Decision Making in Complex Environments

Final Project

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Introduction

This paper uses the Analytical Network Process (ANP) software to incorporate all social, political, and economic aspects into a predictive model of the severity of HIV epidemic in a selected group of developing Southeast Asian nations. The mode of HIV transmission is well documented and is directly related to behavior. Recent studies have provided empirical evidence that there are political, social and economic conditions that facilitate the spread of HIV in the developing world. This model attempts to incorporate the interaction between behavioral and empirical factors that is not accomplished by epidemiological studies.

Epidemiological data in the developing world is often incomplete and based on estimation. Use of the ANP method may be used as a more complete indicator of HIV prevalence or to collaborate epidemiological estimates. It is also intended as a diagnostic tool to learn what factors, or combination of factors are likely to lead to a severe epidemic so that these areas can be target for prevention and control.

Factors that facilitate the spread of HIV and need to be addressed include poverty, income inequality, prostitution, sexual promiscuity, an inability to speak about sensitive sexual or drug related matters and illiteracy gaps between men and woman. Proactive preventive steps include government acknowledgement of the problem and condom use.

This study compares a group of developing Southeast Asian nations in various stages of their HIV epidemic. The six nations are Burma (Myanmar), Cambodia, Indonesia, Malaysia, Thailand and Vietnam. This paper is successful in predicting countries with the most severe HIV epidemic. The results show Burma to have the highest rate followed by Cambodia, which is consistent with estimates conducted by UNAIDS.

Background

"AIDS is not just another infectious threat to health…it is a threat to all aspects of sustainable development "[i] This statement illustrates how severe the AIDS has pandemic

has become and how it threatens the not only the health and lives of the world's population but also the economies of the developing world.

Worldwide an estimated 34.3 million people are infected with HIV. Since the early 1980's, when the virus was first detected in Africa, more than 18 million people have died from the disease.[ii] The impact of the disease is so widespread in some regions, particularly Sub-Saharan Africa, that they exact a heavy toll on income generation, social structures and educational attainment, all inhibiting economic growth.

HIV/AIDS has devastated the developing world but not uniformly. The HIV prevalence varies greatly among countries of different economic level and region. This paper will explore some of the social and economic conditions that allow, or contribute to, the spread of HIV/AIDS in an effort to supply policy options for policy makers at the national and international level.

The health impact of HIV/AIDS is catastrophic but government and other policy makers are often reluctant to commit scarce resources to the health sector. In deciding to intervene, government must consider the counterfactual, what will be the consequences of not intervening, and the opportunity cost of intervention resources. It is argued government intervention to prevent and treat HIV/AIDS is not only a legitimate action to maximize the total well being but also in terms of equity, because of the tendency of HIV/AIDS to disproportionately strike the poor.

Regarding the decision to intervene, counterfactually, the situation in Sub-Saharan Africa has made apparent the cost of inaction is tremendous. Despite this evidence, the decision to do so is not an easy one because resources of most developing nations are extremely limited and still present a substantial opportunity cost for prevention. It is therefore important to thoroughly examine the causes of HIV/AIDS in order to expound to policy makers the immense consequences of inaction, not only in terms of health but a nation's very future.

Although HIV/AIDS is nearly 100% fatal, it is not immediately symptomatic or fatal, allowing a long period for someone with HIV to spread the virus, as well as a long period over which that person needs medical care. The increased cost of heath care to developing nation's governments and their limited health care sector's are tremendous. This enormous direct cost of AIDS is not only in medical cost but also in drugs and funeral cost. The annual cost of treating and AIDS patient is often equivalent to the cost of educating 10 primary school students for the same period of time. WB[iii]

The development of protease inhibitors and their use in treating HIV/AIDS has been largely successful in the developing world and led to a marked decreases in AIDS mortality rates. Unfortunately these drugs are very expensive, US$7,000-$12,000 a year for the rest of patient's life, and are well beyond the limited resources of most developing countries. The fight against HIV in the developing world is a completely battle.

Economic development in the third-world tends to lead to common patterns such as increased urbanization and weakening of traditional family ties and values. Therefore, growth may lead to conditions facilitating increased spread of HIV/AIDS. Mead Owen of the World Bank has conducted some of the most comprehensive studies.

"The Effects of Societal Variables on Urban Rates of HIV Infection in Developing Countries" used baseline data from the US Bureau of the Census and other sources to gauge the significance of eight variables to explain the great discrepancy of HIV infection rates among developing countries. Two sub-groups were used, a high-risk group consisting of commercial sex workers and intravenous drug users, and a low-risk group, pregnant women, used to represent HIV prevalence in the general population.

The results showed that the following variables were significant indicators of HIV infection rates in developing urban areas. A brief summary of the results follows. There is a negative relationship between income and HIV infection. A $2000 increase in per capita GNP is associated with about 4-percentage point reduction in HIV infection rate

among low-risk urban adults. A significant positive correlation exists between inequality (GINI coefficient) and HIV prevalence. A reduction of inequality from .6 to .3 points is associated with a 3-point reduction in the low-risk HIV infection rate.

