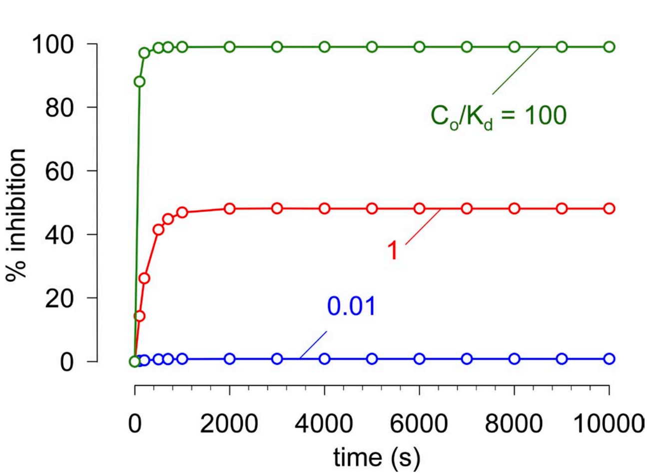

Figure S1. Percent inhibition of net secreted flow as a function of time in the two-dimensional single-crypt computation, with J_v° = 10^{-3} µL/cm²/s for indicated C_o/K_d.

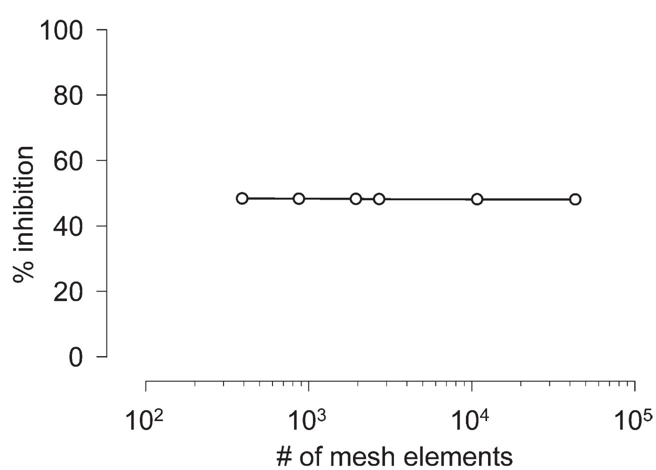

Figure S2. Percent inhibition of net secreted flow as a function of the number of mesh elements for the two-dimensional single-crypt computation for J_v° = 10^{-3} µL/cm²/s and $C_o/K_d = 1$.