Supplemental Appendix. Costing analysis of national HIV treatment and care programme in Vietnam

1. Cost items included and excluded from the scope of the study

The study focused primarily on accounting for costs of providing HIV/AIDS care and treatment services in Vietnam on an on-going basis to serve as a basis for projecting budgets needed over the next few years. This included both direct and indirect costs.

The scope of the study starts with HIV patients registering for care at an HIV treatment provider, and therefore does not cover the HIV prevention and HIV testing and counseling components of the HIV program. Costs of prevention of mother to child transmission programs were not in the scope of this study.

It was not possible to make estimates of some types of costs. The study did not cover societal costs borne by patients such as opportunity costs of patient time when seeking care (i.e. income foregone to seek care), transport and accommodation costs or any informal payments to health workers. The study also did not attempt to estimate opportunity cost of state health worker time, i.e. the income they could gain by working in the private sector at higher wages, because too many assumptions would have to be made and information on market wages is scarce. It was not possible to estimate market rental values of buildings because information on building area and values was not available to the research team. Due to a lack of information on land values, it was also not possible to include estimates of opportunity costs of land use. Information on depreciation costs of fixed expenditures is missing for many facilities because of incomplete records of assets, year of procurement and value at time of procurement or inability to identify to which ward or diagnostic department the asset belongs. The study also did not cover start-up costs of training when new ART clinics were set up. On-going training costs related to maintaining the program and updating knowledge were not available in the format required. Therefore, the estimates in this study are low compared to the full costs because of missing information on depreciation of buildings, depreciation of equipment, training costs, inability to estimate opportunity cost of labor time or of informal payments and opportunity costs of time for patients.

2. Sample design

Patient information about services and drugs used is not available in electronic form. Therefore, this study involved selection of a sample of patient records from which to manually extract data because the time and cost of extracting data for all cases was too high.

2.1 Sample requirements and site selection

Vietnam Administration of HIV/AIDS Control (VAAC) requested that the sample include cases from both the north and south regions of the country, with a special request that Khanh Hoa (in the central region) be included in the sample and that Ho Chi Minh City (HCMC) account for a substantial part of the sample because of their high HIV caseload. It was also proposed that the sample include cases treated in facilities supported by PEPFAR, Global Fund and the Government, and that facilities at the district, provincial and central levels all be represented. While random cluster sampling with stratification could ensure an adequate sample to meet these requirements, it was additionally requested that the sample be selected from the set of 31 facilities currently involved in the 2009 ART facility survey in order to

link costing results with outcomes. It should be noted that inpatient cases were only selected from provincial and central levels as most HIV cases with opportunistic infections requiring inpatient care are referred to these facilities. Among the 31 facilities included in the 2009 ART facility survey, a total of 21 were selected for this costing study. Table 3 indicates sites included in this study.

