Supplemental Material For:
Kinetics of Influenza A Virus Infection in Humans

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(Dated: April 9, 2006)

This document contains additional details on the parameters, and statistics of the fits for the simple model (Table I), the model with delays (Table II), and the IFN model (Table III).

Patient	V_0 (TCID$_{50}$/mL)	β ((TCID$_{50}$/mL)$^{-1}\cdot$d^{-1})	p (TCID$_{50}$/mL$\cdot$d^{-1})	c (d^{-1})	$t_{\frac{1}{2}}$ (h)	δ (d^{-1})	$\langle t\rangle$ (h)	R_0	SSR (TCID$_{50}$/mL)^2
1	3.5×10^{-1} $(1.8-5.1)\times10^{-1}$	3.4×10^{-5} $(2.6-4.3)\times10^{-5}$	7.9×10^{-3} $(5.2-15)\times10^{-3}$	3.3 $(2.3-5.0)$	5.0	3.4 $(2.7-4.1)$	7.1	9.6 $(5.7-22)$	4.6
2	1.4×10^{-3} $(0.059-3.8)\times10^{-3}$	1.6×10^{-4} $(1.2-5.0)\times10^{-4}$	4.1×10^{-3} $(2.3-4.7)\times10^{-3}$	2.1 $(1.5-2.8)$	7.7	11.2 $(4.0-77)$	2.1	11.2 $(5.9-23)$	7.0
3	1.0×10^{-2} $(0.12-2.5)\times10^{-2}$	1.3×10^{-4} $(0.49-3.4)\times10^{-4}$	3.2×10^{-3} $(1.1-11)\times10^{-3}$	2.1 $(1.3-3.2)$	7.9	2.1 $(0.99-6.3)$	11.4	37.7 $(15-82)$	8.3
4	9.1×10^{-1} $(8.6-9.5)\times10^{-1}$	6.3×10^{-6} $(4.8-7.3)\times10^{-6}$	4.2×10^{-2} $(3.7-4.7)\times10^{-2}$	3.1 $(2.9-3.2)$	5.4	2.8 $(2.7-2.9)$	8.7	12.4 $(10-16)$	4.0
5	4.3×10^{-1} $(4.2-4.5)\times10^{-1}$	2.3×10^{-5} $(2.2-2.3)\times10^{-5}$	1.0×10^{-2} $(0.80-1.2)\times10^{-2}$	4.2 $(3.9-4.4)$	4.0	5.1 $(4.7-5.2)$	4.7	4.4 $(3.6-5.4)$	9.0
6	3.3×10^{-1} $(0.66-6.0)\times10^{-1}$	3.8×10^{-6} $(1.4-5.7)\times10^{-6}$	7.1×10^{-2} $(4.1-20)\times10^{-2}$	3.6 $(1.6-4.9)$	4.6	3.6 $(2.3-4.7)$	6.7	8.3 $(6.2-27)$	13.6
avg	9.3×10^{-2}	2.7×10^{-5}	1.2×10^{-2}	3.0	5.6	4.0	6.0	11.1	7.1
95% CI	$1.4\times10^{-2}-6.1\times10^{-1}$	$8.8\times10^{-6}-8.3\times10^{-5}$	$4.8\times10^{-3}-3.0\times10^{-2}$	$2.4-3.6$	$4.6-6.9$	$2.6-6.1$	$3.9-9.2$	$6.6-18.5$	$5.1-9.9$

TABLE I: Best fit parameter values for the target cell limited model without delay with $T_0 = 4\times10^8$ cells. The best fit initial virus titer (V_0), infection rate constant (β), average rate of increase of viral titer per infected cell (p), viral clearance rate (c), half-life of free virus ($t_{1/2}$), infected cell death rate (δ), average lifetime of infected cells ($\langle t\rangle = \langle\delta^{-1}\rangle$), basic reproductive number (R_0), and sum of squared residuals (SSR) between the experimental data and the model fit are given for each patient. The 95% confidence intervals given in parenthesis underneath each patient's best fit parameter estimates were obtained by 200 bootstrap replicates. The geometric average and geometric 95% confidence interval across patients for each parameter is also given.

