Healthcare Issues Facing the Developing World: Physician shortages and inadequate drug access

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Abstract

I review numerous articles and reports to first understand the economic need to address two important healthcare issues facing the developing world. Secondly I address the problem of a shortage of physicians, and discuss possible ways to improve on this problem, which include incentive and non-incentive methods. Thirdly I examine some obstacles facing the accessibility of required drugs for managing severe diseases of the developing world.

1. Introduction: The status of healthcare and quality of healthcare delivery in developing countries

The urgency of adequate healthcare in developing nations is apparent in many respects. For instance, mortality rates for the poorest of the developing countries - representing approximately 2.5 billion people are in the order of 121 per 1000 people [1] (World Bank, 2002). Pressing medical problems for these countries include high maternal mortality rates, low birth weight, infant mortality, and poor child growth and development, as well as severe diseases- such as measles, malaria, tuberculosis, HIV/AIDS, and diarrhea.[2]

This paper seeks to understand two major problems affecting the health of the developing world. I do this by addressing three related goals. Firstly, I seek to explain the need for improving on health in developing countries. There has been particular research connecting health to income growth, as well as findings that the control of widespread disease could avoid losses in GDP and economic growth[3]. Secondly, I address the physician shortage problem and potential effective ways to deal with this problem. In developing countries for every thousand people there are merely .4 physicians available, not to mention that the physicians that do work in these parts are drawn to the more urban areas within these countries (World Bank, 2002). A serious inequity with respect to access to health services results as one fifth or fewer physicians in developing countries work in the rural sector (Cavender, 1998). There are many reasons why physicians might not want to work in developing countries including high

[1] The "poorest" refers to those with low incomes of $765 or less.
[2] See Appendix 1 for further details.
[3] See Cropper (2003) and World Health Organization (2004).

relocation costs, lower incomes, and differences in living conditions. Thirdly, I will shed some light on the access and availability of essential pharmaceuticals that are required to treat widespread diseases. Acute Respiratory Infections such as influenza and pneumonia are a frequent cause of death. Malaria and tuberculosis are also common diseases in developing parts of the world [4]. However, AIDS is perhaps an even more severe concern due to the rapidity and lethality of its spread[5]. While HIV/AIDS afflicts approximately 42 million people worldwide and about 29 million in Africa alone, AIDS related diseases kill more than three million people every year (World Health Organization, 2004). Thus access to the proper drugs is an important part of the war against such deadly diseases. Several issues currently surround the rigid availability of adequate drugs, including time inconsistency, high costs and a lack of funding for research and production, and hence a lack of effective developmental research. These issues must be addressed effectively in order to manage this problem.

Thus far, not a great deal of significant research has been done in these areas, especially not of an empirical nature. The health economics issues facing the developing world are often addressed individually in literature with only certain aspects given focus, for instance how one particular incentive for physicians might be effectively implemented, or the economic affects of a particular disease. Using various journal articles, books, and major world organization reports, I will summarize relevant issues and analyze findings of these problems- physician shortages and poor access to essential drugs. I will also suggest appropriate methods and considerations for dealing with these

[4] See Cropper (2003) and World Bank (2002).
[5] Note that it is estimated that one-third of the 40 million people with HIV/AIDS worldwide are co-infected with tuberculosis. World Health Organization (2005)

problems, discuss implications of the current poor management of these problems, as well as propose directions for future work in this matter.

2. The Link between Health and Economic Capacity

There are also other economic reasons driving the need to address healthcare needs effectively. Good health is often thought to facilitate the earning of higher incomes and a higher standard of living, whereby poor health possibly causes one's earning capacity to be limited. In addition, along with findings that income levels affect health outcomes, there is a cyclical effect whereby more income enables one to access the required healthcare. See for example Ettner (1996) and Case (2001). I will briefly examine some research that supporting the existing affect that health has on income and economic capacity viewpoint.

2.1 Health and Income

Part 1: Health and income

One of the main reasons to be concerned about the health status of developing nations relates to the well-documented positive relationship between income and health.

For instance, Fuchs (2004) notes that health and income is particularly strongly related for countries with below average income levels.

> When 149 countries are sorted into quintiles according to Gross Domestic Product per capita in the late 1990s, those in the middle quintile ($ 3860 average GDP per capita) have 20 years more life expectancy than countries in the lowest quintile ($

> 800 GDP per capita), but only 10 years less than countries in the highest quintile ($ 20 910 GDP per capita). (Fuchs, 2004, page 3)

Superior health suggests a higher survival rate for infants, which raises GDP per capita by increasing the ratio of workers to dependents. Better health among adults increases labor force participation and improves the productivity of those who are at work (Fuchs, 2004).

Additional studies on the effects of health on income include the works of Fogel (1994) which finds that approximately one third of the economic growth in England over the past 200 years is due to improvements in health and nutrition. Similarly, Barro (1996) finds that life expectancy has a significant positive effect on growth regressions. Mayer (2000) determines that health affects the dynamics of all of the main indicators of socioeconomic status in Brazil including income, and wages. Konac (2003) asserts that chronic health problems and inadequate public health systems tend to decrease productivity and production levels of the labor force. Thus, at the microeconomic level household disposable income levels are lowered and at the macroeconomic level lower national income levels are lowered.

Smith (1999) examines the relationships between health and wealth, and health and income. Poor health may limit an individual's capacity to earn income and accumulate assets by restricting work time and at the same time increase medical expenses. This paper seeks to detail the size of the relationship between health and household wealth, estimate empirically the effect health has on savings, and examine the influences of economic status on health.

To demonstrate the association between wealth and health, Smith (1999) created a table whereby household median wealth is arranged against the head of the household's

self-reported health in 1984[6]. This table shows that across all age groups those with good health had 74% more wealth than those with poorer health. Similar results exist for income as well. It is also indicated that changes in wealth between 1984-1994 are associated with initial health, and there are again similar results for income. Similarly changes in health over time are also associated with changes in wealth. If the health of those individuals with 'very good' health in 1984 had a median wealth of 66.3 thousand and they maintained equally good health in 1994 they would have a median wealth of 100 thousand. If in 1994 their health was 'excellent' and median incomes were 121 thousand, and their health had deteriorated to 'poor', incomes reduced to 31 thousand. Corroborating these findings are some statistics from the National Center for Health Statistics of the United States. Between 1979 and 1989 white men with household incomes below 10 thousand were expected to live approximately 6.6 years less than white men with household incomes of 25 thousand. The same differential statistic for black men was 7.4 years. Note that these statistics represent unadjusted means and correlations. It is also worth noting that certain risk behaviors such as smoking, a common cause of lung cancer and heart diseases, is a more common habit among lower income groups and groups with less education.

Of course the direction of causation among wealth or income and health are difficult to pinpoint. Wealth and income could grow more quickly among those with better initial health as good health enables the capacity to build earnings. Or wealth and income could assist in protecting ones health through the ability to eat nutritious foods or live where there is great sanitation of water and waste disposal.

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[6] Data from PSID (Panel Study of Income Dynamics,) for ages 25-54.

Smith (1999) continues on to develop empirical models relating health and wealth. Ordinary least squares regression models are used with three dependent variables consisting of changes in household wealth, out of pocket medical expenses, and total medical expenses. Household wealth is defined as net equity in homes, other real estate, vehicles, business equity and financial assets. The main independent variable is the onset of chronic health problems and additional controls for demographic factors, health risk behaviors, and pre-existing health conditions are included. In the case of a dramatic health shock, total medical costs are approximately 29 thousand and mean reduction in wealth is approximately 17%, or about 7% of overall household wealth. Since health problems may also tend to persist in the future, the eventual impact on wealth may be greater.

HRS is a panel survey that contains extensive measurement of baseline health status as well as current and past behaviors and detailed economic histories. Smith next estimated the labor supply effect of a severe health shock to be approximately 4 hours a week or a 15% decline in the probability of remaining in the labor force.

Thus, similar to previous literature described, Smith (1999) finds that there is indeed a solid link whereby health affects both wealth and income, motivating the need for effective healthcare in developing nations even further.

Part 2: Health, nutrition, and development

Strauss (1998) examines the relationship between health, nutrition, and economic development. Health is often considered an input to human capital through its effect on labor market output, much like education. This paper examines evidence of such a

relationship. In the development literature there has been a long time consideration of theoretical models of nutrition-based efficiency wages[7]. For instance, the hypothesis that poor nutrition affects productivity was discussed by Leibenstein (1957). Strauss (1998) links aggregate movements in height to long-run changes in standard of living. Fogel (1994) originally found that stature is a useful index of well-being of a population. Naturally, genetic influences will play a significant role in these results also. However these differences do provide information about changes over time and in each country.