Table S1. List of health facilities included in the study

	Province/City	Region	Health system level	Integration	Donor support	Available services			
						Pre-ART	ART 1st line	ART 2nd line	Inpatient care
Adults									
1. National Hospital for Tropical Diseases	Hanoi	North	Tertiary	Integrated	PEPFAR	X	X	X	X
2.Tropical Disease Hospital	Ho Chi Minh City	South	Tertiary	Integrated	PEPFAR	X	X	X	X
3.Dong Da Municipal Hospital	Hanoi	North	Provincial	Integrated	PEPFAR	X	X	X	X
4.Viet Tiep Provincial General Hospital	Hai Phong	North	Provincial	Integrated	PEPFAR	X	X	X	X
5a. Ninh Binh Provincial General Hospital	Ninh Binh	North	Provincial	Integrated	Government only				X
5b. Ninh Bình Provincial AIDS Center	Ninh Binh	North	Provincial	Stand-alone	Government only	X	X		
6. Hai Duong Provincial AIDS Center	Hai Duong	North	Provincial	Stand-alone	Global Fund	X	X		X
7. Khanh Hoa Provincial AIDS Center	Khanh Hoa	Central	Provincial	Stand-alone	Global Fund	X	X		
8. Dong Thap Provincial General Hospital	Dong Thap	South	Provincial	Integrated	Government only	X	X		X
9. Can Tho Provincial General Hospital	Can Tho	South	Provincial	Integrated	PEPFAR	X	X	X	X
10. Dong Anh District Health Center	Hanoi	North	District	Integrated	PEPFAR	X	X		
11. Tu Lieu District Health Center	Hanoi	North	District	Integrated	Global Fund	X	X		
12.Pho Yen District Hospital	Thai Nguyen	North	District	Integrated	Global Fund	X	X		
13. District 2 Preventive Medicine Center	Ho Chi Minh City	South	District	Integrated	PEPFAR	X	X		
14. Binh Tan District Community Counseling and Support Center	Ho Chi Minh City	South	District	Stand-alone	Global Fund	X	X		
15. Tan Chau District Hospital	An Giang	South	District	Integrated	PEPFAR	X	X		
16.Chau Phu District Health Center	An Giang	South	District	Integrated	Global Fund	X	X		
Pediatrics									
1. National Pediatrics Hospital	Hanoi	North	Tertiary	Integrated	PEPFAR	X	X	X	X
2. Hai Phong Pediatrics Hospital	Hai Phong	North	Tertiary	Integrated	PEPFAR	X	X	X	X
3. Pediatrics Hospital 1	Ho Chi Minh City	South	Tertiary	Integrated	PEPFAR	X	X	X	X
4. Pediatrics Hospital 2	Ho Chi Minh City	South	Tertiary	Integrated	PEPFAR	X	X	X	X

3. Analytical weights

The sample design aimed at getting a diversity of HIV treatment facilities of different types, sizes and funding agencies. The estimation of average costs is highly sensitive to the distribution of these factors across the sample. In order to make estimates of average costs, therefore, we weighted our sample observations so that they are proportional to the size of the relevant group or strata. This section explains how this was done.

Adult patients

For adult first-line ART patients, we have 16 treatment facilities in 6 different strata defined by the type of facility and the funding agency.

Table S2: Number of sampled facilities in adult Pre-ART and first line ART by strata

	Central and provincial levels	District level facilities	Provincial AIDS Center	Total
PEPFAR	5	3	0	8
GF	0	4	2	6
NP	1	0	1	2
				16

We have obtained information from VAAC on the total number of adult first line ART patients by facility, and donor to create Table 4. While the total number of adult patients reported to be in first line ART by the end of 2009 is 35 232, the detailed tabulation contains slightly fewer, 35 163 (equivalent to 99.8% of the total). Nevertheless, we can repartition these into the facility type and funding source table similar to the above. It is important to note that our sample is missing some subgroups of patients. For example, our sample did not include facilities under other Ministries such as the Ministry of Labour or prison facilities under the Ministry of Public Security (501 cases). The sample also did not include the only PAC funded by PEPFAR (in Bac Giang) (56 cases), nor the central or provincial hospitals funded by the Global Fund (1361 cases), nor various district level facilities funded by the national program (693 cases). The 2611 patients in these unrepresented facilities account for only about 7.4% of all first-line adult ART patients.

Table S3: Number of adult ART patients by strata

	Central and provincial	District	PAC	Other	Total
PEPFAR	9529	12789	56	233	22607
GF	1361	7352	440	4	9157
NP	1662	693	780	264	3399
	12552	20834	1276	501	35163

To calculate weights, we first estimate the proportion in each strata among facilities represented in our sample, excluding the facility types for which we have no information.

