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New technologies - an Economic Triage for the HIV Pandemic

The premise of this article is to illustrate the principle of how the efficient allocation of limited resources can be applied to managing a Pandemic healthcare crisis. It is necessary to begin with a Pandemic Healthcare definition, its evolution, geography, demography and finally applying a 21st century technology to create an efficient use of limited resources. The definition of a Pandemic is an epidemic of infectious disease that has spread through human populations across a large area. The most significant Pandemic facing the world today is HIV and its resultant AIDS (Acquired Immune Disease Syndrome) infections which drain the resources of third world countries and impact their GDP growth. This Pandemic has put a strain on governments by diverting internal resources and billions of aid dollars.

Geographically speaking, Pandemics are primarily located in countries where lesser educated labour forces are concentrated in urban centres¹. Further compounding the issues are that most men from rural settings work for weeks in urban settings. During these periods they are often promiscuous, visiting prostitutes, as in capital cities like Kinshasa in the DRC or in cities such as Johannesburg in South Africa. When they return home periodically they are likely to be carrying the disease, cohabit with their spouse and often the wife and newborn children are infected with HIV. Positive HIV pregnant women receive HIV drugs prenatally to protect the fetuses through various programs but are mainly supported under an umbrella program known as MTCP – Mother To Child Programs². While funded by tens of millions of dollars, due to cultural norms, HIV infected mothers breast feed despite NGO (Non-Government Organisations) warnings a 75% recidivism rate of HIV babies persists in the first months of life².

Other issues compound circumstances in these developing nations, but suffice it to say these countries are paternal societies and given the poverty levels men no longer measure their wealth in land ownership or traditional livestock, but rather by the number of children they sire³. Also the migration of workers in Africa constitutes the largest issue regarding the diversion of funds to the spreading of the disease. These countries afford low cost labour where developed countries secure favourable trade terms. While developed countries do experience HIV, because of their higher education levels and better information dissemination, HIV remains an extremely small percent of their population (the growth of HIV is now actually on the decline amongst developed economies).

Another factor diverting Western developed nation's resources from reaching developing countries is that procedures employed to control migration in an effort to prevent disease spread⁴. As an example, considering Europe and America as a single hypothetical economy with a combined GDP of \$32.6 Trillion⁵ (as one single immigration destination), the amount spent on disease spread border enforcement is about equal to the combined total GDP in the 20 slowest developing African countries (\$80.4 Billion⁵) enduring the HIV Pandemic¹. This expenditure on border control is as costly as current western national expenditures on preventing terrorism⁶. Statistics available are subject to significant variances, as much as 20%, in reporting processes, surveillance (5), corrupt past and current governments, since many of these developing nations seek foreign aid as part of their GDP budget.

Underdeveloped countries account for approximately 90% of the worldwide Pandemic¹. The financial resources required to nourish and grow the economies of these underdeveloped countries carry the greatest diversion in tertiary expenditures for their own GDP growth for the development of infrastructure and improvement healthcare. Tertiary expenditures relate to lost expenditures in reactive problem solving mode verses proactive (planned and budgeted) solutions. Not only are these internal resources being diverted but so are tens of millions of dollars of foreign aid.

Considering the diversion of resources from developed countries to underdeveloped nations, make no mistake that while human rights and altruism play a large role, it is the ***self-interest for trade gains as a major Macro Economic principle*** that keeps developed nations focused on aid to these developing nations. In many instances government policies are primarily driven by real political strategies, but this is a topic for another article. In economic terms, real drain based on a Pandemic presents true ***opportunity costs*** for these developing nations.

Below are the items that first need to be considered primarily in terms of ***opportunity costs*** to improve the three critical sectors required for any nation:

Primary steps for Economic development for GDP growth.

