

Global Health Impact

Manufacturing Company and Source Accreditation Methodology



Introduction

The Global Health Impact Source Index evaluates organizations' drug contributions to alleviating the global burden of HIV/AIDS, tuberculosis (TB), and malaria. Various source organizations invest in the distribution of important drugs, each with differing cost-effectiveness as well as aggregate impact. Some of the most widely renowned source organizations include UNICEF, the World Bank's International Development Association (IDA), and the World Health Organization. This study evaluates the impact that each source has on relieving the burden of disease in third-world countries and creating a comprehensive Source Index. Within the Source Index, there are figures showcasing the proportions of Global Disease Burden Alleviated by Source's Drugs, a ranked list of Source Total Drug Scores, and Drugs' Impact Scores by Source.

Sources are ranked and compared based on the number of disability-affected life years (DALYs) that they alleviate. This is found by calculating the number of lives saved per source per disease, and the percentage of total lives saved by an individual source. This is then multiplied by the estimated DALYs alleviated by each drug globally from the GHI index. The information used to calculate the above points is the shipment information for each source and the daily dosage information for each regimen. By analyzing the data in this way, a succinct method for directly comparing the impact of each source is able to be determined.

This metric for evaluating the impact that each source has on the burden of disease creates the potential for further analysis into the effects of source manufacturers on greater issues of disease.

Materials and Methods

The final data that is used to calculate each source that provides drugs to treat HIV/AIDS, TB, and malaria's impact is the total number of lives saved by each drug source, the percentage of lives saved by each source, the DALYs alleviated thanks to each drug source, and the overall cost-effectiveness for each shipment. In order to calculate this information, data must be collected for the shipping information for each source and for the daily dosage information for each regimen. Below, the process for data collection and calculation is detailed.

Treatment Years (by Regimen)

$$\text{treatment years} = \frac{(\text{Total Number of Units per Shipment}) * (\text{Quantity in Each Package})}{(\text{Daily Dosages per Shipment}) * (365)}$$

The initial breakdown is found by taking data from the Global Price Reporting Mechanism (GPRM) database provided by the World Health Organization (WHO). This records shipment data for HIV/AIDS, malaria, and TB medications broken down by year. For each regimen from each source, the total number of units (TNU) in each shipment is found by multiplying the quantity in each package by the number of total packages in the shipment. In order to then find the number of "lives saved" in each shipment (i.e. the number of individuals who could receive a year's worth of treatment), the TNU is first divided by the daily dosage of the regimen to find the number of daily dosages a shipment provides, and then by 365 to find the number of year-long treatment plans the shipment provides. The result, which we will call the Lives Saved by regimen, is the total number of years of life saved of each specified regimen. This data provides a basis for deeper analysis into the impact that various regimen sources have in third world countries.

Alleviated DALYs (by Drug, by Source)

$$DALYs\ Alleviated\ by\ drug\ and\ source = (Percentage\ of\ Lives\ Saved) * (DALYs\ Alleviated\ by\ drug)$$

Before DALYs alleviated by drug and by source can be found, we 1) calculate the percentage of Lives Saved attributed to a given drug and given source. Then we need to 2) find the DALYs alleviated by that given drug. Finally, 3) we multiply the two values together as shown above. In other words, we take the percentage of Lives Saved for each drug and source and multiply this number by DALYs alleviated with each drug. This results in alleviated DALYs by drug and by source. We explain how we get 1) and 2) below.

1. Percentage of Lives Saved (by Drug, by Source)

$$Percentage\ of = \frac{\Sigma(LDS)}{\Sigma(LD)}$$

To find the percentage of Lives Saved for each drug for each source, we begin by finding the summation of Lives Saved for each regimen that contains a specified drug, regardless of source (which we will name LD). Then, total the Lives Saved for each regimen that contains the same specified drug from a specified source (labeled as LDS), the LDS is divided by the LD, resulting in a percentage of lives saved by each drug from each source.