Strata	**% of patients**
PEPFAR large hospital	29.3%
PEPFAR district facility	39.3%
Global Fund PAC	1.4%
Global Fund district facility	22.6%

National program hospital	5.1%
National program PAC	2.4%
Total	100%

We use this proportional distribution to estimate the total number of patients we would need in our sample for the sample to be representative of each of these strata (Table 5 proportional sample columns). We assume that this distribution of patients across strata is the same for pre-ART, first year ART and second year ART. The reason for this assumption is a lack of administrative information from VAAC on pre-ART patients, or a distinction between 1st and later year ART patients in the statistical information systems.

Table S4: Difference between actual sample and proportional sample for Pre-ART and first-line ART

Strata	Pre-ART actual sample	Pre-ART proportional sample	1st year ART actual sample	1st year ART proportional sample	Later year ART actual sample	Later year ART proportional sample
Actual sample size	305	305	332	332	323	323
PEPFAR large hospital	102	89	100	97	96	95
PEPFAR district facility	60	120	60	130	61	127
Global Fund PAC	42	4	43	4	43	4
Global Fund district facility	71	69	82	75	81	73
National program hospital	10	16	27	17	25	16
National program PAC	20	7	20	8	17	8

To obtain the first component of our analytical weights (the strata weight), we take the proportional sample size and divided by the actual sample size. The result is that weights would be less than one in cases where we have oversampled a category of facility, but would be greater than one if we had undersampled. For example, we oversampled cases treated in PACs funded by Global Fund for 1st year ART with 43 cases, whereas if we had selected the sample proportional to the total patients in that type of facility we would have had only 4 patients. Our analytical weights will therefore reduce the importance of these types of facilities in our cost estimates.

There is a second component of our analytical weight related to the actual number of each type of case in each type of facility. We want to ensure that the cost estimates also reflect the difference in distribution of patient types across different size facilities within each strata. Therefore we create an additional weighting factor that indicates the proportion of the total patients in each strata that are treated at each facility. We use information reported by each facility about their total patient load in pre-ART, 1st year first line ART and later year first line ART to obtain these estimates. Only Tan Chau district hospital was not able to separate out 1st year ART from 2nd year ART so we took the median value of all other facilities (29.3% in 1st year 70.7% in later year ART) to allocate patients across the two types for this facility. For the national program facilities, each strata has only one facility so the relevant proportion is 100%. To obtain the final weights, we take the strata weight from above and multiply by the facility proportions in Table 5. They are presented below in Table 7.

Table S5: Proportional distribution of patients across facilities within strata and type of adult patient

PEPFAR large hospitals	Pre-ART	1st year ART	2nd year ART
1 NIITD	26.5%	6.7%	14.5%
2 TDH-HCMC	16.5%	48.8%	60.4%
3 Dong Da	7.4%	19.4%	6.0%
4 Viet Tiep	40.5%	17.8%	11.7%
10 Can Tho	9.2%	7.3%	7.5%
Total	100%	100%	100%
PEPFAR district facilities	Pre-ART	1st year ART	2nd year ART
11 Dong Anh DHC	40.0%	57.6%	26.1%
14 District 2 HC	39.9%	27.2%	66.6%
16 Tan Chau District Hospital	20.0%	15.2%	7.2%
Total	100%	100%	100%
Global fund PAC	Pre-ART	1st year ART	2nd year ART
7 Hai Duong PAC	69.0%	61.22%	76.62%
8 Khanh Hoa PAC	31.0%	38.78%	23.38%
Total	100%	100%	100%
Global fund district facility	Pre-ART	1st year ART	2nd year ART
12 Tu Liem DHC	35.5%	20.9%	23.9%
13 Pho Yen DHC	25.2%	30.9%	24.4%
15 Binh Tan DHC	29.8%	35.5%	43.4%
17 Chau Phu DHC	9.5%	12.7%	8.3%
Total	100%	100%	100%

For second-line adult ART there are far fewer facility types involved. Second-line ART is only provided by facilities with PEPFAR funding. Some 61.8% of second-line patients are being treated in central or provincial hospitals with the remainder treated in district level facilities. In our sample we have only 5 facilities and all of them are central or provincial level hospitals. However there is some variation in the patient loads at these facilities. Therefore instead of facility type, we have decided to use patient load for classifying facilities. Our sample only contains facilities with a medium (10-40 patients) and large (41+ patients) second-line patient load, with no facilities treating fewer than 10 patients. Using facility size for provincial and central level facilities, we find that our data represent only 59.1% of all adult second-line treatment. The remaining patients are treated in small facilities (5% of total), medium patient load district facilities (24.2%) and large patient load district facilities (11.6%).