Infrastructure: If we cannot provide roads and a sustainable power grid, then a nation is not able to consider its second phase of development - to provide healthcare for the growth in productivity which is often its primary resource, low cost labour. The first resource defining the ***wealth of a nation*** is labour (its work force) which is the main requirement for the productivity of its other assets, capital investment and arable land, as the other two legs of its ***production possibilities frontier***. The greatest opportunity for GDP growth in developing nations seeking to improve their balance of trade is the virtual exporting of their low cost labour. Using this principle of ***comparative***

advantage, utilizing their labour cost advantage, is their most productive direction for growth. Implicit in considering developing countries in Africa, which accounts for more than 60% of the worldwide Pandemic, the assets of labour and arable land, if infrastructure arteries are available, are usually their key resources for GDP growth. Today, however, given climate change, much of the land resources in emerging nations have been reduced from fertile to arid, either by climate change, neglect or political redistribution. Zimbabwe is a prime example of an underdeveloped country where farm land was seized by the government for political land reforms. Today, more than 70% of the arable land in emerging economies now sits unproductive⁷.

As in so many developing countries, where poor governments try to redistribute the land, it's frequently done without thought given to agricultural education where previous productive land now sits fallow, again leaving labour as the single largest resource for GDP growth. On a tertiary note, no power grid can exist (be it fossil fuel, hydroelectric or nuclear power) without distribution arteries by road or cable (above or underground) to maintain and service power grid sites for the population. Consequently, achievement of a real healthcare system to create a productive work force is not viable without first a solid infrastructure.

- **Healthcare System:** Improving healthcare to a developing work force is fundamental to a nation's productivity and its resultant growth in their GDP. Without a strong healthcare system, accessible to the general population, more work days are lost as a result of a more anemic labour force. Workers who are hampered by the need for acute medical care are estimated to decrease national work force productivity tenfold⁸. As listed in point one of this three-point discussion, implicit in the requirement for implementing a healthcare system to improve labour productivity (aside from roads, rail or arteries to distribute healthcare), is also an infrastructure networked power grid. Hospitals, clinics or doctor's offices without a solid power grid, requiring capital investment, create a further strain on internal and foreign capital resources again depleted by the Pandemic. Medical care affords little value if it cannot be delivered to the work force at large.
- **Education:** As the last leg of the three essentials to any developing nation's growth, once artery and power grid infrastructure is in place and a healthcare system is developed and delivered, a nation's final growth and productivity phase can only be attained through education and training of a work force. Avoiding illness is a key factor

to insure more work days for manufacturing and or agriculture. Labour, as stated above, is a mainstay for a developing nation to derive its wealth. Education and skill training ensures growth. This permits **comparative advantages in trade** by elevating production efficiency of labour when capital and land are lacking as resources given lower wages and standard of living costs in developing nations. Pandemics keep capital investment out of the available markets through instability and can have negative multipliers. Increased foreign capital investments positively create multiplier effects, taking advantage of lower labour costs, resulting in higher productivity which in turn means more employed workers, increased local expenditures and finally higher GDP (Keynesian theory for the marginal propensity to consume, MPC ⁸). In reverse, a lack of capital investment due to a Pandemic and its resultant low producing labour force can work to drive an economy into a lower GDP. However higher worker productivity can increase foreign investment regardless of any government's foreign economic policies. Improving skill sets amongst workers through training programmes promotes the strength of a Sovereign nation's most valuable asset - labour. Being competitive in trade through its low cost labour force has the greatest impact on GDP growth unless of course a country is mineral rich. But even with mineral rich nations, if there is a shortage of healthy and skilled labour, then that too can decrease foreign investment. Again in phase three, education can only be fulfilled if there is infrastructure to allow the delivery of Healthcare and distribution of medical services and goods to the population.

