Chapter 13

The Impact of HIV/AIDS on the Health System and Child Health*

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Summary: This chapter reviews the impact of HIV/AIDS on the health sector and on the health status of children in 40 developing countries with medium-high HIV prevalence rates. The study finds that HIV/AIDS has (i) generated a substantial increase in the overall burden of disease, (ii) crowded out the health resources assigned to the care of traditional sicknesses, (iii) directed most of the additional demand for care at the secondary and tertiary levels thus causing a congestion at these levels while weakening primary health care, including the programs targeted at children and mothers, (iv) caused a substantial increase in health expenditure that was financed by the households in poor countries and by the public sector in the middle income ones and (v) eroded the delivery capacity of the whole health sector due to mounting infection rates among the staff and falling expenditure on fixed investment and maintenance. As for the impact on U5MR, the evidence shows that countries with high HIV prevalence rates, a high coverage of child health services and low U5MR in the pre-AIDS era, there was a marked reversal of the declining trend in child mortality. In contrast, in countries with low-medium HIV prevalence, low pre AIDS coverage of health services for children and high pre-AIDS U5MR, the surge in AIDS-related child mortality was more than offset by a decline in child mortality due to an expanded coverage of basic child health interventions. Finally, the chapter illustrates the merits and limitations of the policy and programme responses introduced so far to fight the new pandemics. It concludes that the current efforts on prevention ought to be intensified and the severe problems encountered in this area rectified. At the same time, the future of child mortality will depend also on: a renewed strengthening of PHC as the main vehicle for the treatment of all child diseases, both AIDS and non-AIDS related; a rapid expansion of PMTCT programs; and a gradual expansion of the treatment of mothers and other adults with generic antiretroviral drugs according to simplified protocols. The chapter also provides, on the basis of a simple mathematical model, a few suggestions on the choice of the optimal mix between prevention and treatment policies under different assumptions concerning their relative costs and efficiency.

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This study presents the views of its authors and not the official UNICEF position in this field.

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AIDS, PUBLIC POLICY AND CHILD WELL-BEING *

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1. Introduction

This chapter focuses on the way AIDS has impacted the health sector and the health status of children in 40 countries with medium to high HIV prevalence. With the rise in prevalence rates at antenatal clinic reaching in some cases 50 percent (as in some areas of Botswana) and with adult prevalence rates of over 20% in several parts of Africa, the health sector has been particularly hard-hit. It now suffers from attrition of personnel, while at the same time it is required to perform at well above its pre-epidemic levels of activity to control the spreading contagion and to care for the affected persons. In countries currently experiencing adequate economic growth and low infection rates, increases in health budgets will often be sufficient to cope with the crisis. But several highly indebted poor countries have high infection rates and have also been experiencing a weakening of the health sector since the 1980s, especially since their adoption of structural adjustment programmes (Simms et al 2000). In most of these countries, AIDS has also caused a rapid increase in the demand for hospital-based treatment that resulted in a weakening of primary health care. How to control the negative effect of HIV/AIDS without weakening other essential interventions is the main health sector challenge faced by the policy makers of many developing countries.

The health sector response to the HIV/AIDS pandemic has initially focused on the prevention of the contagion and the treatment of opportunistic infections. In some middle income countries, the response has gradually included also the treatment of AIDS-affected newborns, mothers and - in some case – adult males. In contrast, in all countries, the public policy response to the mitigation of the health impact of HIV/AIDS on children and families has been limited, and families and communities have thus been obliged to bear the devastating effect of AIDS in terms of poor health, impoverishment and social marginalisation. Thus, the optimal mix of health policy in AIDS affected countries is still the subject of an evolving debate.

To try to answer these questions, section 2 of this chapter assesses the impact of the AIDS pandemic on the functioning of the health sector. The main aim here is to understand the changes in actual demand for and supply of public and private health services for AIDS and non-AIDS ailments. Section 3 reviews in turn the impact of AIDS on the availability of health services for children and child mortality. Contrary to the case of the educational sector, where AIDS appears to have had so far a limited impact on enrolments (see chapter 12), there is evidence that AIDS has had a devastating impact on child mortality in many countries. Section 4 discusses the health policies and programs introduced so far to respond to the new pandemics. It discusses also the comparatively neglected issue of the treatment of HIV positive people with antiretroviral drugs. This focus is justified by the numerous direct and indirect benefits for children that would be generated by the introduction of an affordable and innovative approach to the treatment of AIDS. Finally, section 5 discusses the best-practice measures that have been or could

realistically be introduced to sustain health care provision for children and mothers in AIDS affected countries.

