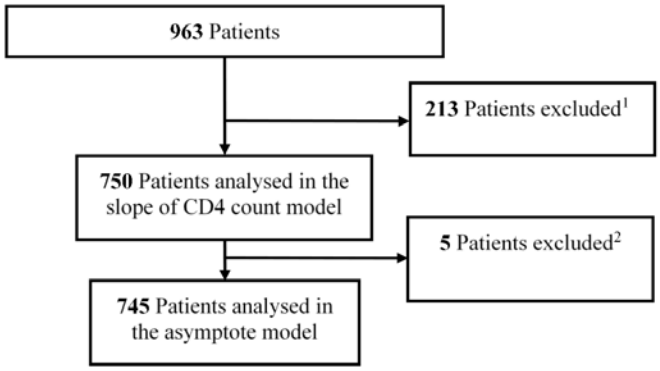
S2 Appendix

Figure A: Data selection diagram



[1] Patients with only one visit, at baseline

[2] Patients with a baseline CD4 count ≥500 cells/μL

Figure B: Proportion of missing viral load result per visit over throughout follow-up period.

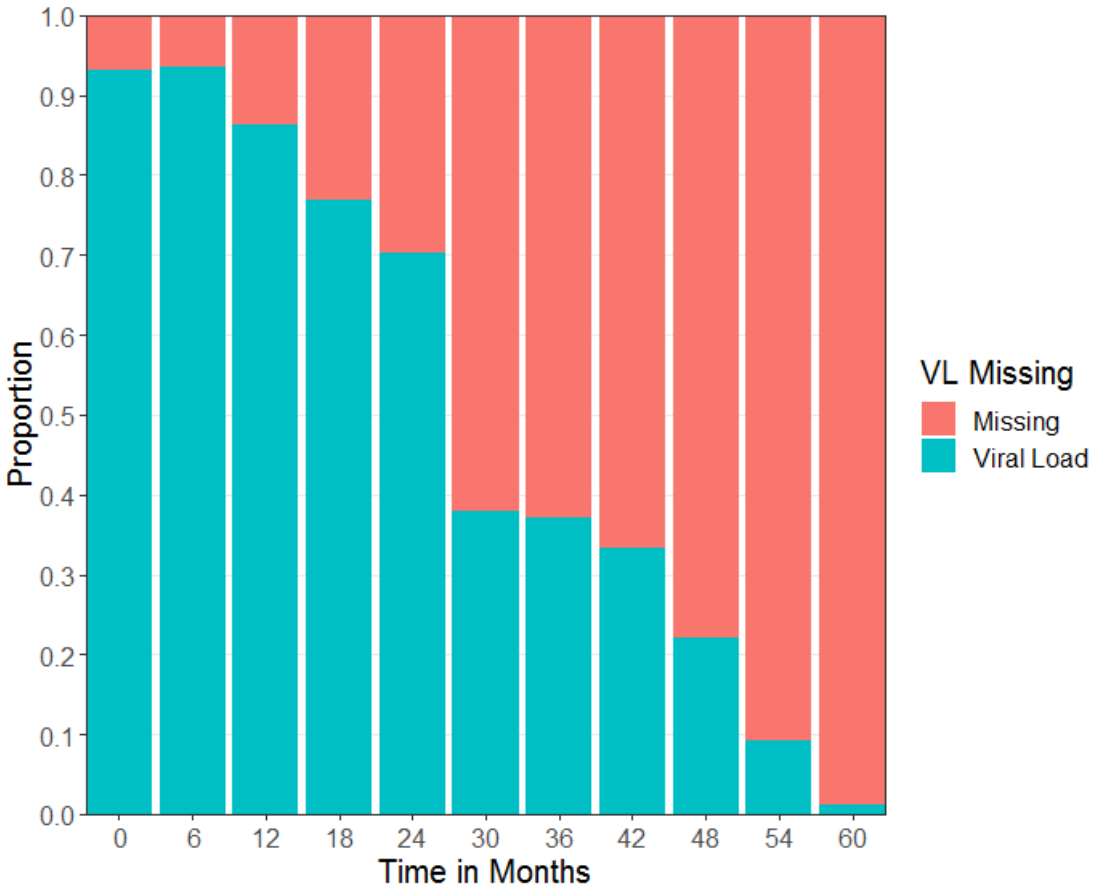
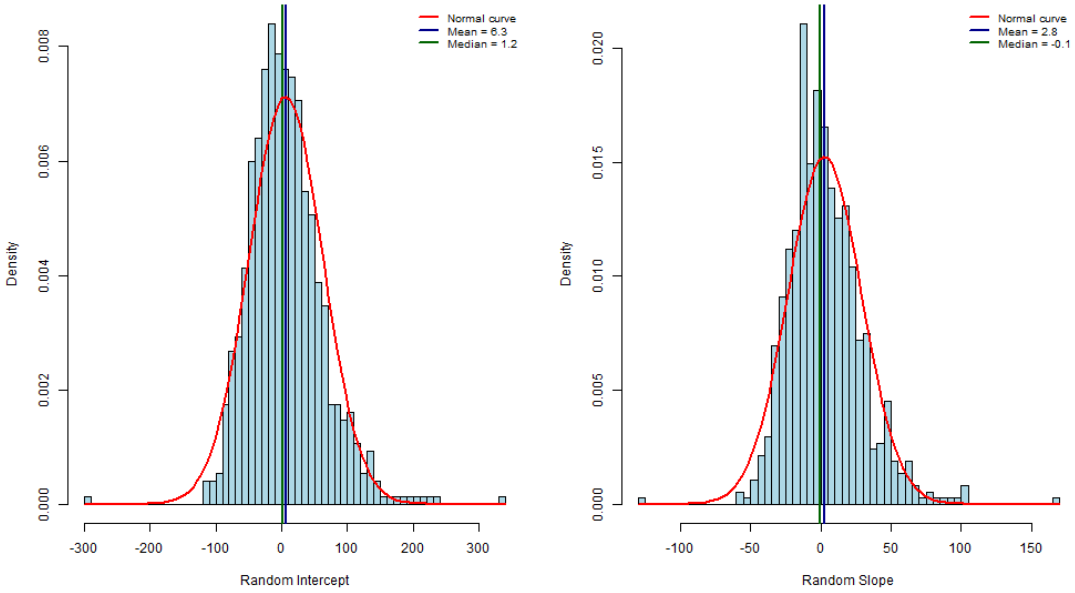
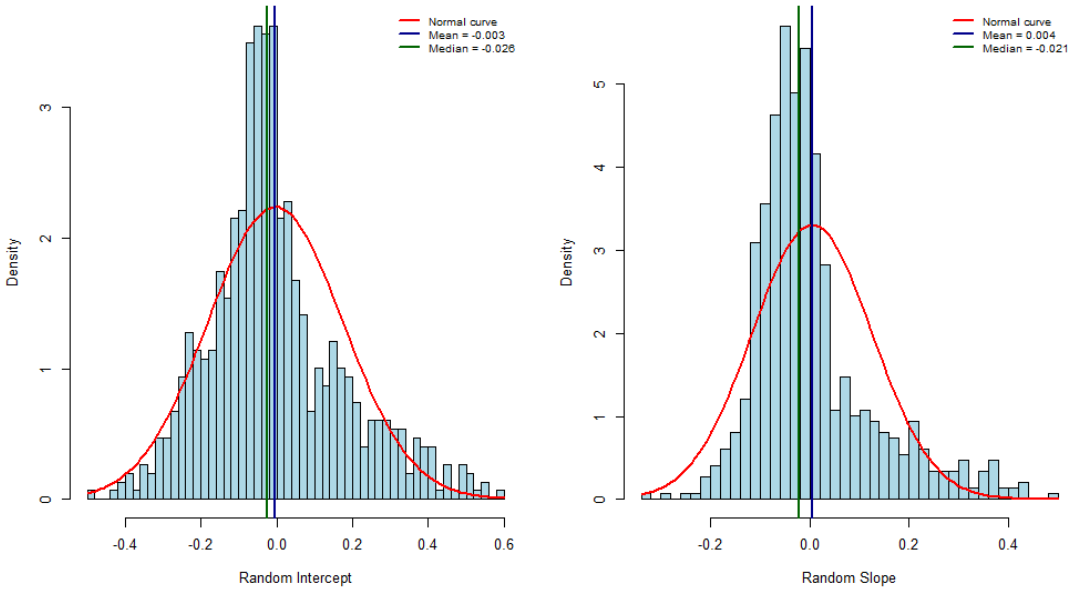