Strauss (1998) presents nonparametric estimates of the bivariate relationship between height and (log) hourly wages of men in the urban areas of the United States and Brazil. Data for the US sample is drawn from the National Longitudinal Survey, based on 1992 wages for white males aged 27 to 35 years of age. Similar Brazilian data is taken from NEDEF define. A strong association is found between height and wages in Brazil. Taller men are found to earn more, a 1 percent increase in height is associated with a 8 percent increase in wages. Of course it is also likely that higher earnings facilitate better health with causation running in both directions. Strauss (1998) notes that differences in height are probably due to both the large differences in nutrition in the two countries along with differences in the type of labor that is more common in each part. Lower income countries such as Brazil typically employ more physical intensive labor. The correlation between height and education is also calculated, and it is found that taller men appear to be better educated in both countries, and in Brazil more so. For instance among men aged 25-34 a 10cm gap in height is associated with 1 more year of education in the United States and a 1.5 years in Brazil (noting that education systems are

[7] According to the nutrition-based efficiency wage model, employers do not lower the wage in an involuntary employment equilibrium model. Workers would consume less and thereby lower their productivity thus raising their cost per efficiency unit of labor.

quite different in the two countries, thus (Strauss 1998) find that for Brazil this is a more significant increase). To test whether height is simply a proxy for a wage function, the relationship between height and wages are presented for two different groups of Brazilian men. One group is of those with no education and the other with some education. It is found that some positive association between height and wages can be attributed to education, even for those with no education some relation persists (a 1 percent increase in height is associated with a 4 percent increase in wages).

According to Strauss (1998), the foremost conclusion is that there is recent evidence, including his own findings, building in favor of the notion that health does affect income, and there are more notable large returns for lower levels of health.

However one cannot ignore the cycle whereby labor markets generate income creating potential sources of nutrition and good health and nutrition affects an individual's physical capacity to generate income. This cycle highlights the possibility for a significant portion of the population of developing countries to be caught in a poverty trap.

There are also numerous economic consequences resulting from severe and fatal diseases common to the developing world, and I now turn my discussion to findings on this subject.

2.2 Diseases of the Developing World

Part 1: The Macroeconomic costs of AIDS

There is often a view put forth, that suggests that the macroeconomic impacts of AIDS is modest, especially in comparison to the costs it does in non-economic terms. Bell (2003) seeks to counter this notion, and suggests that the macroeconomic costs of AIDS are indeed quite large. Bell (2003) formulates a set of variants designed to illuminate the effectiveness of policy when the aim is to avert an economic collapse following the outbreak of the AIDS epidemic.Most models find that the effect of AIDS on mortality reduces the pressure of population on existing land and capital, thus increasing the productivity of labor. See for example Arndt and Lewis (2000) and Bonnel (2000)

Despite any drop in savings and investment (due to a reallocation of expenditures towards medical care), the impact of AIDS on GDP growth is diminished by the counter effect of increased labor productivity. Consequently, the net effect on the growth rate of per-capita GDP is very modest. However Bell (2003) believes that the economy in question should stress the importance of human capital and how it transmits over generations and promotes economic growth. AIDS will eventually lead to a slowing down of economic growth. Here the focus is given to Africa as it has a particularly low level of human capital and high prevalence of the disease. There are several stages to the decline of economic growth, according to Bell (2003). First, AIDS damages existing human capital in a particular way. It tends to affect young adults a great deal. A few years after being infected, those infected will become sick and weak, and then if it progresses it will kill them in their prime, destroying the human capital progressively built up in them

through child-rearing, formal education, and learning on the job. Second, AIDS affects the generation of human capital formation. The quality of child-rearing depends heavily on the parents' human capital, as broadly defined above. If either or both parents die while their offspring are still children, the transmission of knowledge and potential productive capacity across the two generations will be weak. The loss of income due to disability and early death also reduces the lifetime resources available to the family, which may well result in the children spending much less time (if any at all) at school. Third, children might contract the disease in adulthood making investment in their education less attractive, even if both parents remain uninfected. Such effects are noticeable in the long run, as poor education of children today translates into low productivity of adults a generation hence. Finally, as such individuals grow into adults, they are in turn less able to raise their own children and to invest in their education. The cycle continues, and with no action an economic productivity will experience a significant slowdown. If nothing is done, the outbreak of the disease will eventually precipitate a collapse of economic productivity. Bell (2003) continues on to extend on the overlapping generations (OLG) model of Bell and Gersbach (2002). This model analyzes child labor, education and growth, to deal with disease filled environments, in which premature adult mortality can be mitigated by spending measures to combat it. Parents may prefer current consumption to the level of human capital attained by their children, (thus creating allowances for premature mortality in adulthood).

> The decision about how much to invest in education is influenced by premature adult mortality in two ways: first, the family's lifetime income depends on the adults' health status, and second, the expected pay-off depends on the level of premature mortality among children themselves when they attain adulthood. The outbreak of AIDS leads to an increase in such mortality, and if the prevalence of the disease becomes sufficiently high, there may be progressive collapse of human capital and productivity. (Bell, 2003, page 8)

The primary concern is to evade such a collapse with effective interventions. Such interventions include spending to contain the disease and treat those infected, income support or subsidies towards childhood education and taxes to finance the expenditure program. Bell (2003) expresses the human capital attained by each child upon reaching adulthood to be given by:

$$\lambda_{t+1} = \begin{cases} z(s_t)\, f(e_t)\, \lambda_t(s_t)+1, & s_t = 1,2,3 \\ \xi & s_t = 4 \end{cases} \quad (1)$$

where $z_t(s_t)$ represents the strength with which capacity is transmitted across generations. This initial basic model is designed to acknowledge the effect of premature adult mortality on family structure and the childhood education.

This paper continues to calibrate this model in order to produce findings for the case of Africa. The unit time period of the model is a generation, and with two overlapping generations, the span of each is set at 30 years. Given that the data described are aggregate in form, it is assumed that the population is otherwise homogeneous in the period leading up to the epidemic.

A family with n_t children has a total income in state s_t (s_t = 1;2;3) of $y_t(s_t) = \alpha[\Lambda_t(s_t)+n_t(e_t(s_t))\gamma]$, where scalar $\alpha(> 0)$ denotes the productivity of human capital, measured in units of output per efficiency unit of labor input. Child supply efficiency units of labor are defined as $\gamma(1(j)e_t(s_t))$ when the child works $1\text{-}e_t(s_t)$ units of time.

GDP can be defined as $Y_k = \alpha L_k \lambda_k$ where k represents calendar years child labor is disregarded. L_k and λ_k denote the size of the labor force and the average level of

efficiency in that year, respectively. The labor force series begins in 1965, thus that year is the starting point for the calibration procedure. The system is then anchored to λ_{65} through progressive substitution using equation (1). Data on educational attainment are attained from Barro and Lee (1996). The data are in average years of schooling among the population aged 25 and older.

The outbreak of the AIDS epidemic is then modeled as an adverse shock to an existing profile of premature adult mortality. The AIDS prevalence rate increased from approximately 1 percent in 1990 to over 20 percent a decade later. Therefore 1990 is chosen as the date of the outbreak of the epidemic in South Africa, and 1960 as the starting point in the chosen 30-year framework.

Bell (2003) concludes that the AIDS epidemic will peak far in advance of the economic damage that it will eventually cause. Accumulated losses in GDP per capita will be large, even if the measures designed to combat the disease are well chosen and the fiscal means employed to finance them are highly efficient. In the absence of such measures, an economic collapse is a reasonable possibility. Such findings are most probably due to the dangerous and selective character of the disease. When AIDS affects young adults, it destroys their potential to build human capital. It also affects their children and their ability to become economically productive in the future. This weakening of the mechanism through which human capital is transmitted and accumulated across generations becomes apparent only after a long lag, and it is progressively cumulative in its effects. Where the prevalence rate is still low) it is crucial to contain the disease at once, including for economic reasons. In those parts of the world where the epidemic is in a far more advanced stage, combating the disease and its economic effects requires a large fiscal effort, the effective design of which is a

complicated matter. In terms of effective interventions, human capital embodied in individuals during childhood via effective training will pay off into old age, not only for them, but also for their children. "In the absence of the epidemic, there would have been the prospect of modest, but accelerating growth of per capita income. As things now stand, the African economy could be on the brink of a progressive collapse" (Bell, 2003, page 14).