2. Framework of analysis

2.1 Short term impact of HIV/AIDS: the demand for and the utilisation of health services

The spread of HIV/AIDS has massively increased the 'burden of disease', as the weakening of the immune system of the people affected has raised the susceptibility to a host of other diseases and increased the incidence of opportunistic infections such as TB and meningitis. TB is the most common of such opportunistic infections and in sub-Saharan Africa, up to 50 percent of people with HIV develops TB. Meanwhile, in countries with a high prevalence of HIV, a large proportion of TB cases are attributable to HIV co-infection. In south Africa, such proportion reaches, for instance, 44 percent.

Whether the surge in latent demand for health care deriving from this surge in the burden of diseases induced by AIDS is being transformed into an increase in effective demand for health care depends on a number of factors. To start with, it depends on 'prices', including the price of health care for HIV/AIDS, the price of health care for the old diseases and the price of other essential items such as food and funeral services. The second main factor is the change in the household income of the people affected by HIV and a third is social stigma. Household income has a positive effect on the demand for health care, but it is likely that the increase in demand is greater in the case of AIDS than that of other diseases because of its perceived greater lethality (see Nandakumar 2001 on Rwanda). Meanwhile, social stigma about AIDS has the opposite effect on the demand for the care of HIV/AIDS (see Muyinda et al 1997 on Uganda). In an asymmetric information context (i.e. when the patient is unaware of her condition), the demand for health care depends also on the behaviour of physicians who deliberately aim at influencing their preferences. Gibney et al (1999) show, for instance, that physicians in Zimbabwe frequently choose not to test patients for HIV, in spite of their request, out of fear that they would be traumatised, and, in particular, that they would commit suicide.

The spread of HIV/AIDS may give rise to a substitution effect (or 'crowding out' effect) by which the demand for health care for non-AIDS diseases declines due – for instance – to the increase in the burden of disease, the high cost of HIV/AIDS treatment or an increase in user fees in the health sector owing to budgetary stringency. The spread of HIV/AIDS may also give rise to a complementary effect ('crowding in') that may occur because of a reduction of the cost of care of non-AIDS diseases due, for example, to lower transport costs or smaller marginal forgone incomes in case of visits to health care facilities motivated by AIDS. These effects could be described by the following hypothetical statement of a HIV patient aware of it condition: "Since I can afford only the care of the (more lethal) AIDS disease, I will forego treatment of other diseases" (crowding out). Or, "Since I have to attend health facilities to be treated for HIV/AIDS, I will size this opportunity to follow a treatment also for some other disease" (crowding

in). Whether the first or the second effect prevails, is a matter for factual investigation though the evidence reviewed below suggests that in high prevalence and low income countries the first effect dominates. The most relevant changes that have taken place in this area over the last decade can be summarised as follows:

(i) the overall demand for health care has increased sharply due to a surge in the burden of disease due to HIV/AIDS. In particular, mortality by HIV/AIDS-related conditions has increased in importance, though at a different pace in different parts of the world. Worldwide, HIV/AIDS is now the fourth most important cause of death, ahead of tuberculosis, malaria and diarrhoeal diseases. As noted, the spread of HIV/AIDS has also been often accompanied by rising prevalence in other infectious diseases.

Table 1. Rank and percentage burden of disease for the main causes of death – world (2000)

RANK	DISEASE	PERCENTAGE OF DEATHS
1	Ischaemic heart disease	12.7
2	Cerebrovascular disease	9.9
3	Acute lower respiratory infections	7.1
4	HIV/AIDS	4.8
5	Chronic obstr. Pulmonary disease	4.8
6	Perinatal conditions	4.2
7	Diarrhoeal diseases	4.0
8	Tubercolosis	3.0
11	Malaria	1.9

Source: elaboration of data from WHO (2000)

In the 'high prevalence countries'[1] of sub-Saharan Africa, in 1999-2000 HIV/AIDS was by far the first cause of death (Table 2) despite a possible under-reporting and under-estimation of its prevalence due to classifications problems. For instance, in Zambia, about 70 percent of 40,000 recorded TB cases – and a similarly high share of total deaths - in each year are related to AIDS (Silungwe, 2000). Yet, HIV/AIDS is not the main cause of death in all African countries. In Ghana (prevalence rate 3.6 percent), for instance, in 2000, malaria accounts for 40 percent of all outpatient visits, while the TB, HIV/AIDS, measles and leprosy cases combined accounted for only one fifth of the malaria cases (Senaya, 2001).

