HIV TECHNICAL REPORT

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I. Data Dictionary (ORS 2010)

Column	Header Name	Description
A	Country	Name of country
B	WHO Region	WHO-classified region (AMR, AFR, EUR, SEA, WPR)
C	Population	Population size of country
D	Geographical Region	E.g: AMR = "Central America," "Latin America"
E	WHO Group	Group A = Low and middle income countries outside the Americas (AFR, EUR, SEA, WPR) Group B = Low and middle income countries within the Americas (AMR)
F	DALYs	WHO age-weighted DALY estimates for all age groups
G	Adult DALYs	WHO age-weighted DALY estimates for ages 15+
H	Children DALYs	WHO age-weighted DALY estimates for ages 0-14
I	Retention Rate	Overall percentage of patients returning to the Study (max=97.14%)
J	Retention Rate (ADULT)	Percentage of adult patients returning to the study
K	Retention Rate (CHILDREN)	Percentage of child patients returning to the study
L	Overall (Adults & Children) # Receiving Treatment	Number of all individuals receiving antiretroviral therapy
M	Overall (Adults & Children) # Needing Treatment	Number of all individuals needing antiretroviral therapy

Column	Header Name	Description
N	Overall (Adults & Children) % Treatment Coverage	Percent of adults and children needing treatment who were receiving treatment = (Col L / Col M)
O	Adults # Receiving Treatment	Number of adults (15+) receiving treatment = (Col L - Col R)
P	Adults # Needing Treatment	Number of adults (15+) receiving treatment in 2010 = (Col M - Col S)
Q	Adults % Treatment Coverage	Percent of adults needing treatment in 2010 who were receiving treatment = (Col O / Col P)
R	Children #Receiving Treatment	Number of children receiving antiretroviral therapy
S	Children # Needing Treatment	Number of children needing antiretroviral therapy
T	Children % Treatment Coverage	Percent of children needing treatment who were receiving treatment = (Col R / Col S)
Y-AJ	Impact Score	Drug and country-specific impact scores. = (DALYs * treatment coverage * percent (first- or second-line) * proportion of treatment with drug for that treatment * efficacy of that treatment * percent of treatment credited to drug for each regimen of which that drug is a part

AK	Overall Treatment Impact per Country	Country-specific impact of HIV treatment of any type
AM	List of Group A Countries	List of the 46 countries designated as Group A by the WHO: low and middle income countries excluding the region of the Americas
AN	List of Group B Countries	List of the 20 countries designated as Group B by the WHO: low and middle income countries excluding the region of the Americas
AP-AR	Antiretroviral Treatment Break-down Summary	Includes: -Regimen for adults or children -Percentage of adults/children receiving that line of treatment in group a countries -Percentage of adults/children receiving that line of treatment in Group B countries
AT	1st and 2nd line adult and children regiments for Group A countries	1st and 2nd line adult and children regimens for Group A countries
AU	Proportion	Percentage of adults and children using a specific 1st or 2nd line regimen in Group A
AV	Efficacy	Efficacy of specific drug regimen in group A
AW	1st and 2nd line adult and children regiments for Group B countries	1st and 2nd line adult regimens for Group B countries
AX	Proportion	Percentage of adults or children using a specific 1st or 2nd line regimen in Group B

AY	Efficacy	Efficacy of specific drug regimen in group B
BB3:BD14	Originator Company Impact	Company-specific impact based on the impact of each drug
BB16:BG27	Treatment Coverage	Treatment coverage data by region, age group, and sex
BK:BS	HIV Retention Rate	Used in columns I:K

II. WHO Groupings

45 mid and low income countries affected by HIV are categorized into six regions by the WHO. Note that countries from North America are not considered.

1. Sub-Saharan Africa
2. Latin America and the Caribbean
3. East, South and South-East Asia
4. Europe and Central Asia
5. North Africa and the Middle East
6. Western Pacific

Various WHO regions are then placed in two groups.

1. Group A: Sub-Saharan Africa, East, South and South-East Asia, Europe and Central Asia, North Africa and the Middle East, and the Western Pacific
2. Group B: Latin America and the Caribbean

iii. Scoring Calculations

HIV 2010 and HIV 2013:

The current scoring mechanism is as follows:

1 For each country, age-specific treatment coverage is first calculated.
a. For adults:
Treatment Coverage (Col Q) = number of Adults Receiving Antiretroviral Treatment / number of Adults Needing Antiretroviral Treatment = Col O / Col P
b. For children:
Treatment Coverage % (Col T) = number of Children Receiving Antiretroviral Treatment / number of Children Needing Antiretroviral Treatment = Col R / Col S

Note: If for either adults or children, the number Receiving Antiretroviral Treatment or the number Needing Antiretroviral Treatment is unavailable, the treatment coverage for the region of which that country is a part is used as fallback data (from UNAIDS, cells BB16:BG27).