Robalino (2002) develops a model of optimal growth in order to understand the risks of an HIV/AIDS epidemic. It also examines the expected economic impacts in 9 countries in the Middle East and North Africa region[8]. The model used principally encompasses an HIV/AIDS diffusion component based on two transmission factors, sexual intercourse and the exchange of infected needles among injecting drug users.

On average, Robalino (2002) finds GDP losses across countries for the period between 2000-2025 might approximate 35% of today's GDP. It is also found that in all countries it is possible that losses surpass current GDP. It is also shown that delaying action for 5 years can cost approximately 6 percent of current GDP.

Part 2: The potential impact of an effective HIV/AIDS vaccine

Stover (2002) examines the cost effectiveness of an AIDS vaccine and how an effective vaccine could impact the epidemic. In order to do this, the study uses two computer simulation models, one using data from Zimbabwe and the other using data from Kampala and Thailand. The models are then used to investigate effectiveness, duration, cost and type of protection on impact and cost-effectiveness. One model is the

[8] These countries are Algeria, Djibouti, Egypt, Iran, Jordan, Lebanon, Morocco, Tunisia, and Yemen.

Imperial College model and the second is the iwgAIDS. Simulation models are found useful because they can illustrate the effects of vaccines that have not yet been developed. The Imperial College model examines the heterosexual spread of HIV among adults aged 15-49. This group then is segregated according to age, sex, and sexual activity class. This model further classifies the population into four categories: (1) fully immunized, (2) partially immunized, (3) not immunized and (4) previously vaccinated but no longer protected by the vaccine and not eligible for revaccination yet. The iwgAIDS model includes many individual characteristics affecting the probability of HIV transmission such as level of sexual activity and injecting drug use. These characteristics are then continuously distributed over age. In the iwgAIDS model individuals can be vaccinated with either fully or partially protecting vaccines. Individuals become eligible for re-vaccination if vaccine protection diminishes as a function of the time.

Stover (2002) essentially concludes that the ideal AIDS vaccine would be inexpensive with a very high effectiveness and have lifetime duration. It would be implemented through a program reaching most of the adult population and supported through effective health education warning of the consequences of risky sexual behaviour. Such a vaccine would provide the means to reduce HIV prevalence to very low endemic levels. In addition, vaccines with effectiveness levels as low as 50 percent can still aid in controlling the epidemic if there is a high coverage (or 65 percent) of the adult population. Of course, even the most effective vaccine programs cannot entirely eliminate HIV infections.

Part 3: The economic value of malaria prevention

Cropper (2001) looks to estimate the monetary value of malaria prevention for households in Tigray, Ethiopia. There are two reasons why it is important to understand the monetary value to reductions in malaria cases. Firstly, within the health sector and outside of that sector, malaria prevention programs must compete with other programs for funds. Thus a dollar value is useful to compare malaria prevention programs with other programs whose benefits are more easily monetized and to compete with them for funding. Secondly, in order to create and implement malaria prevention programs, it is essential to measure what individuals are willing to pay for them.

Cropper (2001) developed a three-part survey instrument to measure both the cost of illness (COI) associated with malaria and willingness to pay (WTP), for malaria prevention. The first part of the survey included questions about a household's current health status, knowledge of malaria, and past expenditures on malaria prevention and treatment. The second part presented the respondent with one of two contingent valuation scenarios-a hypothetical vaccine scenario or a bednet scenario. The third part requested information on the education, income, assets, occupation, of household members and housing construction.

The hypothetical vaccine scenario suggests that a vaccine is not currently and might never be available. A hypothetical vaccine was described to the respondent, available as either a pill or injection, which would prevent the recipient from contracting malaria for one year. The scenario ensured understanding of the benefits of the vaccine, and provided reminders of substitute goods and the budget constraint. It was also emphasized that a separate vaccine would need to be purchased for each member of the

household in order to protect them from getting malaria for one year. The respondent was asked whether he would purchase one or more hypothetical vaccines at one of five randomly assigned prices. The lowest price was Birr 5 (0.8 USD) and the highest price Birr 200 (32 USD). If the respondent answered 'yes' to the original choice question, he was then asked how many hypothetical vaccines would be purchased and to whom they would be given.

Alternatively, respondents received an insecticide-treated bednet (ITN) reliant valuation scenario. This scenario included an explanation of how using a bednet reduces the probability of contracting malaria. This scenario also checked respondent understanding of how the bednet works, and provided reminders of substitute goods and budget constraints. Information about the costs of annual re-impregnation of an ITN over its 4-year expected life was then presented. The respondent was offered the opportunity to purchase one or more bednets at one of five randomly assigned prices. Prices per bednet ranged from a low of Birr 8 (1.3 USD) to a high of Birr 100 (16 USD), with Birr 40 (6.4 USD) as the middle price. The highest price, which is lower than the highest price charged for the hypothetical vaccine, is based on an estimate of the maximum amount that one could conceivably charge. As with the hypothetical vaccine scenario, if the respondent answered 'yes' to this choice question, he was asked how many bednets would be purchased and for whom in the household they would be used.

This survey was conducted in January of 1997, and Tangua Abergelle and Kola Tembien were the two districts surveyed. Within these districts, 12 villages were given the vaccine survey version, and 6 the bednet scenario. A total of 569 respondents were offered the hypothetical vaccine scenario and 279 respondents who were offered the bednet scenario.

Cropper (2001) then computes a per episode COI reflecting the costs recent malaria episodes experienced during the past two years for the respondent and a child/teenager in his household. These costs are multiplied by the number of incidents experienced by family members during the last two years (and then divided by 2) to derive an annual household COI. Such calculations are done for all households in the sample. Cropper (2001) makes two possible assumptions, "high productivity" which equates adult productivity with the daily wage, and "low productivity", which assumes productivity is half of the daily wage. Average annual household COI ranges from Birr 196 (31 USD) using high productivity assumptions to Birr 58 (9 USD) using low productivity assumptions. Annual household COI averages Birr 103 (17 USD) if an adult's time is valued at 75 percent of the daily wage for unskilled labor.

A household demand function is then estimated for a hypothetical malaria vaccine and then the willingness to pay to prevent malaria as the area beneath this demand function to the left of household size. The demand function is taken from Grossman (1972) where demand for health-related goods is defined using utility $U= u(X_1,...X_n, L_1,...,L_n, S_1,...,S_n, \boldsymbol{Z})$. $\boldsymbol{Z}$ is a vector representing taste variables that affect how household place weight on the consumption of children and adults, and on health and other goods. $\boldsymbol{X}$ denotes consumption and $\boldsymbol{L}$ denotes leisure time and $\boldsymbol{S}$ denotes disutility from time spent ill. $S_i = s(A_i, M_i, H_i, E)$, $i=1,...,n$, in other words time spent ill is also a function of preventative care A, medical treatment M, individual characteristics H, and prevalence E, and i=1...n are time periods. Total expenditure on preventative care, medical care, and other goods cannot exceed an individual's income, which serves as the budget constraint. The head of household chooses $\boldsymbol{X}$, $\boldsymbol{L}$, $\boldsymbol{A}$ and $\boldsymbol{M}$ such that they maximize household utility subject to the budget constraint and the health production functions. This yields a

household demand function for preventive care $A^* = \sum A_i$ that depends on non-wage income, wages, prices, household and health characteristics of family members, and the prevalence of malaria. A*= g $(I, w p_a p_m Z, H, E)$ where p_a is the prices for preventative care and p_m is prices for medical care. In the surveys, households were told that the vaccine would prevent each person who received it from contracting malaria for one year. Thus, $S_i = 0$ if the vaccine is purchased.

According to the survey, respondents (or quantity) are clearly sensitive to price. Calculated as the area under the household's demand curve between 0 and n vaccines, annual household WTP is, on average Birr 229 (36 USD) (using the Truncated Poisson model), with a median value of Birr 158 (25 USD). A WTP of 36 USD on average, is approximately 15 percent of imputed annual household income, or about two to three times the expected annual economic losses (medical costs plus productivity losses) per household from the disease.

2.3 Conclusion

In this section, the articles presented essentially motivate and support the notions that if healthcare in the developing world is not paid enough attention, there will be serious economic repercussions. Quality of health has been shown to affect income levels, as well as wealth accumulation and economic development. It was demonstrated that the AIDS epidemic has, and will continue to have a strong affect on potential GDP. AIDS is a serious threat that must be dealt with, as it affects youth and this is where the start of the economic impact begins.