Next to be considered are the external resources providing funding for Pandemics, in particular, the worldwide battle against AIDS. Most underdeveloped countries receive aid for fighting the HIV Pandemic through various vehicles. Organizations listed below account for > 95% of all funding

- NGO's (Non-Government/Non-profit Organizations)
- Worldwide public health organizations grants that monitor Pandemics (World Health Organization)
- International agencies such as UNICEF
- Foreign Aid from EU
- Foreign Aid from the UN
- Foreign Aid from the US

Most of the resources are formatted and delivered in traditional distribution forms, not much different from 100 years ago. Underdeveloped countries without significant improvements to their infrastructure to enable them to reach the population most in need of HIV medical care are diverting valuable donated humanitarian funds through inefficiency. In combatting HIV, it is estimated that only 30% of the total external sums⁹ reach underdeveloped nations through aid required to grow their GDP. Currently the available internal national funds and external foreign aid funds allocated for the treatment of AIDS is not sufficient to address the size of the infected populations. HIV AIDS patients are stated at more than 30 million¹ in Africa alone. This number is woefully underestimated due to limited surveillance given the areas covered. In most instances statistical methods used to extrapolate the total infected population are poorly collated as a result of staff and infrastructure, not by institutions such as the W.H.O Geneva but rather by in-country field workers who are generally unskilled and therefore less adept at proper data gathering due to a lack of available educated in-country administrators. Often, as is the NGO donor groups disbursement procedure require in-country administrators under the false assumption that a non-indigenous administrator would not be able to work as efficiently as a native to the country. Sadly, due to poverty, reliable in-country administrators are often unskilled and are at the mercy of alternate agendas which are too numerous to address in this article.

The question arises if there are limited funds available for drug treatment wouldn't it be better to focus expenditures on a vaccine? Unlike the polio Pandemic of 60+ years ago, the HIV Pandemic cannot be fought with a traditional vaccine. After nearly 30 years, the medical community has yet to come up with a vaccine for those not infected. At best, drugs have been developed to allow individuals to live a quasi-normal life by the use of daily drugs and a healthy life style. Rather than delve into why the vaccine has evaded development, (as there is no shortfall in efforts), clearly the major pharmaceutical companies would be the winners with bountiful profits, given the enormous size of the populations to be vaccinated in the emerging nations of the world.

Such a vaccine and its relative capital value would surely be very high considering there are hundreds of millions of persons who would be at risk for the HIV infection worldwide. For those reading this article and who wonder why, after nearly 30 years there is still no vaccine, suffice vaccine for polio¹⁰, where the medical community had a static viral DNA to combat. HIV is a moving target with a constantly mutating DNA and the traditional platform to battle viruses is not applicable.

Given there does not seem to be a HIV vaccine on the horizon, for those countries struggling with this Pandemic, the crux of the ***economic dilemma*** and this article is to improve resource (HIV drugs) allocation efficiency (national internal expenditures as well as incoming foreign aid)

in order to **reduce opportunity costs** for the growth of these developing nations. The medical community needs to consider a new form of diagnostic test in a **Triage format** (definition prioritizing need and place of treatment) to make more efficient determinations of who gets drugs, versus who does not, based on need, urgency and considering the limited funds available. Currently, when a diagnosis is made for a positive HIV patient, thereafter these patients need to be tested and monitored for a human immune marker known as CD4, which rises and falls depending on how well the immune system is combatting the disease. The CD4 cells are a monitor of how our immune system is functioning. A normal CD4 count reference range in humans is from 500cells/mm³ to 1000cells/mm³¹¹. Generally HIV progresses into AIDS (Acquired Immune Deficiency Syndrome) somewhere between as little as 2 years to 7 years based on living conditions and general health. This time frame is based on a statistically significant population bell curve with 95% confidence interval limits². Given the limited amount of money available (see table 1.1), after the initial diagnosis has taken place, the medical community relies on CD4 tests to let doctors know when HIV infected persons are in danger of a lower immune status when the HIV infection has converted to AIDS and therefore the patients immediately require HIV drugs.