2. Of those treated, percentages who receive first, second, or third-line treatment are provided by UNAIDS, the WHO, and the Futures Institute (Cells AP2-AR13). For example, of the adults treated in group A countries, 97.10% receive first-line treatments, 2.90% receive second-line treatments, and .05% receive third-line treatments.

3. Calculating treatment efficacy depends on three variables: Group designation, age status, and treatment. Multiple treatment regimens are used in all sub-groups. For example, there are 9 regimens categorized for group A adult first-line treatment. The proportion of each sub-group that is treated by each regimen is also provided by UNAIDS, the WHO, and the Futures Institute. d4T+3TC+NVP, for example, accounts for 27.70% of all first-line treatment for adults in group A countries.

Note: Study data is then used to calculate the efficacy of these regimens in each region. First, if data is available for that treatment in that subgroup, that is used. If that data is not available, the average efficacy for that regimen across all subgroups is used. If this is also unavailable, the average efficacy for all regimens in that sub-group is used. There are cases where there is no suitable fallback data, so we disregard that regimen entirely.

4. Having gathered the information in (1) - (3), we can calculate the im = DALYs (adult or children, Col G or Col H) * Treatment coverage (Col Q or Col T) * Percent treated (Cells AQ2:AR13) * Proportion treated by the regimen (Col AU or Col AX) * Efficacy of regimen (Col AV or Col AY) * Proportion of regimen constituted by the drug (1/n, where n = number of drugs in regimen)

Let's take a look at the impact of the drug d4T, also known as stavudine, in Afghanistan according to the 2010 model. Afghanistan is listed as a Group A country, or a low/middle-income country outside of the Americas region, specifically in the EMR geographical region. The following is the DALY and treatment coverage data for Afghanistan (Columns F-J, N-V). There are 45 out of 1,050 adults diagnosed with HIV receiving treatment, and 1 out of 550 children diagnosed with HIV receiving treatment.

Adult DALYs for HIV	**= 21,733.66**
Children DALYs for HIV	**= 2,307.78**
Total DALYs for HIV	**= 24,041.45**

Adult Treatment Coverage	= 45/1,050	**= 4.29%**
Children Treatment Coverage	= 1/550	**= 0.18%**
Total Treatment Coverage	= 46/1,600	**= 2.88%**

Given that Afghanistan is a Group A country, the following table shows what percentage of adults and children use first line, second line or third line regiments (Columns AR-AT). Second-line and third line regiments are used if previous regimens have been ineffective

Adults	**93.00%**
First-Line Regimens	97.10%
Second-Line Regimens	2.90%
Third-Line Regimens	0.05%

Children	**7.00%**
First-Line Regimens	96.80%
Second-Line Regimens	3.20%
Third-Line Regimens	0.01%

The table shows that of all the people receiving treatment in Group A countries, 93% are adults and 7% are children. Of all the adults receiving treatment, 97.1% of them use first line regimens, 2.9% use second line regimens, and 0.05% use third line regiments. As for children, 96.8% use first line regimens, 3.2% use second line regimens, and 0.01% use third line regimens. The following table shows the proportion of adults and children that use each specific drug regiment holding the drug d4T (first and second line) and the efficacy of each regiment (Columns AV-BA). For example, 27.7% of adults use the first-line regiment d4T+3TC+NVP, which has a 72.01% efficacy rate.

Adults	Cell	Regimen	Cell	Propor-tion	Cell	Efficacy	Cell
First-line (97.10%)	AQ6	d4T+3Tc+NVP	AT7	**27.7%**	AU7	**72.01%**	AV7
	AQ6	d4T+3TC+EFV	AT9	**14.00%**	AU9	**84%**	AV9
Sec-ond-line (2.9%)	AQ7	d4T+3TC+LPV/r	AT25	**1.9%**	AU25	**N/A**	AV25

Children	Cell	Regimen	Cell	Propor-tion	Cell	Efficacy	Cell
First-line (96.80%)	AQ11	d4T+3TC+NVP	AT31	**34.9%**	AU31	**50%**	AV31
	AQ11	d4T+3TC+EFV	AT33	**15.6%**	AU33	**78%**	AV33
	AQ11	d4T+3TC+LPV/r	AT36	**5.9%**	AU36	**50%**	AV36
Sec-ond-line (3.2%)	AQ12	d4T+3TC+LPV/r	AT47	**4.6%**	AU47	**N/A**	AV47
	AQ12	d4T+3TC+ABC	AT50	**1.4%**	AU50	**N/A**	AV50

In addition to DALY and treatment coverage, we also need to multiply three variables to determine efficacy:

1. Percentage of adult/children using 1st, 2nd or 3rd line regimen.
2. Proportion of adults/children using drug regimen Y that has drug X.
3. Efficacy of the regiment Y that holds the drug X.