2. DALYs Alleviated by Drug

$$Drug\ DALY = \Sigma(DALY's\ of\ Regimens\ Including\ Drug / Number\ of\ Drugs\ in\ Regimen)$$

The original DALY values are taken directly from the GHI database⁴. Several regimens use more than one drug for treatment. Thus, to get the DALYs alleviated by drug, and not regimen, we first divide the impact score of the regimen by however many drugs are within each regimen. We then attribute the DALYs to each drug and sum all drug impact scores from any of the regimens that include that drug to get the total drug DALYs alleviated.¹

Daily Dosage.

Done differently by disease, explanation on how daily dosage is calculated has been subcategorized by disease.

HIV/AIDS

Using Access Data and WHO provided drug guidelines, data on the number of milligrams of each regimen to use per day was extracted and used in our database.^{10,11,12,13} Dividing this number by the shipment strength of each drug, found from the GPRM database, the resulting number was the number of units a patient should take a day.² In other words, the Daily Dose by pill, or whatever unit they intake the regimen through, for a given patient.

¹ In the case of MDR TB, DALYs alleviated by drug were attributed proportionally by quantity within the WHO recommended regimen.

² Select regimen daily dose information was directly provided from the HIV section of the WHO - thanks to Boniface Dongmo for the data and discussion of the methodology.³⁶

TB

Using MSF medical guidelines and WHO provided drug guidelines, data on the number of milligrams of each regimen to use per day, assuming an average weight of 70kg, was extracted and used in our database.^{5,6,7,8,9} Then dividing these regimens into their individual drugs by the same method described in the 2) DALYs Alleviated by Drug section. The following steps are as above for HIV.

Malaria

Being the most complex process, we segmented the patients affected with Malaria around the world by their varying age groups. Children have been grouped by ages 0-4 years, 5-14 years, and all those patients above 14 years being labeled as adults. The data we possess should give us Malaria incidence figures for all age groups in countries, ultimately allowing us to determine the correct dosage treatment by weight.

The first step in our calculations is determining the weight for our age groups in the years 2010, 2013, and 2015. Our weight/age data comes from The World Health Organization. So, for the 0-4 age group we took the mean weight of 2.5 year old boys and girls then averaged them together, which gave us an average weight of 14.5 Kg.³ Then we found the weight for the 5-14 age group, similarly taking the mean weight of 10 year old boys and girls then averaging them together. This led us to an average weight of 25.4 Kg; finally, we estimated 45 as the age to represent the adult group, which gave us a weight of 75 Kg.^{14,32,33,34,35}

After configuring the average weight per age group, we now must find incidence values for malaria, by the respective year and age group. The incidence values were then directly input from GHDX.Org data search tool. Filters were added in the search tool to precisely calculate these incidence values: location (all countries), year (2010, 2015), age (<5, 5-14, 15+) measure (incidence), and cause (malaria).

Now that we have the average weight for our age groups and the incidence values for most of the 217 countries in our model, we can find our dosage per weight group. Unfortunately, we did not have incidence values for all 217 countries, the countries that did not have available incidence data were not factored into the weighted average calculations. The equation that will give us our weighted average of the total incidence population's weight. $(AX + BY + CZ)/(A+B+C)$. A, B, and C, represent the incidence of malaria in each age group. Variables X, Y, and Z are the actual average weight of their respective age groups. So our numerator in the equation basically sums up the product of each age groups' average weight and incidence. Then our denominator adds up to the total people affected by malaria, regardless of age group. So we then take our numerator (the weighted total incidence) and divide it by our denominator (Sum of incidence from all age groups). This calculation provides a weighted average for body weight for each of our countries where Malaria is present. We then go to the Malaria Manufacturing sheet, take our body weight value, and find the corresponding dosage in the table.^{14,15,16,17,18,19,20,21,22,23,24,25,26,27,28,29,30,31} After that divide by the dosage of each unit and we have our universal daily dosage for a regimen.