Just as WBC's (white blood cells) indicate when your body is fighting off an infection, so do physicians need to monitor HIV patients CD4 cell counts to monitor how well an AIDS patient's immune system is battling HIV. In the case of a patient's first diagnosis of HIV which has not yet converted to AIDS, given poverty and a poor nation's infrastructure, the retention rate of infected patients to return for ongoing monitoring is usually very low, inhibiting physicians to monitor CD4 counts to define when a patient is in need of HIV drug therapy (CD4 count drops significantly once a patient converts from HIV to AIDS). Periodically is essential to determine who needs to be on drugs versus those who do not. On one level, poor infrastructure (roads) makes it difficult to get rural HIV positive patients to urban centres where there are hospitals offering western style equipment to monitor for CD4 counts. Second, poor infrastructure due to insufficient power grids make it difficult for hospitals to use these western style sophisticated CD4 testing equipment when there is no source of stable uninterrupted power.

Clearly the health of the work force in developing countries is being kept from increased productivity by this pandemic drain on resources. Many patients, provided with education can do well without drugs through improved nutrition, rest and in general life style changes. The impediment despite aforementioned statements, because of education, infrastructure and geography is the inability of patients outside of a 30 mile perimeter of hospitals with western style capital equipment requiring drugs are not receiving them. Again the dilemma for a more efficient allocation of a limited resource (HIV drugs) could benefit from a technological development in the form of a portable, chemical and non-mechanical CD4 Triage monitoring device¹⁰ (lateral flow immunological platform¹³) to make determinations without restraints of

Western style capital equipment requiring skilled technicians, uninterrupted power supply, biomedical engineers and refrigeration for reagents, all at a significant cost prior to even the expenditure to purchase such equipment for \$100K. Usually most developing countries, for the obvious reasons of cost, maintenance and skill level, may only have two or three available in the country. Also this type of equipment requires blood samples to be spun down to plasma using a laboratory centrifuge to prepare samples to test for CD4 cell counts¹¹. Conversely, a device that is portable, unaffected by heat, does not require power nor a high level of skill to perform the test, can be transported to rural areas for more efficient determinations on who requires HIV drugs. Given a diagnostic device that can meet the criteria above to provide HIV drugs to only those in urgent need, Aid donors would therefore be able to expand the dollars available to address a larger number of those patients who have converted to AIDS and are at a 200 CD4 count or below¹¹. Since various sources¹² cite different numbers for the worlds HIV population, the mathematics remains the same for the allocation of available funds, as long as per patient treatment costs remain the same. If a HIV positive person has not fallen below a CD4 count 200 mm³ cells, then drugs are of lower value (lower opportunity costs) if life style changes can maintain a healthy CD4 cell count, thus technology can reduce unwarranted expenditures that may be better applied elsewhere to improving the quality and productivity of the work force. **Opportunity costs** for a productive labour force are highest based on misallocation of HIV drugs to those who do not benefit from immediate therapy. At \$1.00 USD per day or \$365 USD per/patient/ year, the funding required to treat just 10 million people alone in Africa is \$365¹² million USD. Multiply this by 3 or 30 million infected HIV persons we would reach approximately \$1 billion (actual verses promised worldwide available annually⁹). Given the distribution costs, facility costs, administration costs and staff costs only about 1/3 of these funded resources⁹ reach HIV patients. Therefore the net expenditure available for 10,000,000 HIV infected persons, if we accept the cost formula cited above is \$1.00/patient x 365/days = \$365/year x 10,000,000/persons = \$365 million/year or approximately 1/3 of \$1 billion.

Considering that **economics is the study of the distribution and allocation of scarce or limited resources**, efficiency in dealing with this epidemic is clearly defined as those who have HIV converted to AIDS and the most efficient manner to allocate drugs with lower **Opportunity costs** that would positively affect GDP growth.

Currently the financial model for treating AIDS is as follows;

- HIV drugs at \$1/day cost \$365/patient yearly or 365 million USD for 10 million patients¹⁴
- Actual vs. committed funding worldwide for HIV drugs annually: \$ 1 Billion.
- 20% of 30 million HIV patients are AIDS infected persons below CD4 200mm³
- An **Economic Triage Solution** increases drugs from 1 to 6 million patients.