We follow the same procedures as above to estimate the strata weights, with strata defined by patient load and only covering hospitals. Hospitals with a large patient load represent 84.3% and hospitals with medium patient load represent the remaining 15.7%.

Similar to first-line ART, we also find that facility size varies, while our sample is relatively uniform in size across facilities. Therefore we also estimate the additional weighting factor to adjust for facility size measured by number of second-line ART patients.

Table S6: Proportional distribution of patients across facilities within strata for adult second-line treatment

Large patient load	Second-line
1 NIITD	15.5%
2 TDH-HCMC	69.0%
4 Viet Tiep	15.5%
Total	100%
Medium patient load	Second-line
3 Dong Da	76.7%
10 Can Tho	23.3%
Total	100%

The final weights used in the analysis of adults ART are found in Table 9.

Table S7: Analytical weights for Pre-ART and first-line ART for adults

Facility	Pre-ART	First-year	Later year	Second line
1 NIITD	1.313	0.341	0.686	0.627
2 TDH-HCMC	0.735	2.259	2.717	2.877
3 Dong Da Hosp.	0.332	0.945	0.269	0.630
4 Viet Tiep Hosp.	1.505	0.866	0.788	0.684
6 Ninh Binh PAC	0.365	0.398	0.455	
7 Hai Duong PAC	0.129	0.119	0.145	
8 Khanh Hoa PAC	0.064	0.087	0.051	
9 Dong Thap	1.557	0.628	0.660	
10 Can Tho	0.410	0.353	0.354	0.176
11 Dong Anh DHC	2.399	3.756	1.658	
12 Tu Liem DHC	1.224	0.713	0.831	
13 Pho Yen DHC	1.240	1.159	0.889	
14 District 2 HC	2.393	1.776	4.025	
15 Binh Tan DHC	1.025	1.329	1.583	
16 Tan Chau Hosp.	1.200	0.990	0.460	
17 Chau Phu DHC	0.385	0.477	0.304	

Pediatric cases

Overall at the end of 2009 there were 1987 pediatric patients, 1790 on first-line treatment and 197 on second-line treatment. There were a total of 72 facilities treating pediatric patients, 36 funded by PEPFAR, 6 by Clinton Foundation alone or in combination with Global Fund, 14 funded by Global Fund and 16 by the National program. Of these facilities, only 3 were central hospitals, 40 were provincial hospitals, 4 were PACs and 25 were district level facilities. Three facilities had more than 200 patients, all of which are hospitals in our sample. There were 7 facilities with 40 to 200 patients, six of which were hospitals, with one hospital in our sample. The rest of patients were treated in 62 facilities with patient loads of fewer than 40 patients. The two larger facility groups account for about 67% of all pediatric patients, or 63% if we only include hospitals. No information is available to separate out second line from first line pediatric cases in the national statistics.

For our estimates, we created two strata consisting of large hospitals (> 200 patients) and medium size hospitals (from 40 to 200 patients). To create weights we excluded information about small facilities and about non-hospitals facilities as these types of facilities were not represented in our data.