Figure C: Histograms of estimated random intercept and slope obtained for the slope of CD4 count polynomial models



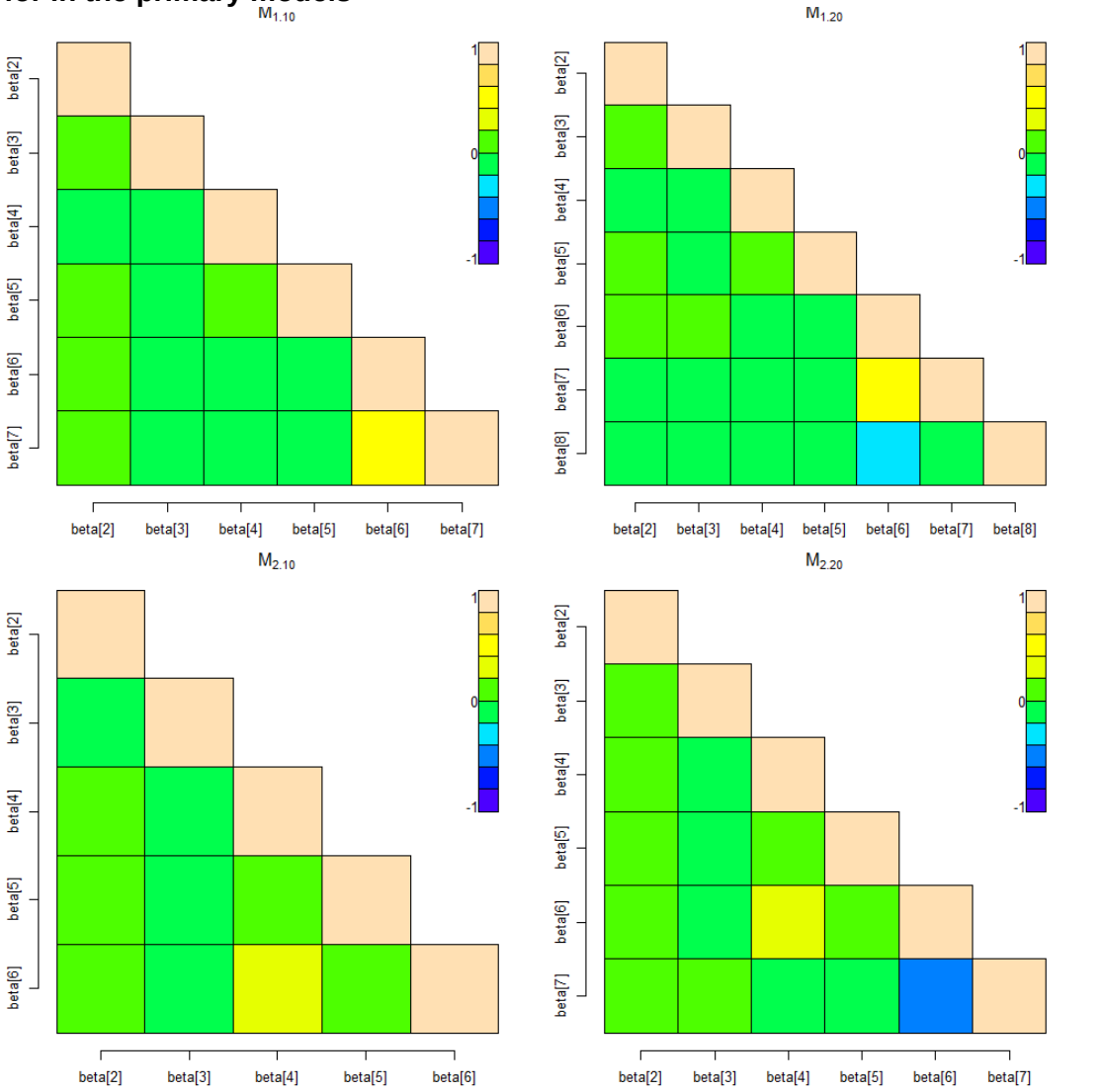
Legend: the red-line is the distribution super imposed on the random intercet and slope histograms. The blue-line and green-line is for mean and median of the distributions.