Results

The data shown below details the results for the 2015 analysis of the source impact for HIV/AIDS, TB, and malaria.

Alleviated DALYs

The alleviated DALYs for each source for each disease are shown below. These numbers were then used to compile the data in several different ways, as shown in the subsequent sections. Some sources do not have any values for this model because it is based off of the data from the GPRM Reporting Database from 2015 and there were no values for those companies from that year.²

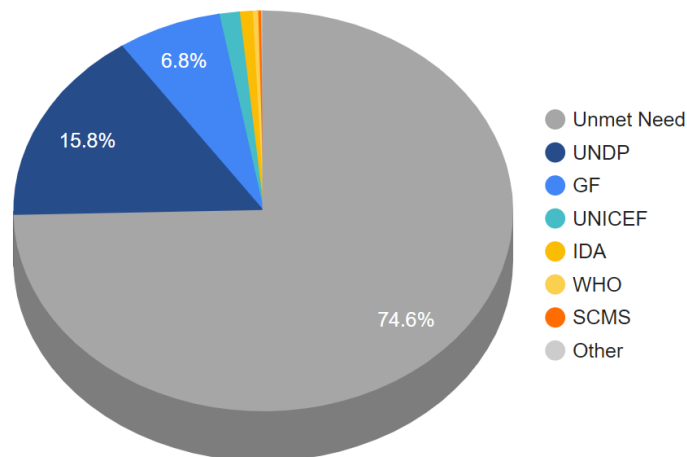
Sources	Totals
GF	14673140.15
GFOLD	-
IDA	1801072.409
PEPFAR	128658.439
SCMS	384708.9779
GDF	-
MP	246375.6825
UNICEF	2837397.42
WHOCPS	59238.50706
UNDP	34261670.5
WHO	747210.9943
CHAI	0
UNITAID	-
Total:	55139473.08

Source Abbreviation	Full Source Name
GF	The Global Fund to Fight AIDS, Tuberculosis and Malaria
GFOLD	The Global Fund to Fight AIDS, Tuberculosis and Malaria (when data were not standardized)
IDA	IDA Foundation
PEPFAR	The United States President's Emergency Plan for AIDS Relief
SCMS	Partnership for Supply Chain Management System (PSCMS)
GDF	Global Drug Facility

MP	Missionpharma A/S
UNICEF	United Nations Children's Fund
WHO/CPS	The WHO/Contracting and Procurement Service
UNDP	United Nations Development Programme
WHO	World Health Organization
CHAI	Clinton Health Access Initiative
UNITAID	UNITAID

Proportion of Global Disease Burden Alleviated by Source

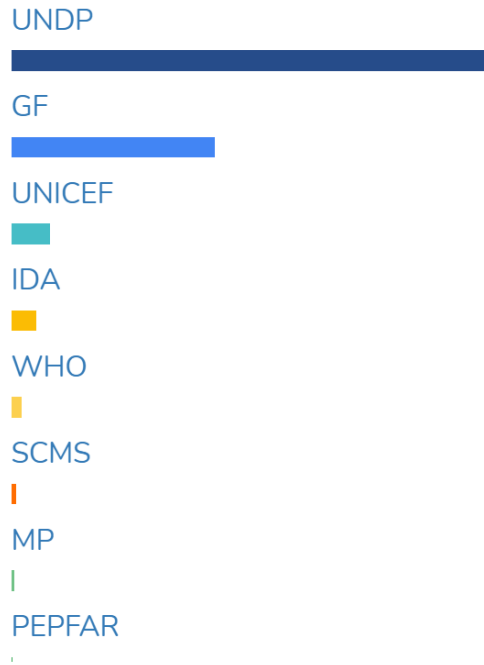
The proportion of the global disease burden alleviated by source subtracts the alleviated DALYs from the overall DALY number reported for a disease by the WHO. This allows for the unmet need to be shown in the graphic. This creates a greater perspective for the information that is reported. The DALYs alleviated and unmet need³ numbers are divided by the total DALY number in order to develop a percentage.