Similarly, malaria is estimated to have significant WTP value if dealt with effectively. Such knowledge will assist in funding programs to deal with such diseases in an effective manner.

3. The Nature of the Physician Shortage Problem

In this section I examine the issues pertaining to the physician shortage problem created by a lack of effective incentives for physicians to practice in developing nations.

There are numerous reasons why physicians might not be keen on working in a developing nation, despite the immense need for healthcare in these parts. For instance, many individuals who choose to go into the medical care industry base their decision to do so on expectations of sufficiently high incomes[9]. Practicing medicine in a rural or developing environment could undermine this possibility. If incomes are lower in rural areas, then the prices that physicians can charge for their services will also be lower. Although the money prices of some goods may be lower in rural areas, the effective prices of certain goods might be higher if these goods are less available, for example in the case of luxury type goods (Jack, 1999). If relocation is necessary either after medical school or during their career, physicians might find the costs involved too high. Physicians will also consider the adequacy of things such as the quality of local education systems, sanitation, housing conditions, and amenities, especially if they have to support and raise their families. There could be new languages to learn and an unpleasant distance from family and friends for an indefinite period of time. For these reasons many physicians are drawn to more urban areas. Of course there are physicians that may

[9] See for example Jack (1999) and Lee (1983).

personally desire to work in a developing country, perhaps in order to help those less fortunate or for the experience of living and working in a new country.

Cavender (1998) examines the perspectives of physicians from abroad participating in placements in Ecuador. He notes that doctors from the United States are sometimes grateful for the chance to be in a place where healing is an act of service and more than just a "profit-motivated business venture—a place where physicians are respected and appreciated, rather than doubted and sued" (Cavender (1998), page 6). However, there are not nearly enough of these physicians to compensate for the attraction of so many other physicians to urban cities. Thus, there is a disparity between the geographic distribution of physicians and the apparent need for them (Chomitz, 1998). Couperand (2003) describes an "international recruitment pipelines for doctors", whereby physicians are sought after aggressively.

> Doctors from sub-Saharan Africa are recruited to South Africa. Doctors from South Africa are recruited to Canada or Australia. Doctors from Canada and Central America are recruited to the USA. Doctors from Australia, Europe, Africa and Asia are recruited to the United Kingdom. Similar patterns emerge in the global nursing workforce. It appears that the predictable flow of these pipelines is recruitment from the poor for the benefit of the rich... it is the rural areas of the poorer country that suffer the most. (Couperand, 2003, page 1)

As an illustration, the Zambian public health service retained approximately 50 of more than 600 doctors trained in the country since independence, and the doctor-population ratio in Uganda is approximately 1:24700 (Couperand, 2003).

Effective government intervention is crucial to attending to this global mismatch, but the question of such methods still remains. Hence I shall now discuss more promising solutions to this mismatch, including both incentive and non-incentive methods.

3.1 Solutions

In this section I review the theoretical framework about compensation incentives and then examine the existing empirical literature regarding such incentives.

Part 1: Non-incentive based methods

Recall the problem discussed above of developing nations recruiting doctors from industrialized or developed nations. Many developed nations also have difficulties supplying their rural areas with adequate healthcare (as local physicians are deterred from working in these parts), and thus often recruit physicians from developing nations. As mentioned earlier, such recruitment works to the disadvantage of the developing areas of developing countries. Couperand (2003) suggests several potential methods for controlling such excessive recruitment. First, developing countries could train more physicians. "The key is for this increase in medical student numbers to place an emphasis on rural origin students and link this selection to appropriate rural-based education" (Couperand, 2003, page 1). Second, developed countries recruiting doctors from developing countries could pay compensation to that country (on a government level) for any doctors recruited. This was an adopted resolution at the 4th World Rural Health Conference in Calgary, in 2000[10]. However this is somewhat difficult to implement effectively. For instance it could be hard to attach appropriate payment amounts to short-term contracts and cases where a physician returns to his home country

[10] Over 300 rural doctors and healthcare workers from 30 countries participated. The conference was a collaborative effort between the University of Calgary, the Society of Rural Physicians of Canada (SRPC), the Alberta Rural Physician Action Plan, the Canadian Medical Association, Memorial University, the University of Alberta, and the WONCA Working Party on Rural Practice.

or a contract is unexpectedly extended. Third, governments and their recruiting agencies could refrain from advertising in the journals of developing countries. Finally, along similar lines, it is also suggested that recruiters not visit developing countries in order to attract their health professionals.

Part 2: Incentive based methods

> The World Health Report 2000, *Health Systems: Improving Performance* defines incentives as "all the rewards and punishments that providers face as a consequence of the organizations in which they work, the institutions under which they operate and the specific interventions they provide". (Adams 2000, page 1)

Bennet (1997) defines a set of basic payment strategies and accompanying key incentives for healthcare providers (See Table 1, Appendix 1). This table is based on economic theory where responses reflect efforts by physicians (as suppliers of service) to maximize their incomes subject to constraints imposed by external fees and payment mechanisms. Of course economic incentives are one of many factors that influence practice patterns in the medical care sector. Other considerations include professional ethics, training, experience and the nature of relationships between the provider and paying organization.

Payment mechanisms are often thought to influence the effectiveness of the healthcare provided. For instance, Gauri (2001) maintains that part-time district surgeons in South Africa paid on a fee-for-service basis tend to expend minimal time and effort on their public sector patients. Instinctively, the fee-for-service mechanism provides the most likely effective incentive for physicians, because the more service (and intensive the

service) that is provided, the more they will earn. However this does not necessarily guarantee any standard in terms of the quality of service. Meanwhile salaried physicians can easily shirk on the job due to the isolation in which they work. If adequately remunerated, such posts might actually attract individuals looking for low stress positions.

Physicians should be motivated to work in developing countries via higher incomes yet research generally shows that this is not a consistently effective method. Consider the following example: suppose that the relative supply of physician services in urban and rural areas, with both populations roughly equal. If the physician supply is increasing and physicians are more inclined to work in urban areas, it would seem urban incomes would fall in relation to rural incomes, and at some point real incomes would be higher in rural areas than in urban areas[11]. Thus a migration movement would be expected from urban to rural areas. However such results are rarely seen, and if anything incomes tend to increase in urban areas (Jack, 1999). One suggested reason for such an increase is the monopolistically competitive disposition of the market for physician services. Due to the costs of searching for physicians and switching between physicians that are exiting and entering the market, physicians may be in a position to induce demand, and thus boost incomes.

Several other studies are in agreement on the lack of effectiveness of income as an incentive tool. Extra pay for hardship posts is common but often unsuccessful (Hammer, 2002). In a study of Indonesia, it appears that only moderately remote areas can be staffed using modest cash incentives (Chomitz, 1998). Also, even if physicians were

[11] This analysis is obtained from an orthodox demand and supply framework. Graphical analysis accompanying this discussion can be found in: Jack(1999)

equally positive about living in a rural or an urban area and could earn the same real income practicing in either location, they would tend to concentrate in larger communities, thus speeding up development time and translating into greater lifetime earnings (Wallack, 1981). Now I shall look to other possible incentive techniques.

There are several other possible useful tools. Numerous countries, including the United States, offer subsidized medical education under the stipulation of serving a period of service in remote rural locations (Hammer, 2002). For instance, there is the National Health Service Corps (an organization providing scholarships and loan assistance for medical students planning on rural service) as well as other assorted student loan forgiveness programs to indirectly serve as financial incentives by lessening the financial burden of tuition. In Indonesia, most physicians are trained in and wish to work in the metropolitan city Java. In order to place physicians in more remote areas the government has utilized a system of compulsory service for medical school graduates. Previously, those assigned to more remote regions were rewarded with shorter periods of service (Chomitz, 1998). Similarly, Bangladesh uses a point system, where the acceptance of unattractive postings earns a physician points towards increasing the chances of future postings to more appealing locations. The ability of governments to effectively use such indirect means rather than wage differentials depends on the ability to exploit either a market failure (such as capital markets where medical education is very expensive) or a government-induced constraint in medical education or labor markets (Hammer, 2002).

3.2 Considerations for Designing Incentives

Here I will review Hammer (2002), which uses two noteworthy theoretical models to examine how a government can sort between physicians with different opportunity costs of relocation. This would allow an understanding of how to identify the physicians that would be willing to serve posts in developing countries. This article also addresses how the quality of existing health providers (traditional healers) might affect the government's training policies.