For the adult group in Afghanistan, DALY = 21,733.66 and treatment coverage = 4.29%. Recall that 97.10% of adults use first line regimens and 2.9% use second line regimens. The impact formula for the adult regiments is as follows:

The impact of d4T in the drug combination d4T+3TC+NVP (1st line) is: 21,733.66*97.1%*27.7%*4.29%*72.01%/(1-97.1%*27.7%*4.29%*72.01%)/3
= 60.7

The impact of d4T in the drug combination d4T+3TC+EFV (1st line) is:
21,733.66*97.1%*14%*4.29%*84%/(1-97.1%*14%*4.29%*84%)/3
= 35.66

The impact of d4T in the drug combination d4T+3TC+LPV/r (2nd line) is:
21,733.66*2.9%*1.9%*4.29%*0%/(1-2.9%*1.9%*4.29%*0%)/3
= 0

For the adult group in Afghanistan, DALY = 2,307.78 and treatment coverage = 0.18%. Recall that 96.8% of adults use first line regimens and 3.2% use second line regimens. The impact formula for the adult regiments is as follows:

The impact of d4T in the drug combination d4T+3Tc+NVP (1st line) is:
2,307.78*96.8%*34.9%*0.18%*50%/(1-96.8%*34.9%*0.18%*50%)/3
= .234

The impact of d4T in the drug combination d4T+3TC+EFV (1st line is:
2,307.78*96.8%*15.6%*0.18%*78%/(1-96.8%*15.6%*0.18%*78%)/3
= .1631

The impact of d4T in the drug combination d4T+3TC+LPV/r (1st line) is:
2,307.78*96.8%*5.9%*0.18%*50%/(1-96.8%*5.9%*0.18%*50%)/3
= .03954

The impact of d4T in the drug combination d4T+3TC+LPV/r (2nd line) is:
2,307.78*3.2%*4.6%*0.18%*0%/(1-3.2%*4.6%*0.18%*0%)/3
= **0**

The impact of d4T in the drug combination d4T+3TC+ABC (2nd line) is:
2,307.78*3.2%*1.4%*0.18%*0%/(1-3.2%*1.4%*0.18%*0%)/3
= 0

Total impact of d4T is the sum of all the impact of d4T within those regiments:
= 60.7 + 35.66 + 0 + .234 + .1631 + .03954 + 0 + 0
= 96.79664

Finally, we determine the length of treatment using the formula: 1/(1-retention rate). If the length of treatment is larger than 35, we use 35 instead; otherwise, we use the calculated length. Denoting retention rate as a,

If length = 1/(1-a) < 35, equivalently, a<0.9714 = 97.14%, we keep use the calculated length and we don't need to modify the retention rate.

If length = 1/(1-a) > 35, equivalently, a>0.9714 = 97.14%, we need to modify the length to be 35 and thus we modify the retention rate to be 97.14%.

The retention rate in Afghanistan is 96%. Therefore, length of treatment is determined to be 1/(1-96%) = 25 years. Hence, for Afghanistan in 2010, the impact score of d4T is:

96.79 / 25 = **3.87.**

This is then repeated for all the countries and then summed together for a total the total impact of d4T, which is **539,861.48.**

HIV 2015:

This model is essentially the same as HIV 2010 or 2013, except it doesn't have WHO group for HIV 2015. So the treatment efficacy will only depend on 2 factors: first or second line regimens, and age status. In total there are four types: 1st line regimens for adult, 1st line regimens for children, 2nd line regimens for adult, and 2nd regimens for children. The impact score for certain drug and certain country will be summation of four parts.

IV. Example of Scoring Calculation: ViiV

Let's walk through a quick example of how to calculate the final impact score of the company GlaxoSmithKline (Cell BD7). GlaxoSmithKline produces the drugs ABC and AZT. Its total impact on HIV, then, is the summation of the total impacts of ABC and AZT, 16,508.81 and 503,417.77 respectively. The final impact of the company ViiV is 519,926.58.

V. Assumptions

Data	Column/ Range	Notes
Efficacy	AV, AY	Survey data used for treatment regimens in various subgroups (e.g. adult first-line treatment in A countries). Fallback data where not available of: (i) average efficacy of that regimen in all subgroups; then (ii) average efficacy of all regimens in that subgroup.
"A" and "B" extrapolation	Col E	We extrapolate A or B status to countries without a WHO-designated status
Drug Impact	Y:AJ	We assume each drug in a drug regiment have equal impact, and therefore multiply the regiment impact by 1/n, n being the number of drugs in the regiment, to determine drug impact.

i. The model also pools together newborns with children age 14 and below. However, the effects of HIV drugs on newborns can be drastically different than that of young children and teenagers.

ii. The proportion of DALYs recovered due to first-, second-, or third-line treatment is assumed to be equivalent to the proportion of treatments that are first-, second-, or third-line. Here we test extending a greater proportion of DALYs to either first-, or second- and third-line, treatments.