The ratio of male to female, ages 20-39 showed in cities where men greatly outnumber women there are significantly higher HIV prevalence rates. A higher ratio of men to women is associated with single men separated from family and social constraints and more likely to engage in risky sexual behavior. A decrease in the ratio from 1.3 to .9 would lower the low-risk infection rate by about 1 percentage point.
Male-female literacy gap is also a significant variable in that when women are less educated, have fewer skills and are more likely to turn to sex work or a sexual relationship for financial support. The average country that eradicates a 20% literacy gap can expect low-risk urban HIV infection to be about 1% point lower.

A country's foreign-born population is commonly associated with economic growth because it is an indication of a nation's openness and economic opportunities. It also has a detrimental effect in that countries with larger foreign-born populations have higher HIV prevalence. Similar to high male-female ratios, recent emigrants are usually separated from tradition family structure, more likely to postpone marriage and therefore more likely to seek out commercial sex or other risky sexual practices. A country with 5% foreign-born population will have a prevalence rate about 2% higher than a country with no foreign born-residents.

Increased military presence has a similar effect on sexual behavior and HIV prevalence. Countries with a high percentage of military personnel in its urban centers will have higher HIV prevalence rates. A reduction in percentage of urban population that is military from 30% to 12 % will reduce low-risk HIV prevalence by about 1% point.
The age of the epidemic, as measured by number of years since the first reported case, directly contributes to prevalence rates. On average, counties averaged .7% increase in infection rate for low-risk and 5.7% increase in high-risk groups per year.

Social conservatism, as it influences the supply and demand for risky sexual behavior, is an also a significant indicator of HIV prevalence. The percentage of the Muslim population was used as a proxy measurement for social conservatism.
Several variables that many epidemiologists theorized as contributing factors did not explain to a statistically significant degree cross-country variation in HIV prevalence. The variables were the ratio of male to female secondary school enrolment, rate of urban population growth, percentage of male population circumcised, the availability of condoms in 1982 and 1990, and public health expenditure as a percentage of gross national product.[iv]

The severity of the pandemic and its economic impact on countries in the advanced stages is startling. It is vital to determine the economic variables that lead to the spread of HIV as well as measure the full extent of its detriment. Inexpensive preventive policies to avert conditions conducive to HIV spread combined with public awareness and education can be very effective and extremely cost effective. The policy makers of the world desperately need this knowledge to make the decisions that will determine the present and future course of the HIV/AIDS pandemic.

Methodology and Framework

The use of the Analytical Network Process (ANP) software in this paper is a variation of its common usage for decision-making weighting benefits, opportunities, costs and risks. This paper used a predictive approach that weights a simplified Cost/Benefits model. *Costs* are factors that contribute to or hasten the spread of HIV while *benefits* are factors that control the spread of virus. The predictors were broken down in to criteria, economic, Political, social and other for contributing factors and economic, social and government for Controlling factors

Phase 1

Because this is a predictive rather than decision-making model the BOCR subjective evaluation of merits was not conducted. Instead a pair wise comparison was made between contributing and controlling factors based on current literature on HIV/AIDS in

the developing world. Factors that encourage the spread of HIV are for more present and persistent in the developing world than conditions that suppress the virus's spread and the two predictors were weighted accordingly. Contributing factors. Costs were given a value of .667 while controlling factors were given a score of .333.

Phase II

The controlling factors were broken down into criteria, sub-criteria and in some cases sub-sub criteria given local priorities and global priorities. The Contributing factor criteria are Economic, Political, Social and Other. Economic is broken down into sub-criteria, Income inequality and Poverty. Both low GDP per capita and a high GINI coefficient (a indicator of income inequality in a country) are strongly correlated with higher HIV prevalence rates.

The criterion "Other" is broken down into Geography, Smuggling (of both drugs and persons) and the age of the epidemic in that country. Geography refers to proximity to a country that already has a severe HIV epidemic and smuggling is included because both human and drug smuggling are closely associated with high-risk behavior that leads to HIV infection. The age of the epidemic is important because the prevalence increases exponentially over time will be higher as the time goes on, increasing the risk of infection to those engaging in risky behavior.

Political is broken down into sub criteria of a recent or current history of war, international isolation (either political or economic) and government. War erodes a number of economic and social fabrics that help prevent the spread of the disease and isolation can lead to increased poverty or lower awareness of the Virus, leading to its spread. Government is further divided into Corruption and ineffectiveness as corruption in government promotes corruption in the general population including such activities as prostitution and drug use.

HIV is a social disease and spread through social activities therefore cultural norms and behavior is very important to the spread or control of HIV. Norms and behavior are

broken up into four sub-sub criteria, Drug use, Prostitution, Sexual promiscuity and Social taboos of speaking about sex and or drugs. Education is also and important factor because of the importance of awareness in HIV prevention. Illiteracy is also a major obstacle to awareness and a large gap in literacy between men and women not only make them less aware but also less skilled and employable and more dependent on men for financial support and less able to control their sexual behavior.