First, consider the following model to look for the design of an optimal payment system with two rural service options, defined by the type of opportunity cost the physician has. The length of the service term is denoted by q, the social value of rural service per unit time (constant) is denoted by b, and P denotes the payment received by the physician from the government. Staying in the rural area is assigned either a high or low opportunity cost depending on individual preferences, and is increasing and convex in the time spent in the area. Cost is $c_i(q)$ where $i = L, H, cL(q) < cH(q)$, and $cL'(q) < cH'(q), for\ q > 0$. The proportion of physicians with low opportunity costs is φ and $(1\text{-}\varphi)$ have high costs. Physician's net utility is defined as $P - ci(q)$. The government's objective is to maximize a social welfare function W which is the social benefit of medical care minus the financial costs of delivery where welfare, W is defined as $\varphi(bqL - PL) + (1-\varphi)(bqH - PH)$ (1). The two rural service options are (qL, PL) and (qH, PH) As long as the costs of high-cost types are not too high, the optimal menu includes two periods of service, $qL > qH$, satisfying $cL'(qL) = b$ and $cH'(qH) = b - [\varphi/(1-\varphi)][cH'(qH) - cL'(qH)]$ (2) where

$PL = cL(qL) + [cH(qH) - cL(qH)]$ and $PH = cH(qH)$ (3). This model suggests that the total payment to low-cost physicians is less than that paid to high-cost physicians. The physicians with lower opportunity costs are persuaded to spend more time in rural areas, however they are paid more than their opportunity cost. Meanwhile physicians with higher opportunity costs will be inclined to work in urban areas. If the opportunity costs of high-cost physicians were significantly high, it would be optimal for the government to send only low-cost types to rural areas.

Next, Hammer (2002) considers the effects of competition on the performance of physicians, where competition serves as an incentive. First assume that the government can only pay a monthly wage and that incentives must come from the market. Often in rural areas of developing countries there are local traditional healers. This alternative option to patients (consumers) could affect the quality of service provided by the physician, though price competition. The quality of physicians' services is determined by the physician's level of training and is fixed by the government. If competition is imperfect, the physician will earn a current profit, representing a part of the overall compensation earned from serving in the developing area. Individuals have diverse tastes, some may prefer to visit a traditional healer, and others might choose to see a physician. They base their choices on quality of services, prices, and their individual tastes. This article continues to describe the interaction of the urban physician and the traditional healer in the following model of spatial competition. Individuals are uniformly distributed along [0,1], with the traditional healer at 0 and the physician at 1. An individual located at position x gains net surplus $r_0 = u_0\text{-}p_0\text{-}t_x$ by purchasing care from traditional healer, $r_1 = u_1\text{-}p_1\text{-}t(1\text{-}x)$ by purchasing care from physician. The utility of care received from provider i is u_i (dependent on quality), pi is price charged by provider i,

and t represents consumer's unit travel cost (limits the extent to which the traditional healer and the physician differ). An individual's utility from self-care is denoted as *x*. The traditional healer and the physician have no alternative opportunities in the village (thus costs of provision are zero). Travel costs are small enough for all consumers to visit either the healer or the physician. Equilibrium prices charged by the traditional healer and the physician are $p_0 = t+\Delta u/3$ *and* $p_1 = t-\Delta u/3$ where $\Delta u = u_1-u_0$ is the quality differential. The physician's equilibrium profit is $t/2 + \Delta u/3+\Delta u^2/18t$, increasing in Δu for $\Delta u>-3t$. Providing that the physician's quality is not much smaller than the quality of the local healer, an increase in local healer quality decreases the physician's profit. Although, one could also argue that higher quality traditional healers could signify less need for high quality city-trained physicians.

This paper continues by addressing the effect of traditional healer quality on training policies. Increasing the quality of the traditional healer would reduce optimal training levels of physicians, and further reduce profits that can be earned by physicians who relocate. This would imply that the healer and physicians are substitutes. As the potential earnings of physicians fall, it is necessary to employ more resources to encourage physicians to work in these rural areas. Consequently, optimal physician quality could increase if these costs are substantial enough. In this case, healer and physician quality would be complements, suggesting that regions with better local healers should also attract better-trained physicians.

Now that several theoretical points regarding varying physician opportunity costs of relocation, and the role of existing healthcare providers have been discussed, I will review some empirical findings on the effectiveness of actual incentive systems that have been implemented.

3.3 Physician Preferences

Chomitz (1998) looks at how physician choices are affected by varying incentives in Indonesia. This is a rather extensive paper of which I have summarized the more significant findings.

As mentioned earlier, most doctors in Indonesia wish to work in Java (a more urban city), primarily for the good hospital facilities and more rewarding opportunities. Prior to 1992 the government used a compulsory service system for medical school graduates to assign doctors to rural health centers of the Indonesian archipelago. Completing service in remote parts was compensated with shorter periods of service, ranging from one year at the more remote postings to five years at desirable locations in Java. Physicians were also promised positions in the civil service hierarchy upon completion of compulsory service. However in 1992 this system was altered. Physicians were hired under contract instead of as civil service employees due to a freeze in hiring new civil service workers. Compulsory service remained mandatory and physician pay was related to the remoteness of location served. Although incomes were higher for physicians serving in more remote areas than if serving in 'ordinary areas', total incomes were very similar for both areas when the amenities and opportunities for supplementary incomes from private practices in more urban parts is taken into account. The system was further modified in 1996 in order to account for this. Doctors serving in very remote regions would be granted a 90% chance of civil service appointment, those serving in remote regions would have a 50% chance, and those in ordinary areas were only given a 10% chance. Civil servants were eligible for subsidized specialist training, and specialists benefit from high prestige and income, thus this was expected to serve as a

more powerful incentive. To assess whether or not this expectation held true, stated preference analysis is used.

The sample is composed of 14 of Indonesia's 32 medical schools, a group comprising 70% of all graduates. The schools include both public and private schools, and three off-Java schools. A survey was administered to 585 students in their final year and conducted over the period May-June 1997. The survey consisted of two parts; background information questions (such as religion, gender, birthplace etc.) and 18 choice tasks between two hypothetical assignments, which were randomly generated. Assignments differed in terms of location, income, length on contract, and the probability of subsequent specialist training and civil training. The separation of specialist training and civil service is important here because it becomes possible to evaluate the impact of each benefit individually. Four models were run, for each combination of gender and birthplace (outer island or Java/Bali). The differences between the choices of assignments were independent variables. Private school was interacted with the income, civil service, and specialist training difference variables. The characteristic, "grew up in rural areas or a small town" was interacted with the difference in the very remote and remote dummies and a dummy for "ever failed a course" was interacted with probability of specialist training. Statistically insignificant interaction variables were dropped from the equations, which were then rerun.

The results showed that the coefficients are almost all plausible and statistically significant. Doctors were found to be willing to forgo a substantial amount of income in order to shorten their contacts by one year. For instance, males from Java or Bali public institutions would forgo Rp 187,000 /month for shorter contracts, and females of the

same background would forgo Rp 429,000/month[12]. An increase in the probability of civil service appointment (from 0% to 100%) is valued at Rp 2,189,000/month by male public school graduates from Java/Bali, and is valued at Rp 2,691,000/month by females of the same background. Specialist training is valued at Rp 4,247,000/month by twenty-five year old male public school graduates and at Rp by 4,974,000/month by twenty-five year old female public school graduates. In addition, individuals who are from the more remote outer islands of Indonesia appear more willing to serve their compulsory contracts. For the most part these incentives are valued equally or more by graduates of private institution as those from public institutions. Also, females seem to value these incentives somewhat more than males do. Intuitively, this makes sense since females often get married and have children at younger ages than males and thus they could be more reluctant to relocate and live where local amenities would make it less ideal to raise a family than if in an urban city.

Chomitz's study (1998) comes to four major conclusions. Firstly, there is an observable disutility of compulsory service terms leaving undesirable alternatives, such as indefinite unemployment, illegal work as a doctor, or abandonment of their training in favor of another career. Yet if public authorities were to waive the rules and allow these graduates to satisfy their compulsory service in more urban areas such as Jakarta, other graduates could perceive this as inequitable. Secondly, specialist training can be an expensive and inefficient incentive. Perhaps the types of physicians that are interested in specialist training are not well suited to work in remote areas. If they are simply filling the compulsory service to obtain special training for the prestige and income, they might not serve the remote areas adequately. Thirdly, by having to delay specialist training (by

[12] 1 Indonesian Rupiah = 0.000152991 Canadian Dollar, 2003

the term of compulsory service) physicians will be that much older when they have finished their training, reducing returns to training. Fourthly, the results that people from the outer islands would be more willing to serve in remote locations suggests that increasing the presence of outer island students in medical schools yields substantial gains. This might be accomplished through adequate scholarships and assistance in preparation for university.