[1] The distribution of the prevalence rate among people of 15-49 years of age estimated by UNAIDS is as follows:

Prevalence Rate	0.5-1	1-5	5-10	>10	Total
SSA	2	14	8	16	40
S/SEA	1	--	--	--	1
EE	--	1	--	--	1
LAC	6	10	1	--	17
OECD	3	--	--	--	3
Total	12	25	9	16	62

Table 2. Rank and percentage burden of disease for the first 10 causes of death in Sub-Saharan Africa (2000)

RANK	DISEASE	PERCENTAGE OF DEATHS
1	HIV/AIDS	20.6
2	Acute lower respiratory infections	10.3
3	Malaria	9.1
4	Diarrhoeal diseases	7.3
5	Perinatal conditions	5.9
6	Measles	4.9
7	Tuberculosis	3.4
8	Cerebrovascular disease	3.2
9	Ischaemic heart disease	3.0
10	Maternal conditions	2.4

Source: elaboration of data from WHO (2000)

The distribution of the burden of disease among children tends to be different, especially in low prevalence countries. In this age group, HIV/AIDS is generally contracted only at birth from the mother, while other types of ailments (measles, diarrhoea and malaria) affect a greater number of children and still account for most of child deaths in these countries. For instance, in Ghana, malaria is still the main cause of death and accounts for 25 percent of all deaths among children under 5 years of age (Senaya, 2001). Yet, in countries with a comparatively low initial level of U5MR, and a large increase in prevalence rates over the last 10-15 years, HIV/AIDS represents now the most important cause of death also among children.

Even in medium-prevalence countries – such as Thailand (1999 prevalence rate of 2.15 percent) - the relative importance of AIDS remains high. Tangcharoensathien et al. (2001) show, for instance, that over 1993-97 AIDS was the sixth cause of death despite the under-reporting of AIDS deaths outside hospitals. In many cases, AIDS deaths are attributed to diseases such as malaria, TB, respiratory afflictions and fever. If account is taken of such classification bias, also in Thailand AIDS becomes one of the top three causes of death.

The situation is obviously less worrying in low-prevalence countries though – even in this case – HIV/AIDS still remains a serious public health problem for certain population subgroups. For instance, Saavedra (2000) shows that in Mexico (1999 prevalence rate of 0.3%) AIDS represented in 1997 only the 15th cause of death among the general population but the 9th among the population of working age. In specific sub-populations, the problem is more acute. Avila-Figueroa, (1999) suggests that AIDS is the first cause of death in men between 25 and 44 years old in Brazil, Mexico and Venezuela.

(ii) a second way of assessing the importance of AIDS consists in looking at service utilisation data. Indeed, the demand for HIV/AIDS-related health care services (measured ex-post, i.e. after the service has taken place) increased in relative terms as a share of the total demand for health care in practically all countries with prevalence rates of HIV/AIDS greater than 2 percent.

- *Hospital bed utilization.* A constraint on the supply of non-AIDS focused health services is the increasing bed occupancy rates by HIV/AIDS patients that has – ceteris

paribus - crowded out the non-AIDS patients. Information on bed usage by AIDS patients is available from major hospitals in a number of countries (WHO 2001a). For several hard-hit countries, loss of hospital capacity could be of the order of 50 percent as indicated by the data in Table 3 and the literature surveyed below.

Table 3. Percentage of hospital beds occupied by HIV positive patients in selected developing countries with medium to high prevalence rates (circa 1995)

City	Hospital	% beds occupied by HIV-positive patients
Chiang Mai, Thailand	Provincial	50%
Kinshasa, D.R. Congo	Mana Yemo	50%
Kigali, Rwanda	Central	60%
Bujumbura, Burundi	Prince Regent	70%
Nairobi, Kenya	Kenyatta National	39%
Kampala, Uganda	Mulago	56%

Source: World Bank (1999)