Benefits, or controlling factors have three criteria, economic, social and government. Economic are broken down into government spending on health care and international aid received. HIV is easily prevented with simple and inexpensive means and basic awareness and health care is a strong weapon against HIV infection

Socially, conservatism, as is often present in a predominantly Muslim nation, significantly decreases the supply and demand for risky sexual behavior and therefore controls the spread of HIV. The availability and social acceptance of condom use is probably the single most powerful prevention method for those engaging in risky sexual behavior. Finally the simple willingness of a government to admit it has HIV problem in itself creates a great deal of awareness that significantly.

Global priorities were calculated and the top 11 (**Bolded in Table 1)** sub and sub-sub criteria were chosen for analysis and synthesis in Phase three for analysis and synthesis

Table 1 Criteria and Priorities

Predictors	**Criteria**	**Sub-Criteria**	**Local Priorities**	**Sub-sub Criteria**	**Local Priorities**	**Global Priorities**
Costs (Factors that contribute to the spread of HIV) (.65)	Economic (.346)	Income Inequality	.249			**.056**
		Poverty	.751			**.169**
	Other (.098)	Geography	.297			.019
		Smuggling	.169			.011
		Age of Epidemic	.539			.034
	Political (.209)	Government	.547	Corruption	.667	**.050**
				Ineffectiveness	.333	.025
		International Isolation	.23			.031
		War	.189			.026
	Social (.346)	Cultural Norms/Behavior	.75	Drug Use	.119	.020
				Prostitution	.365	**.061**
				Sexual Promiscuity	.281	**.047**
				Taboo (sex/drugs)	.235	**.040**
		Education	.25	Female literacy gap	.665	**.037**
				Illiteracy	.333	.019
Benefits (Factors that control the spread of HIV) (.35)	Economic (.327)	Gov't Health Spending	.333			**.038**
		International aid	.667			**.076**
	Social (.413)	Muslim Population	.667			**.096**
		Condom Use	.333			**.048**
	Government (.259)					**.091**

Phase III

Decision networks were created for the main contributing factors Prostitution, Sexual promiscuity, Taboo of speaking of Sex/drugs, (Education) Female education gap, illiteracy, Economic, Income inequality, Poverty, and Government Corruption.

An example of the actors comprising the network for Prostitution are Consumers, Individual Women, Pimp/Traffickers, Police and Tourists. Similar decision sub-networks were created for the other 10 high priority covering control criterion. These included a cluster for the alternatives (the six Southeast Asian nations) and major actors or factors. (See page 5 of full report for details of all high priority covering control criteria.

Phase IV

Sensitivity Analysis

Sensitivity analysis testing shows if the value given to the contributing factors (Costs), .667 in this study, is below .85, Burma remains the country with most severe HIV epidemic. Above .85 Cambodia becomes the most severe. Burma remains the most severe throughout the lower range of values for contributing factors. Cambodia is the most sensitive of countries and drops to the 3rd ranking if the controlling factor falls below .5.

This variability is no cause for great concern, first because these are extreme and unlikely values and second because Cambodia in reality has the second highest rate of HIV, first by some estimates, and therefore does not greatly diminish the results.

When controlling factors are used as the control criterion its value must drop below .15 for Cambodia to overtake Burma as the most severe epidemic. If the controlling factors value rises above .5 Cambodia drops to third in the rankings.

Results

The results are promising in that they realistically predict the most severe HIV epidemics and follow the ranking of the countries with the exception of Vietnam and Thailand, which are reversed.

This may be due at least in part to the timing of the epidemic. Thailand was the first nation in Asia to suffer an HIV epidemic. Due to the severity of the epidemic the government was forced to take a number of steps to curb the epidemic. This is why Thailand has among the highest rankings in the controlling factors and therefore contributes to its lowered predicted severity. Although the measures have been largely successful the prevalence was at a substantially higher level and although growing at a much slower pace, remains high.

Vietnam on the other hand was not exposed to HIV until relatively late, the early 1990's. Despite conditions in Vietnam favorable to a fast spreading epidemic, the young age of the epidemic in the country has not yet raised the prevalence to severe levels. This may be a strong indicator of a future severe epidemic in Vietnam.

Table 2: Synthesis results

	Alternatives	**Priority**	**Ranking**
	Burma	0.2425	1
	Cambodia	0.1937	2
	Vietnam	0.1674	3
	Thailand	0.1379	4
	Indonesia	0.1366	5
	Malaysia	0.1217	6

[i] Bernhard Schwartlander, Geoff Garnett, Neff Walker, Roy Anderson, "AIDS in a New Millennium," Science Magazine, (Volume 289, Number 5476, July 2000): 65

[ii] UNAIDS, Global HIV/AIDS and STD Surveillance, UNAIDS (June 2000) http://www.unaids.org/epidemic_update/report/index.html

[iii] UNAIDS, (2000)

[iv] Mead Over, "The effects of societal variables on urban rates of HIV infection in developing countries: An exploratory analysis," EC Report: Confronting AIDS: Confronting Evidence from the Developing World (1998)
http://europa.eu.int/comm/development/aids/limelette/html/lim02.htm