Along with the insights presented here, it would be beneficial to understand the opinions of physicians who are in the middle of an incentive program, or have already participated in one. This would shed some light on the effectiveness of healthcare delivery resulting from such programs. I now turn to discussing this matter.

3.4 The Physician's Perspective

A great deal of the success of a compulsory service program is based in the performance and attitude of the physicians participating in these programs. Cavender (1998) observed such programs through the physician's point of view in Ecuador. In 1970 Ecuador passed legislation to create *medicatura rural*, which provides that all graduates of medical, dental, or nursing school must serve one year in a rural location before acquiring their license to practice. There are four levels of difficulty (related to what?) in placements with a salary range of $113(level 1) and $154(level 4).

The study is conducted with a survey administered to 127 physicians who have completed rural contracts, or were currently serving them in 1994-1995. The survey consisted of two parts: background information questions (age, gender marital status etc.) and questions about experiences during rural contract. Experience questions include

topics such as preparation, adaptation, cultural and language problems, professional and personal benefits from experience, and suggestions for improving the program

In regards to preparation and adaptation, results find that 59% of physicians did not feel prepared for their contract, 16% found orientation programs inadequate, and 35% had problems with housing, food and transportation. In terms of cultural and language differences, 38% found cultural differences to be a problem and many physicians commented on difficulties with indigenous languages. However, 94% found the experience both personally and professional rewarding. Suggestions for an improved *medicatura rural* system include a more comprehensive pre-rural program, greater involvement of health officials at the community and provincial levels, and recruiting better trained personnel.

Since the introduction of *medicatura rural* mortality rates have dropped. Of course there are other significant things required to improve the health status of the Ecuador population (along with other developing areas) such as improved water treatment systems and waste disposal systems. The overall positive note of this study suggests that the program has been a good educational tool for physicians and while the results are inconclusive may have had a positive effect on the health of the population

3.5 Discussion and Conclusion

Although there is not a great amount of literature in the area of economics of physician shortages in developing countries thus far, there are numerous significant conclusions that can be drawn from the sources presented here.

First of all, there is a need for adequate health provision in less developed countries, and incentives introduced through government intervention are critical tools to induce physicians to work in these areas. Income has shown to be a weak incentive, however there are numerous alternative incentives in practice around the world that seem to work.

Reliable global health provision could be difficult to achieve at a reasonable cost, without being able to attract the physicians with lower opportunity costs to these programs, as concluded by Hammer (2002). Not only would these physicians be more willing to stay longer for longer periods but also their payments would be lower than those of higher opportunity cost physicians.

Increasing competition, such as high quality traditional healers, could have a negative effect on the quality of physicians and reduce their profits. High quality healers would also reduce the optimal training of physicians, reducing their incomes further.

Chomitz (1998) shows that in the specific case of Indonesia, the imposed compulsory service program is generally unpopular among medical school graduates. Civil service appointments and specialist training are both strong incentives, although specialist training is roughly twice as powerful as civil service appointments to attract physicians to working in developing nations. The likelihood of higher incomes and more stature from specialist training bring in to question the types of individuals that will be induced by these incentives and thus serve the health needs of these areas. These physicians might not be most concerned with the health needs of patients, not to mention that specialist training can be expensive. Recall that there exists evidence that income is not a strong incentive unless unreasonably high, so it is very possible that prestige is the stronger incentive behind specialist training. See for example Jack (1999) and Hammer

(2002). Females also appear to be less induced by these incentives than the male graduates. This suggests that either females should not be as targeted as males (in rural areas females often reside where their husbands have jobs and not vice versa), or they require further or a different kind of inducement. Perhaps schools, daycare facilities, food, and sanitation are more significant incentives, as these females may have children or intend to have them in the near future.

The physician's point of view of these programs once they are accepted (with the help of incentives) is also important to the success of these programs, as described by Cavender (1998). Surveys conducted in Ecuador show that physicians (the participants) appreciate medical compulsory programs, once they have completed them. However, preparation for such programs was poor and the health status of the populations of these areas has not likely improved due to these programs. Low salaries for participating physicians suggest that such compulsory service programs are perhaps better suited to physicians from the country in question or a country with similar wages, as there is less of a change in lifestyle or nominal sacrifice involved. Physicians from the United States or other more developed countries could easily be discouraged by low incomes or the different cultural and living conditions (unless they are particularly keen on the experience regardless of these factors). This idea is similar to the results of physicians from the outer islands in Indonesia being more receptive to compulsory service than physicians from urban cites. The perspective of participating physicians can be vital to the boosting the motivation of future graduates and to improving the effectiveness of these programs Cavender (1998).

Researching this subject matter is complicated for much of the findings depend on various things such as country specific factors and the specific preferences of physicians.

Different countries have different levels of poverty, political climates, and local amenities, which would affect the desires of physicians to relocate to these parts.

The evaluation and optimal design of incentive systems requires comprehension of specific responsiveness of physicians to incentives. Yet little is systematically known about physician preferences.

These ideas put forth a very interesting query. Even if more physicians were induced by different incentives and worked in underdeveloped areas, would they help the health status of these parts? If not, then what is the purpose? According to Cavender (1998), upon bringing in physicians where needed, the health of the individuals in these areas might not improve. For instance, Filmer (2000) discusses the evidence of two weak links (variation in effectiveness of services and market failure effects) between government spending on health and improvements in health status. Perhaps other important elements also need consideration. In some countries, community health centers remain underutilized (Lee, 120). Adequate medication supplies, health education (many people in these areas rely on self-medication), well-trained personnel, and improved sanitation systems are also vital to the improvement of quality health delivery. Many physicians who participated in the Ecuador study support these views.

Overall, econometric work is lacking on this topic, but this is understandable given that many of the inquiries that it puts forward are difficult to quantify. For example, quantifying preferences. However, one could observe a particular rural location over some period for which there was a relatively consistent inflow of physicians and see how mortality rates progressed during this time, while also considering the quality of medical supplies, personnel, and sanitation. Other factors affecting mortality would have to be controlled for as well. Also, more individual studies (such as Chomitz (1997)) for

different countries are necessary in order to understand and identify the specific needs, effective incentives, and progression of health of a given country. For future research in this area I would wish to focus on this larger picture (in a quantitative approach), whether or not these incentive programs, by placing more health providers in less developed countries, actually lead to the improvement of people's health.

4. Impediments to access of essential drugs

Infectious diseases such as Acute Respiratory Infections including influenza and pneumonia are a serious threat to the developing world. Such diseases killed approximately nine million people in developing nations last year, meanwhile approximately three times as many people died from AIDS (World Health Organization, 2004). Due to its rapid spread and lethality, AIDS is rightly considered a deadly epidemic. HIV/AIDS afflicts approximately 42 million people worldwide and about 29.4 million in Africa alone. AIDS related diseases kill more than 3 million people every year. The failure of developing countries to cope with the AIDS and is symptomatic of fundamental inadequacies in their health care delivery systems (PhRMA, 2003). In this section of the paper I will pay particular attention to HIV/AIDS, tuberculosis, and Malaria. It has been shown that effective drug treatments (which in some cases already exist) could make significant impacts on the controlling of these diseases[13]. Craven (2003) believes that there are potentially four interventions that could significantly lessen the occurrence of certain significant diseases (specifically in Africa). Firstly, policies aimed at producing high rates of economic growth would assist in lowering the incidence

[13] See for example Garnett (2002).

of diseases associated with poverty, such as malaria and tuberculosis. However this is a more long-term strategy and a potentially difficult one to implement in a nation of high export tax, lowering terms of trade, and inefficient delivery of public service. Secondly, health education could eventually assist in alleviating the problem. Thirdly, developing nations could fund the development of an HIV vaccine. Fourthly, the adequate supply of essential drugs that have proven beneficial in treating AIDS in developed countries could be more easily accessible.

> Essential medicines are intended to be available within the context of functioning health systems at all times in adequate amounts, in the appropriate dosage forms, with assured quality and adequate information, and at a price the individual and the community can afford. (World Health Organization, 2004)

Poor access to such drugs can be attributed to high prices as well as a lack of research of effective vaccines and treatments.