Figure 4: Histograms of estimated random intercept and slope obtained from the asymptote model



Legend: **the red-line is the distribution super imposed on the random intercet and slope histograms. The blue-line and green-line is for mean and median of the distributions**

Figure D: Cross correlation plots between corresponding parameters adjusted for in the primary models



Legend: ***M1.10*** **and** ***M1.20*** (referred to as Model 1 in the text) are models without or with cumulative log viral load, respectively. In these models, CD4 counts outcome in the likelihood follows normal distribution, while beta priors follow independent Gaussian normal distribution; and ***M2.10*** and ***M2.20*** ((referred to as Model 6 in the text) are models without or with cumulative log viral load, respectively. In these models, are having ≥500 cells/μL follows Bernoulli distribution, beta priors follow independent Gaussian normal distribution. Beta[2] up to beta[6] represents sex, baseline age, baseline CD4 count, baseline log viral load and time on treatment. For ***M1.10*** and ***M1.20*** ((referred to as Model 1 in the text) beta[7] and beta[8] are time on treatment-squared and cumulative log viral load, respectively, while beta[7] was for cumulative log viral load in ***M2.10*** and ***M2.20*** (referred to as Model 6 in the text) and beta[6] is cumulative log viral load.

Table A: Implementing the model with cubic splines and 3 inner knots for the slope of CD4 counts model with posterior mean and 95% credible intervals.

Parameter	Model without cVL_2		Model with cVL_2	
	Estimate	95% CI	Estimate	95% CI
Female-sex	17.3	(6.00, 28.55)	17.3	(6.16, 28.42)
Baseline age	-6.9	(-12.14, -1.69)	-6.9	(-12.03, -1.70)
Baseline CD4 count	83.8	(78.30, 89.32)	83.8	(78.31, 89.29)
Baseline log viral load	6.7	(1.37, 12.11)	6.8	(1.42, 12.06)
cumulative log viral load	–	–	-0.4	(-9.46, 8.65)

Legend: cVL_2—cumulative log viral load

Table B: Effect of using cubic splines with 5 inner knots for the slope of CD4 counts model with posterior mean and 95% credible intervals.

Parameter	Model without cVL_2		Model with cVL_2	
	Estimate	95% CI	Estimate	95% CI
Female-sex	17.42	(6.27, 28.61)	17.0	(5.71, 28.25)
Baseline age	-6.96	(-12.10, -1.82)	-6.7	(-11.99, -1.47)
Baseline CD4 count	83.72	(78.22, 89.19)	84.0	(78.42, 89.57)
Baseline log viral load	6.83	(1.44, 12.25)	6.82	(1.38, 12.31)
cumulative log viral load	–	–	-0.82	(-9.81, 8.27)

Legend: cVL_2—cumulative log viral load

Table C: Effect of using skew-normal random effect in the slope of CD4 count model with posterior mean and 95% credible intervals

Parameter	Model without cVL_2		Model with cVL_2	
	Estimate	95% CI	Estimate	95% CI
Female-sex	24.2	(13.12, 35.35)	23.8	(12.61, 35.12)
Baseline age	-6.9	(-12.10, -1.70)	-6.4	(-11.61, -1.14)
Baseline CD4 count	82.3	(76.89, 87.73)	82.8	(77.36, 88.29)
Baseline log viral load	7.5	(2.17, 12.91)	7.5	(2.06, 12.91)
Time on treatment	52.3	(45.51, 59.06)	55.7	(48.72, 62.57)
Time on treatment-squared	-23.0	(-25.00, -20.91)	-22.8	(-24.84, -20.78)
cumulative log viral load	–	–	**-19.4**	**(-28.12, -10.74)**

Legend: cVL_2—cumulative log viral load

Table D: Effect of using informative priors in the slope of CD4 count model where parameters followed Gaussian normal distribution with posterior mean and 95% credible intervals.