Sources Total Drug Scores

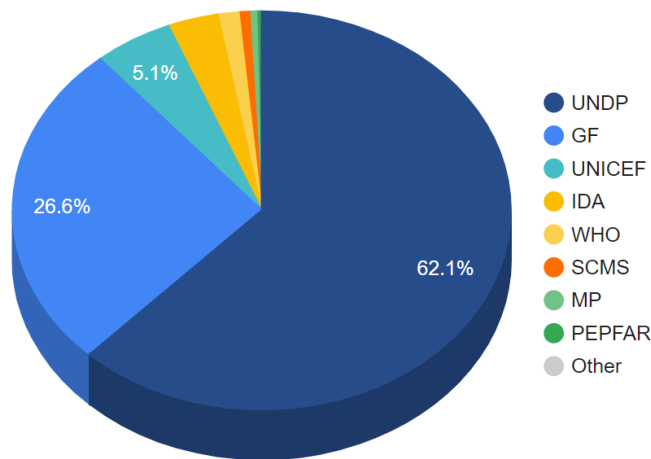
The total alleviated DALY scores for all of the sources are organized so that they are ranked. This graphic allows for the discrepancies between the impact of each of the sources to be easily seen.

³The unmet need is explicitly defined as the estimated DALYs lost absent of treatment for all three diseases combined. In other words, the unmet need is the remaining DALYs in need of drug treatment to be alleviated.



Impact Score by Source

Here, the total alleviated DALY scores are summed and each individual alleviated DALY score for the sources are divided by this sum in order to give a percentage. This percentage is reported in the graphic below. In essence, it reports the same information as the Proportion of Global Disease Burden Alleviated by Source, however it does not report the unmet need.



Discussion

The information used and displayed by the Global Health Impact provides a metric for calculating the overall impact that a sources' drugs have on the effect of several global diseases. However, there are several limitations to the data that is currently displayed. These models do not take into account the cost-effectiveness of the distributors, additional factors that may be at play for combating disease, and have a limited scope.

Cost is not considered as a factor in these models. The various source organizations are working with varied budgets and selling their drugs for varying prices. With this not being considered, it is difficult to get a full picture of the impact that the drug companies are truly having on the populations of third-world countries. A more complete model working to rank the sources would take cost into account.

These models only take into account the work done by sources to alleviate disease through medication and do not take into account other methods of preventing disease. Sources may work in conjunction with each other or have portions of their budgets devoted to the distribution of other technologies. For example, insecticides used for combating malaria may also be distributed by several of the sources used in this study. Without taking this into consideration, it is difficult to get a complete, all-encompassing ranking system for each of the drug sources.

This study is meant to provide a metric of the impacts of sources' drugs on a few important global diseases. HIV/AIDS, TB, and malaria are impactful, global diseases, but they are not the only diseases that these sources distribute medications to treat. This narrow scope makes it difficult to get a complete picture of the true impact that the sources have in developing countries. A more complete model would take into account more disease.

This index is also not meant to measure how "good" a source organization is in relation to its peers, or how effective it has been at ensuring access to drugs. Many sources work in conjunction with each other and every source has a different budget allotted for the payment and distribution of drugs vs other technologies (like insecticides for combating malaria).

These gaps in the work done with this study should be considered when these models are evaluated. These models create a useful tool for comparing sources distribution of regimens within the context of HIV/AIDS, TB, and malaria, but they are not a measure of how good or bad a particular source is. The data in these models is useful but is not a completely conclusive measurement of a source.

Conclusion

Calculating the alleviated DALYs by each drug source allows for a ranking system to be developed. This creates a useful tool for analyzing the impact that sources have on the burden of disease for a few key global diseases: HIV/AIDS, TB, and malaria. However, many other factors are at play such as the cost-effectiveness of the drugs and their availability to the general public in third-world countries. Therefore, this is not an all-encompassing tool, but nonetheless gives useful insight into the impact of various large-scale sources.

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