Next I present and discuss numerous theoretical ideas regarding the obstacles involved in the current availability of essential drugs for various serious diseases. I will refer to specific real world cases and considerations for overcoming particular obstacles.

4.1 Pricing and the Market for Vaccines

Despite the large threat that diseases such as malaria, tuberculosis, and AIDS/HIV pose to the developing world, ongoing extensive research for treatment vaccines remains fairly minimal. This is primarily because developers fear that they would not be able to sell enough vaccine at a reasonable price to recover their expenses. This is discussed in Kremer (2000), who examines various market distortions resulting in poor utilization of vaccines in developing countries.

Kremer (2000) notes that vaccines are generally under consumed in developing countries. The external benefits to the population by helping break the transmission of the disease is rarely the primary interest to individuals. There is little incentive to take this benefit into account. Also, the main beneficiaries of vaccines are children, but even if vaccination costs are inconsequential relative to the extra future wages children will earn if they remain healthy, they cannot pay for vaccinations out of those future wages. In addition, consumers generally appear more willing to pay for preventative treatment. They may wish to see benefits first by observing what happens to others who have taken vaccines. However, the benefits of vaccines are difficult to see, since they are not evident until considerably after vaccines are taken.

Given these ideas, naturally monopoly pricing would likely worsen the situation of low consumption of vaccines. This can justify why governments often purchase vaccines and distribute them to the population for free or at highly subsidized prices. Vaccine development is expensive; however manufacturing additional doses of vaccine is usually less expensive. Thus large government bodies could potentially help producers and the general population to be better off than if there was monopoly pricing to individuals. The producer may be made better off if their sales are higher than under monopoly pricing, providing price does not decrease by a great deal. Consumers who would have paid monopoly prices are also better off providing that the taxes they would pay to finance government vaccine purchases are less than the monopoly price. The consumers who valued the vaccine at more than the production cost but less than the monopoly price can also be made better off, providing that they value the vaccine more than the increase in taxes required to finance government purchases. However, it is also possible that large government purchases make both consumers and producers worse off,

if governments force prices too low. Then they risk making vaccine developers worse off than under a private market system, while also discouraging research.

Further to market distortions, another obstacle in accessing the appropriate pharmaceuticals is time inconsistency, which I shall introduce and discuss in more detail in the next section.

4.2 Time Inconsistency

Part 1: An Introduction to Time Inconsistency

Craven (2003) considers issues and the effects of time inconsistency in the context of effectively dealing with tuberculosis in Africa[14]. He discusses the extent of the problem as well as the need to address this problem before proper pricing of drugs can be determined.

Time inconsistency occurs when policymakers are able to set a policy today with discretion, and in the future may renege upon it if it is then convenient to do so. This tends to lead to diminishing credibility on the part of policymakers. In this context, it refers to the undermining of drug patents, or the exclusive rights of drug companies to manufacture specific drugs (Craven, 2003).

The failure to manage tuberculosis in Africa demonstrates an organizational problem in creating comprehensive immunization programs and in implementing programs of treatment with antibiotics in developing countries. This failure is often

[14] In the context of this paper it is also worth nothing that people with HIV are up to 50 times more likely to develop TB in a given year than HIV-negative people. World Health Organization (2005).

attributed to a lack of funds. African states are poor - many have per capita incomes of less than US$500, while one treatment drug alone can amount to approximately US$1,400 per person per year (Craven, 2003). The delivery costs of a combination of drugs currently utilized in the West are approximately ten times this amount. Thus there are clear benefits to be gained from the development of a more effective vaccine for tuberculosis that can be administered to large numbers of people within the poor medical infrastructure in most African countries. The same applies to other prevalent diseases such as malaria.

In 2001 The Commission on Macroeconomics and Health proposed a policy of differential pricing to supply a parallel pharmaceutical market in poor countries at a much lower price. Problems with such a proposal include the difficulty in deciding where such a discriminatory line is to be drawn and the strong incentive for an illegal but profitable re-export trade to the rich countries. A South African government wishing to pass legislation undermining the principle of patents refused pharmaceutical industry donations of AIDS and HIV drugs to the government.

If governments go against an international patent law, there could be a significant change in the behaviour of drug companies. If governments disobey patent law then the issue of time inconsistency arises. That is, drug companies are alerted to the fact that policies may not be credible. Before making a decision the reaction of other agents would have to be considered. Craven (2003) believes that the best outcome for companies would be to innovate because international patent law protects monopoly profits. However corruption among the government bodies of developing nations would also be a tempting alternative. Consequently, if companies decided not to innovate, companies and governments would be worse off. Thus, companies in Western countries are better off to

innovate to some degree for it is likely to be accommodated by some corporate sector or governmental response.

Thus, Craven (2003) generally argues that the problem of time inconsistency must be considered and addressed before further research on vaccines and drugs is conducted. For developing countries this is especially noteworthy as they often ignore international patent laws.

Time inconsistency relates to other important issues as well, including the research and pricing of drugs and medical treatments, which I will now review.

Part 2: Time Inconsistency, Research and Pricing

Now I return to Kremer (2000), which continues to discuss time consistency and how it affects research and pricing of pharmaceuticals. Although vaccine research is generally very expensive, once vaccines are invented, they can often be manufactured at low cost. Governments are in a strong bargaining position because they are major vaccine purchasers; they regulate vaccines, and hold authority over intellectual property rights. Thus governments and international organizations may bargain for very low prices. While in theory government purchases of vaccines can make both vaccine producers and consumers better off, in practice they are habitually used as a means to transfer wealth from vaccine producers to consumers. Potential researchers anticipate this redistribution, so they invest less in research than they would otherwise.

Time consistency (as discussed earlier) enables governments to pay low prices for vaccines, which is aggravated by political problems in many developing countries. Vaccines become a low political priority, as they deliver a more widely distributed

benefit. They are inclined to receive less political support than expenditures that benefit more concentrated politically organized groups, for instance health worker salaries. In addition, each country has an incentive to free ride off research financed by other countries or induced by their intellectual property rights protection. "Small countries, such as Uganda, can assume that individually their actions will have little effect on total research incentives. However, if all African countries act this way, there will be little incentive for development of a malaria vaccine" (Kremer, 2000, page 17). This free-riding problem exists more for countries that are only a minute fraction of the world market and hence they reap only a small fraction of the worldwide benefits of research.

In the past, developing countries did not present much protection in terms of intellectual property rights for pharmaceuticals. Many developing countries did not grant patent protection (to keep prices low) for pharmaceuticals until recently. India and Brazil are examples of nations that have recently agreed to improve intellectual property rights for pharmaceuticals, under great trade pressure from the United States. Many pharmaceutical firms are skeptical on whether or not these rights will be well enforced. The South African government recently announced that it might attempt to force patent holders on AIDS drugs to license their patents to generic manufacturers. Given the huge importance of an HIV or malaria vaccine to many developing countries, it is far from clear that the U.S. could induce developing countries to establish strong intellectual property rights for such vaccines, with some degree of compensation for the additional costs this would impose on the countries.

Kremer (2000) continues on to note that demand in developed countries has lead to vaccine research in both developed and developing countries. However in developing nations limited intellectual property rights deter research on vaccines against diseases

such as malaria, which have less market in developed countries. If intellectual property rights were enforced globally, national vaccine purchases being more efficient than individual purchases also suggest that international purchases are probably more efficient than national purchases. If producers charge a single monopoly price to governments, certain countries will not be able to afford to purchase the vaccine. All countries could potentially be made better off, if rich countries paid no more than the monopoly price, and the poor countries pay less than the amount at which they value the vaccine, but more than the actual production cost. Kremer (2000) notes that even if poor countries could somehow be induced to establish strong intellectual property rights for vaccine developers, they would still have market power as purchasers, and hence would still likely be able to negotiate a price below the full social value of vaccines. Research and development incentives would thus still be limited. The market could reach efficient size if vaccine developers charged each nation a separate price based on what they were willing to pay, through a system of tiered pricing. In fact, pharmaceutical firms do charge different prices to different countries. However, opportunities for such types of tiered pricing are limited, partly by the possibility of resale, but more so by a fear of political reaction in rich countries. Politically, it is difficult for pharmaceutical firms to justify charging much higher prices in one country than in another. After a Congressional hearing where a major vaccine manufacturer was asked how it could justify charging almost three times as much to the United States government for vaccines as to foreign countries, U.S. manufacturers stopped submitting bids to UNICEF to supply vaccines. Similar objectives as tiered pricing could be achieved by purchasing vaccines internationally for a range of poor countries at one price and then collecting co-payments from these countries that would vary with their incomes. This approach would increase

access to vaccines and ensure those who were more willing to pay for vaccines contributed more towards covering the costs of vaccine research and development. However this approach would require outside funding making up the difference between the price at which vaccines are purchased from manufacturers and the co-payments received from the poorest countries.