Patient	V_0 (TCID$_{50}$/mL)	β ((TCID$_{50}$/mL)$^{-1}\cdot$d^{-1})	k (d^{-1})	$1/k$ (h)	p (TCID$_{50}$/mL$\cdot$d^{-1})	c (d^{-1})	$t_{\frac{1}{2}}$ (h)	δ (d^{-1})	$1/\delta$ (h)	$\langle t\rangle$ (h)	R_0	SSR (TCID$_{50}$/mL)^2
1	4.3×10^{-2}	4.9×10^{-5}	3.9	6.2	2.8×10^{-2}	4.3	3.9	4.2	5.7	11.9	30.4	4.3
	$(0.49-6.3)\times10^{-2}$	$(4.4-5.8)\times10^{-5}$	$(3.3-6.3)$		$(1.7-4.0)\times10^{-2}$	$(2.4-7.9)$		$(2.7-12)$			$(14-60)$	
2	3.1×10^{-7}	1.1×10^{-3}	2.0	12.1	2.1×10^{-2}	11.0	1.5	10.9	2.2	14.3	75.0	6.5
	$(0.040-300)\times10^{-7}$	$(0.58-6.7)\times10^{-3}$	$(1.0-2.9)$		$(2.07-2.09)\times10^{-2}$	$(2.6-40)$		$(3.8-270)$			$(21-300)$	
3	7.0×10^{-1}	1.7×10^{-4}	4.9	4.9	3.0×10^{-3}	2.2	7.5	2.3	10.3	15.2	39.6	8.0
	$(0.00017-62)\times10^{-1}$	$(0.43-9.6)\times10^{-4}$	$(1.7-28)$		$(0.56-26)\times10^{-3}$	$(0.44-3.4)$		$(1.2-15)$			$(12-350)$	
4	4.9	5.3×10^{-6}	4.0	6.0	1.3×10^{-1}	3.8	4.4	3.8	6.4	12.4	19.1	2.9
	$(2.9-6.6)$	$(4.0-7.7)\times10^{-6}$	$(3.1-8.7)$		$(0.68-2.3)\times10^{-1}$	$(2.7-4.3)$		$(2.7-10)$			$(8.3-34)$	
5	1.7	2.7×10^{-6}	6.0	4.0	5.9×10^{-1}	13.5	1.2	13.5	1.8	5.8	3.5	6.6
	$(0.0043-64)$	$(0.60-25)\times10^{-6}$	NA		$(0.29-440)\times10^{-1}$	$(4.0-160)$		$(4.9-180)$			$(1.9-12)$	
6	2.4	8.4×10^{-6}	4.4	5.5	7.1×10^{-2}	3.7	4.5	3.8	6.3	11.8	16.6	11.8
	$(0.035-7.3)$	$(0.54-38)\times10^{-6}$	$(2.3-20)$		$(1.7-94)\times10^{-2}$	$(1.6-8.7)$		$(1.9-10)$			$(5.1-60)$	
avg	7.5×10^{-2}	3.2×10^{-5}	4.0	6.0	4.6×10^{-2}	5.2	3.2	5.2	4.6	11.4	21.5	6.1
95% CI	$7.6\times10^{-4}-7.5$	$6.0\times10^{-6}-1.7\times10^{-4}$	$3.0-5.2$	$4.6-7.9$	$1.2\times10^{-2}-1.7\times10^{-1}$	$3.1-8.7$	$1.9-5.3$	$3.2-8.6$	$2.8-7.5$	$8.8-14.7$	$10.1-46.1$	$4.3-8.7$

TABLE II: Best fit parameter values for the target cell limited model with delay, and $T_0 = 4\times10^8$ cells. The best fit initial virus titer (V_0), infection rate constant (β), transition rate to I_2 (k), average estimated transition time from I_1 to I_2 ($1/k$), average rate of increase of viral titer per infected cell (p), viral clearance rate (c), half-life of free virus ($t_{1/2}$), infected cell death rate (δ), average time spent by a cell in the infected state ($1/\delta$), average lifetime of infected cells (calculated as $\langle t\rangle = \langle k^{-1}+\delta^{-1}\rangle$), average of the sum of the lifetime of cells while infected and not producing virus and while producing virus), basic reproductive number (R_0), and sum of squared residuals (SSR) between the experimental data and the model fit are given for each patient. The 95% confidence intervals given in parenthesis underneath each patient's best fit parameter estimates were obtained by 200 bootstrap replicates. The geometric average and geometric 95% confidence interval across patients for each parameter is also given.

Patient	V_0 (TCID$_{50}$/mL)	β ((TCID$_{50}$/mL)$^{-1}\cdot$d^{-1})	k (d^{-1})	p (TCID$_{50}$/mL$\cdot$d^{-1})	c (d^{-1})	δ (d^{-1})	α ([F]/d)	ε_1 ([F]$^{-1}$)	ε_2 ([F]$^{-1}$)	R_0	SSR (TCID$_{50}$/mL)^2
1	1.0×10^{-2}	4.2×10^{-6}	26.6	3.2×10^{-1}	13.4	7.0	5.2	3.5×10^{-6}	3.0×10^{-7}	5.7	32.8
2	4.4×10^{-5}	2.4×10^{-5}	32.4	5.3×10^{-2}	7.4	3.8	2.2	3.7×10^{-6}	6.3×10^{-6}	18.1	3.1
3	1.2×10^{-1}	7.6×10^{-6}	11.2	1.1×10^{-1}	6.0	6.0	1.1	3.1×10^{-7}	5.3×10^{-7}	9.3	7.6
4	$5.0 \times 10^{+1}$	2.4×10^{-6}	6.1	2.0×10^{-1}	5.3	5.1	1.9	6.3×10^{-8}	0.0	7.1	4.0
5	1.3	4.3×10^{-6}	8.0	1.5×10^{-1}	7.2	7.9	1.7	0.0	4.2×10^{-8}	4.5	11.9
6	$3.5 \times 10^{+1}$	2.9×10^{-7}	10.1	2.5	9.7	9.6	1.1	0.0	0.0	3.1	8.7
avg	2.2×10^{-1}	3.6×10^{-6}	13.0	2.3×10^{-1}	7.8	6.3	1.9	—	—	6.8	8.3
95% CI	4.6×10^{-3}–$1.1 \times 10^{+1}$	1.2×10^{-6}–1.1×10^{-5}	8.0–21.1	8.7×10^{-2}–6.0×10^{-1}	6.1–9.9	4.9–8.0	1.2–2.9	—	—	4.3–10.6	4.5–15.3

TABLE III: Best fit parameter values for the target cell limited model with delay and incorporating an interferon response, with $T_0 = 4 \times 10^8$ cells, $s = 1$, and $\tau = 0.5$ d. The best fit initial virus titer (V_0), infection rate constant (β), transition rate to I_2 (k), average rate of increase of viral titer per infected cell (p), viral clearance rate (c), infected cell death rate (δ), interferon clearance rate (α), effect of the interferons on k (ε_1) and p (ε_2), basic reproductive number (R_0), and sum of squared residuals (SSR) between the experimental data and the model fit are given for each patient. The geometric average and geometric 95% confidence interval across patients for each parameter is also given.