Thus, among the 63% of pediatric ART patients treated in hospitals nationwide, some 32.6% were being treated in medium size facilities with patient loads from 40 to 200 patients, while 67.4% were being treated in 3 large hospitals. We also estimate among facilities of the same strata, what proportion of all patients are treated in each facility using data self-reported by hospitals on the different types of patients. If we compare across facilities, we see quite different patient loads. For pre-ART, the national pediatrics hospital accounts for 50% of patient load in large facilities, while for first and later year first-line ART, the HCMC pediatrics hospital No. 1 accounts for the greatest share. When we move on to second-line ART, the HCMC pediatrics hospital No. 2 accounts for more than 50% (Table 10).

Table S8: Share of patient load by facility and type of patient for large hospitals

	Pre-ART	First year ART	Later year ART	Second line ART
National Hospital of Pediatrics	50.5%	16.7%	22.0%	25.0%
HCMC Children's Hospital No. 1	28.9%	57.9%	50.0%	22.1%
HCMC Children's Hospital No. 2	20.6%	25.4%	28.0%	52.9%

Table 11 presents the actual weights used for pediatric cost estimation. Because Hai Phong pediatrics hospital is only one of 6 facilities of its group, it is highly weighted to ensure that overall averages will take this into account although it places a heavy responsibility on Hai Phong Pediatrics hospital to represent the other facilities.

Table S9: Weights used in analysis of pediatric patients

	Pre-ART	First year ART	Later year ART	Second line ART
National Hospital of Pediatrics	1.110	0.368	0.557	0.964
Hai Phong Children's Hospital	2.713	2.533	1.565	4.122
HCMC Children's Hospital No. 1	0.636	1.318	1.190	0.369
HCMC Children's Hospital No. 2	0.454	0.558	0.712	0.915

Table S10. Variability in cost components in each care phase

	ARV drugs (US$)					OI drugs (US$)					Diagnostics (US$)				
				Facility mean					Facility mean					Facility mean	
	Median	Mean	IQR	Min	Max	Median	Mean	IQR	Min	Max	Median	Mean	IQR	Min	Max
Outpatient cost per patient-year - Adults															
Pre-ART	..	..	..	..	..	5	21	32	0	45	51	60	60	15	99
ART 1st line - Year 1	100	130	57	99	226	22	70	78	9	149	47	54	46	10	130
ART 1st line - Year 2+	157	153	75	100	233	13	36	38	2	70	47	55	30	13	86
ART 2nd line	1369	1368	111	1097	1434	2	30	16	0	41	73	77	53	50	163
Outpatient cost per patient-year - Children															
Pre-ART	..	..	..	..	..	25	57	66	3	71	27	38	44	4	56
ART 1st line - Year 1	71	97	78	56	100	24	65	34	52	94	45	50	19	24	55
ART 1st line - Year 2+	96	127	103	102	131	13	26	18	12	57	35	37	27	19	51
ART 2nd line	834	907	123	778	917	33	48	19	22	116	39	41	37	7	67
Inpatient cost per episode - Adults															
	..	..	..	..	..	39	83	75	35	190	35	47	39	18	95
Inpatient cost per episode - Children															
	..	..	..	..	..	16	41	45	8	83	22	40	40	9	63

IQR, interquartile range. OI (opportunistic infection) drugs included drugs other than ARV drugs, used for care and treatment for PLHIV. Costs were converted using the rate that 1 US dollars equals 18462 Vietnam dong.

Table S10 (continued) Variability in cost components in each care phase

	Labor (US$)					Overhead (US$)				
				Facility mean					Facility mean	
	Median	Mean	IQR	Min	Max	Median	Mean	IQR	Min	Max
Outpatient cost per patient-year - Adults										
Pre-ART	20	23	19	5	47	6	11	10	1	89
ART 1st line - Year 1	55	67	67	24	169	20	27	25	6	104
ART 1st line - Year 2+	61	59	60	20	134	16	21	25	5	78
ART 2nd line	26	47	48	24	84	7	8	2	5	12
Outpatient cost per patient-year - Children										
Pre-ART	58	89	75	45	219	6	3	7	1	12
ART 1st line - Year 1	201	254	111	128	425	9	2	10	4	18
ART 1st line - Year 2+	129	162	59	112	246	7	1	7	1	16
ART 2nd line	153	192	138	115	274	7	1	7	2	16
Inpatient cost per episode - Adults										
	44	67	58	17	149	27	38	30	19	68
Inpatient cost per episode - Children										
	62	82	51	67	97	32	12	34	25	56