- 10M people are treated with HIV drugs. Only 20% have a CD4 count of 200 or less
- Model conclusion is that a misallocation of resources impedes economic growth for developing nations relying on labour to growth their GDP.

(table 1.1)

Current one year model for allocation of funds for HIV drugs

Total population of HIV infected persons		80,000,000
HIV population who have converted to AIDS		30,000,000
Populations below 200 CD4		6,000,000
Available funds for HIV drugs	\$	1,000,000,000.00
Available funds after operational costs	\$	330,000,000.00
Number of persons treated with available funds		904,110
Number of actual HIV AIDS converted needing treatment		180,822
Resource reallocation for added AIDS patients w/HIV drugs		723,288
Added released resources for more efficient drug allocation	\$	264,000,000.00

This exercise (table 1.1) demonstrates that a new technology used to determine who requires drugs versus who does not, could ease the misallocation of limited resources to improve the nation's overall Healthcare and ultimately bolster the labour force productivity. This benefits not only the individual country but all trading partners. Assuming a new form of diagnosis and treatment were implemented which are currently available ¹⁴, a significantly larger population could be treated. However a stumbling block are aid bureaucracies who are resistant to accept such technologies as they are implicitly vested (lured by capital investments by western health care companies) to stay with traditional forms of testing, distribution and allocation of medical treatment. Such new devices (technology currently available) could be employed to target those who are in need of drugs. This would then permit shift of the supply curve for HIV drugs out to the right, providing more medical product at a decreased cost solution for HIV AIDS converted persons, permitting expanded funds which in turn would increase the demand for these drugs as physicians would expand requests for drugs to reach more targeted HIV AIDS patients.

Figure 1.1

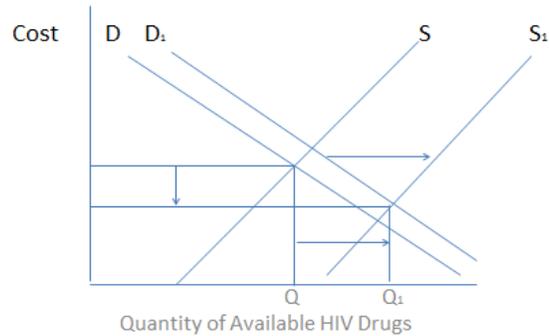
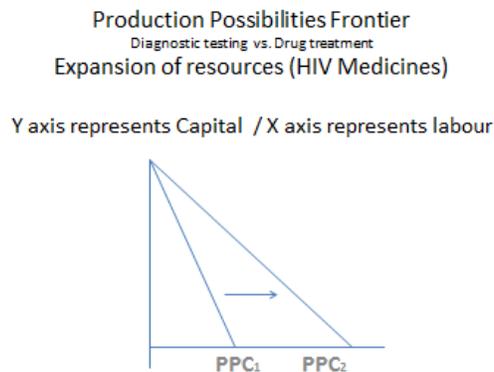


Figure 1.1 clearly shows the benefit of new technology shifting a supply curve outward for labour. Below figure 1.2 illustrates that ***without*** any increase in capital, the ***Production Possibilities Frontier*** is expanded for labour, its most valuable asset in ***comparative advantages for trade***, which then can lead to increased GDP growth through a more productive labour force given via a more efficient allocation of HIV drugs. The two figures combined illustrate a positive shift in labour through a more productive work force resulting from an improved allocation of resources increasing the nation's GDP growth. This net result of using an improved technology permits developed growth through its most valuable asset, labour.

Figure 1.2



In summary, the Economics of managing a Pandemic comes back to basic elementary Macroeconomics: a more efficient allocation and distribution can optimize scarce and limited resources to assist developing nations to increase their GDP

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