4.3 Conclusion

There are several impediments to the development and availability of drugs in the developing world. Market distortions, time inconsistency, pricing, and lack of funding are some of these impediments. Market distortions refer to the terms of consumption, whereby consumers do not respond to all the potential benefits provided by vaccinations. Governments are in a good position to purchase drugs and treatments in order to transfer the "wealth" of these goods from producers to consumers. Time inconsistency is another impediment, referring to government bodies changing policies or going back on them when convenient to do so. The result is a lack of credibility of policies, as perceived by the public (both producers and consumers). Time inconsistency affects both pricing and research also. Research is often limited due to tight funding as well.

5. Discussion

To conclude, there are two significant health issues facing the developing world- a shortage of physicians, and access to essential medicines, required to treat severe diseases.

In economic terms, both problems are worth managing as poor health has damaging implications for income, as well as other economic factors. Effective physicians play an important role in effective healthcare delivery. Severe diseases such as AIDS/HIV have potentially serious long-term effects on GDP and economic growth.

There are incentives to motivate physicians to serve in developing areas, however income has not generally proved to be on such incentive. Other possibilities include promise of further professional development or training.

There are numerous problems affecting accessibility of drugs for the developing world, which must be addressed in order to improve on accessibility. Such issues include time inconsistency, pricing, and a lack of research and funding.

Naturally there are other sources of possible obstacles in the path of improved health in the developing world including underutilized community health centers, poor health education, a lack of trained personnel, and inadequate sanitation systems. Government spending on healthcare and international debt relief programs to allow increased spending capacities are also vital to the improvement of quality health delivery for these areas of the world[15]. Dealing with these two major issues of physician shortages and poor drug access are steps towards managing a problem of a macroeconomic scale. Not only must

[15] See for example Collier (1999) or PhRMA: Health Care in the Developing World (2003).

the methods used be effective to improvement of healthcare systems, but also there should be an observable positive affect on health in the long-run.

Appendix 1

Health, Nutrition and Population Statistics : Low Income Nations
The World Bank Group (2005)

	Most Recent Year	Data
Total population (000s)	2003	2,310,259
Total fertility rate (births per woman)	2002	3.7
Adolescent fertility rate (births per 1,000 women ages 15-19)	2002	103
Life expectancy at birth (years)	2002	58
Infant mortality rate (per 1,000 live births)	2002	82
Under-5 mortality rate (per 1,000)	2002	126
Maternal mortality ratio (per 100,000 live births)	2000	657
Prevalence of child malnutrition--underweight	1999	44
Physicians (per 1,000 people)	1993	0.4
Prevalence of HIV, total (% of population ages 15-49)	2001	2.30

Appendix 2

Table 2: Key payment mechanisms- Bennet (1997)

Payment mechanism	Key incentives for providers
Fee-for-service	Increase number of cases seen and service intensity. Provide more expensive services.
Case payment	Increase number of cases seen, decrease service intensity. Provide less expensive services.
Daily charge	Increase number of bed-days (through longer stays or more cases)
Flat rate (bonus payment)	Provide specific bonus service (neglect other services)
Capitation	Attract more patients to register while minimizing the number of contacts with each and service intensity.
Salary	Reduce number of patients and number of services provided.
Global budget	Reduce number of patients and number of services provided.

REFERENCES

Arndt, C. and Lewis, J. "The Macro Implications of HIV/AIDS in South Africa: A Preliminary Assessment", South African Journal of Economics, 68 (2000): 856-87

Barro, R. Health and economic growth. 1996.

Bell, Clive, Shantayanan Devarajan, and Hans Gersbach. "The Long-Run Economic Costs of AIDS: Theory and an Application to South Africa." World Bank Policy Research Working Paper No. 3152 (2003).

Bonnel, R. "HIV/AIDS: Does it Increase or Decrease Growth in Africa?". ACT, Africa Department, World Bank. (2000).

Case, Anne. "Does Money Protect Health Status? Evidence from South African Pensions". National Bureau of Economic Research Working Paper No. 8495. (2001).

Cavender, Anthony and Manuel Alban. "Compulsory Medical Service in Ecuador: The Physician's Perspective." Social Sciences and Medicine 47 (1998): 1937-1946.

Chaudhury, Nazmul and Jeffrey S. Hammer. "Ghost Doctors: Absenteeism in Bangladeshi Health Facilities." World Bank Policy Research Working Paper No. 3065 (2003).

Chomitz, Kenneth, Gunawan Setiadi, Azrul Azwar, Nusye Isinail, and Widiyarti. "What Do Doctors Want? Developing Incentives for Doctors to Serve in Indonesia's Rural and Remote Areas." World Bank Policy Research Working Paper No. WPS 1888 (1998).

Collier, Paul and Jan Willem Gunning. "Explaining African Eocnomic Performance. Journal of Economic Literature. 37(1999): 64-111

Craven, B M, et al. "Time Consistency and the Development of Vaccines to Treat HIV/AIDS in Africa." Economic Issues. 8 (2003)15-31.

Ettner, Susan. "New evidence on the relationship between income and health". Journal of Health Economics. 15 (1996) 67-85.

Filmer, Deon, Jeffrey Hammer, and Lant Pritchett. "Health Policy in Poor Countries: Weak Links in the Chain." World Bank Research Observer No. WPS 1874 (2000).

Fogel, R. W. "Economic growth, population theory, and philosophy: The bearing of long-term processes on the making of economic policy". American Economic Review. 1994 (84): 369–395.

Fuchs, Victor. "Reflections on the socio-economic correlates of health". Journal of Health Economics. 23 (2004) 653-661

Garnett, Geoff, John Stover, Steve Seitz, and Steven Forsythe. "The Epidemiological Impact of an HIV/AIDS Vaccine in Developing Countries". World Bank Policy Research Working Paper No. 2811 (2002).

Gauri, Varun. "Are Incentives Everything? Payment Mechanisms for Health Care Providers in Developing Countries." World Bank Policy Research Working Paper No. 2624 (2001).

Hammer, Jeffrey and William Jack. "Designing Incentives for rural health care providers in developing countries." Journal of Development Economics 69 (2002): 297-303.

Jack, William. Principals of Health Economics for Developing Countries. Washington: The World Bank, 1999.

Konac, Enver Hakan. "Health and Sanitary Issues in the OIC Member Countries: Income-Health Linkages". Journal of Economic Cooperation Among Islamic Countries. Vol. 24 (2003): 119-50 2003.

Kremer, Michael. "Creating Markets for New Vaccines- Part 1: Rationale". Innovation Policy and the Economy. 1(2001):1-51

Kremer, Michael. "Pharmaceuticals and the Developing World". Journal of Economic Perspectives. 16(2002):67-90

Lee, Kenneth and Anne Mills. The Economics of Health in Developing Countries. London: Oxford University Press, 1983.

Maureen L. Cropper. Poulos, Christine, Dale Whittington, Julian A. Lampietti, Mitiku Haile, and "The Value of Preventing Malaria in Tembien, Ethiopia." World Bank Policy Research Working Paper No. 2273 (2001).

Mayer, D. "Health in the economic and demographic transition of Brazil". Research in Public Health Technical Papers 18 (2000).

PhRMA: Health Care in the Developing World. 2003. 10 May 2004. <http://world.phrma.org/healthcare.devel.world.html>

Smith, James P. "Healthy Bodies and Thick Wallets: The Dual Relation between Health and Economic Status." The Journal of Economic Perspectives. 13(1999): 145-166.

Strauss, John and Duncan Thomas. "Health, Nutrition, and Economic Development." Journal of Economic Literature, 36(1998): 766-817.

The World Bank Group. 2002. Health, Nutrition, and Population. 3 Mar. 2004 < http://devdata.worldbank.org/hnpstats/>.

Ware, John Allyson Davies-Avery, and Cathy Donald. "General Health Perceptions" R-1987/5 HEW RAND (1978).

Wallack, Stanley and Sandra Kretz. Rural Medicine. Toronto: D.C. Health and Company, 1981.

World Health Organization. 2004. Essential Medicines. 25 May, 2004. <http://www.who.int/topics/essential_medicines/en/>