Parameter	Model *1*		Model *1**	
	Estimate	95% CI	Estimate	95% CI
Female-sex	23.8	(12.53, 34.96)	24.6	(13.31, 35.92)
Baseline age	-6.3	(-11.57, -1.08)	-6.3	(-11.55, -1.06)
Baseline CD4 count	82.9	(77.4, 88.38)	82.8	(77.39, 88.28)
Baseline log viral load	7.5	(2.03, 12.92)	7.6	(2.12, 13.05)
Time on treatment	55.7	(48.83, 62.65)	56.5	(49.54, 63.30)
Time on treatment-squared	-22.7	(-24.86, -20.78)	-22.7	(-24.75, -20.68)
cumulative log viral load	**-19.6**	**(-28.25, -10.93)**	**-19.7**	**(-28.35, -11.10)**

Legend: ***model 1*** – Gaussian normally distributed CD4 count in the likelihood; *and* ***model 1**** – model 1 but with informative priors.

Table E: Effect of using skew-normal for random effect in the asymptote model with posterior odds ratios and 95% credible intervals.

Parameter	Model without cVL_2		Model with cVL_2	
	Estimate	95%CI	Estimate	95%CI
Female-sex	6.26	(2.992, 13.902)	6.52	(3.004, 14.397)
Baseline age	0.54	(0.393, 0.744)	0.54	(0.386, 0.748)
Baseline CD4 count	2.90	(2.141, 3.995)	3.04	(2.235, 4.242)
Baseline log viral load	1.25	(0.900, 1.742)	1.27	(0.904, 1. 785)
Time on treatment	3.49	(2.670, 4.536)	4.04	(3.034, 5.425)
Time on treatment - squared	0.67	(0.582, 0.759)	0.65	(0.564, 0.746)
cumulative log viral load	–	–	**0.41**	**(0.236, 0.718)**

Legend: **cVL_2**—cumulative log viral load

Table F: Effect of using cubic splines with 3 inner knots in the asymptote model with posterior odds ratios and 95% credible intervals.

Parameter	Model without cVL_2		Model with cVL_2	
	Estimate	95%CI	Estimate	95%CI
Female-sex	4.62	(2.360, 9.450)	4.62	(2.377, 9. 545)
Baseline age	0.64	(0.486, 0.826)	0.64	(0.484, 0.834)
Baseline CD4 count	2.32	(1.864, 2.912)	2.38	(1.892, 2.995)
Baseline log viral load	1.12	(0.846, 1.454)	1.11	(0.842, 1.459)
cumulative log viral load	**–**	**–**	**0.76**	**(0.465, 1.244)**

Legend: **cVL_2**—cumulative log viral load

Table G: Effect of using cubic splines with 5 inner knots in the asymptote model with posterior odds ratios and 95% credible intervals.

Parameter	Model without cVL_2		Model with cVL_2	
	Estimate	95%CI	Estimate	95%CI
Female-sex	4.67	(2.358, 9.875)	4.74	(2.386, 9.526)
Baseline age	0.63	(0.483, 0.828)	0.64	(0.486, 0.874)
Baseline CD4 count	2.33	(1.855, 2.936)	2.35	(1.856, 2.977)
Baseline log viral load	1.11	(0.849, 1.459)	1.11	(0.841, 1.472)
cumulative log viral load	**–**	**–**	**0.77**	**(0.473, 1.276)**

Legend: cVL_2—cumulative log VL

Table H: Model selection for slope of CD4 count and asymptote models

Model -	without cVL_2	with cVL_2
	cDIC	cDIC
Slope models		
Model 1	47510	47480
Model 2	48120	48130
Model 3	48120	48130
Model 4	47270	47330
Model 5	-3186	-29310
Asymptote models		
Model 6	1716	1695
Model 7	1108	829
Model 8	1701	1695
Model 9	1702	1689

Legend: ***model 1***—models errors and random effects are normally distributed; ***model 2***—models errors and random effects are normally distributed and has cubic splines with 3 inner knots; ***model 3***—models errors and random effects are normally distributed and has cubic splines with 5 inner knots; ***model 4***—random-effects are ***SN*** distributed; ***model 5***—measurement error and random-effects are ***SN*** distributed; ***model 6***—random effects are normally distributed; ***model 7*** –random effects are skew-normally distributed; ***model 8***—random-effects are normally distributed with cubic splines and 3 inner knots; ***model 9***—random-effects are normally distributed with cubic splines and 5 inner knots.