IQR, interquartile range. Overhead costs included administrative operating costs, such as utilities, office supplies, rentals, repairs, and annual capital costs. Costs were converted using the exchange rate at 18,462 Vietnam dong per 1 US dollar.

Table S11. Sensitivity analysis on outpatient cost per patient-year - adults

	Total costs per patient-year (US$)					
	Median			Mean		
	Original	Alternative	Ratio (%)	Original	Alternative	Ratio (%)
Scneario 1: Assume costs are calculated only for actual follow-up period (instead of annualizing indivial patient costs)						
Pre-ART	100	121	121	116	208	180
Scenario 2: Assume ARV regimens prescribed in ART Year 1 were the same as those prescribed in ART Year 2+						
ART 1st line - Year 1	316	336	106	348	374	107
Scenario 3: Assume facilities with OI costs in the lowest quartile had average OI drug costs of all facilities						
Pre-ART	100	103	103	116	119	103
ART 1st line - Year 1	316	319	101	348	351	101
ART 1st line - Year 2+	303	306	101	325	329	101
ART 2nd line	1557	1561	100	1529	1531	100

Table S12. Comparison of stand-alone and integrated facilities

	Stand-alone facilities	Integrated facilities	p value
Non-ARV costs - Pre-ART			
All facilities			
N	82	223	
Total non-ARV costs	206.8	166.5	>0.1
OI drugs and diagnostics	62.0	95.6	>0.1
Labor	87.7	55.1	0.003
Overhead and depreciation	57.2	15.8	0.003
Government + GF facilities			
N	82	61	
Total non-ARV costs	141.7	68.5	0.0052
OI drugs and diagnostics	61.5	46.4	0.0767
Labor	41.9	12.9	0.0036
Overhead and depreciation	38.3	9.2	0.0591
Non-ARV costs - ART Year 1			
All facilities			
N	83	249	
Total non-ARV costs	298.0	207.7	0.010
OI drugs and diagnostics	110.4	125.7	>0.1
Labor	111.2	61.5	0.010
Overhead and depreciation	76.4	20.5	<0.001
Government + GF facilities			
N	83	89	
Total non-ARV costs	298.0	110.7	0.0024
OI drugs and diagnostics	110.4	44.7	0.024
Labor	111.2	43.4	0.0064
Overhead and depreciation	76.4	22.6	0.0162
Non-ARV costs - ART Year 2+			
All facilities			
N	80	243	
Total non-ARV costs	206.8	166.5	>0.1
OI drugs and diagnostics	62.0	95.6	>0.1
Labor	87.7	55.1	0.057
Overhead and depreciation	57.2	15.8	<0.001
Government + GF facilities			
N	80	86	
Total non-ARV costs	206.8	100.2	0.006
OI drugs and diagnostics	62.0	47.3	0.542
Labor	87.7	32.5	0.0013
Overhead and depreciation	57.2	20.3	0.0338
Facility and patient characteristics			
Donors			
Government	1	1	
GF	3	3	
PEPFAR	0	8	
Administrative level			
Tertiary level	0	2	
Provincial level	3	4	
District level	1	6	
All facilities			
CD4 count at ART start (ART Year 1, mean)	113	104	
Number of ART patients (Dec 2009, mean)	250	604	
Number of HIV patients (Dec 2009, mean)	350	831	
Government + GF facilities			
CD4 count at ART start (ART Year 1, mean)	113	96	
Number of ART patients (Dec 2009, mean)	250	214	
Number of HIV patients (Dec 2009, mean)	350	263	