Already in 1988-93, the share of bed occupancy by HIV positive and AIDS patients in selected urban hospitals in Kinshasa, Abidjan, Kampala, Kigali, Lusaka and two Zambian hospitals was close to 60-70 percent (Buvé 1997). In Zimbabwe, bed occupancy for AIDS rose from $1/16^{th}$ of the total in 1990 to $10/16^{th}$ in 2000. In Zambia, hospital bed occupancy by AIDS is expected to swell from about 6 to 43 percent between 1990 and 2005 (Mpundu, 2000). In Botswana, at least 60 percent of hospital bed occupancy is now by patients with HIV/AIDS-related disorders (Mahkema, 2000). Similar results are reported by Colvin et al. (2001) for South Africa and Tembo et al (1994) for Uganda. Thus, in high-prevalence countries, HIV/AIDS clearly has a major effect on the supply of non AIDS related health services.

- *Outpatient consultations*. In high prevalence countries, data on consultations confirm a picture of a health sector crowded out by HIV/AIDS. In Rwanda (prevalence rate of 11.2 percent in 1999), a study of some 350 HIV positive person shows that their per capita annual outpatient visits was 10.9 as opposed to a meagre 0.3 for the general population (Nandakumar et al 2000). The study reveals also that the increased demand for outpatient services is characterized by a considerable inequity – reflecting differential access to services and command over income. To start with, patients in urban areas utilized services 10 times more than those in rural areas (due to easier access to services and higher incomes), those in the top quintile twice as much as those in the bottom quintile, and the married ones 40 percent more than the single or widowed. The study indicates also that only 30 percent of the sample patients were able to fully pay for the cost of the visits by themselves and that the majority had to seek assistance, borrow money from bank or relatives or sell assets.

Even in low-medium prevalence countries, there is local evidence of such crowding out effect. In the Maechan hospital in Thailand, for instance, the share of the total budget spent on AIDS rose from 20 to 40 percent over 1995 and 1997, while that of cases treated for HIV/AIDS rose from 3.7 to 7.1 percent (Tangcharoensathien et al. 2001).

- *Budgetary allocations*. There is evidence that in several countries the demand for and effective treatment of AIDS-related diseases has crowded out that for non-AIDS diseases

in absolute terms. The Thai study just mentioned points to an actual compression of the non-AIDS health budget. A study on Zambia (Mpundu, 2000) describes a similar trend – a trend which entailed also a greater concentration of health resources on the tertiary care and the slashing of precious resources formerly assigned to district health centres. In some districts in Kenya the high hospital bed occupancy by HIV/AIDS patients prevents access to care by people with other conditions who suffer in this way as suggested from higher mortality due to non–AIDS diseases (Rachier, 1999). One of the reason for the higher allocation to AIDS is that it is far more expensive to treat. A study on Zimbabwe (Hansen et al 2000) shows for instance that hospital care for HIV/AIDS patients was twice as expensive than for non-HIV/AIDS patients due to longer average length of stay in hospital and higher direct costs per in-patient day (medication, laboratory tests and X-rays).

2.2 Short term impact of HIV/AIDS: the supply of health services

In many low- and middle-income developing countries, the supply of health services is highly segmented, and it is likely that HIV/AIDS affected these various segments of health care system to different extents. On the one side, the National Health Care system provides services (often for a fee to supplement scarce public funds and external donations) through a three-tier system. In Rwanda, for instance, the public sector is composed of 3 central referral hospitals, 28 district hospitals and 330 health centers, 138 of which are church run (Schneider 2001). In addition, the private sector caters to a minority of high income people while traditional healers respond to local requests in the countryside. The structure of the health care sector is generally as follows:

- The village-based Public Health Centres staffed by one or two low paid Public Health Workers who receive limited training on the screening and treatment of the most common ailments, the referral to higher levels of care of cases they are unable to treat and support to the implementation of public health campaigns;

- The city-based Health Centres/District Hospital staffed by trained nurses and, in some cases, general practitioners. While they provide mainly out-patient care, they often can provide also in-patient care in small wards. Their services are generally paying – though the preventative component of the services provided by these units ought to be free. Fees for services tend to be higher in these institutions than in the PHP. Evidence shows that PHP are under-utilised in relation to the local or central hospital infrastructure.

- General and specialised hospitals located in the provincial and national capitals. They are staffed by nurses, general practitioners and specialists. They provide a range of curative mostly in-patient care services and can count on specialised wards (e.g. for infectious diseases) though they also provide out-patient care. Except for public employees covered by health insurance, hospital-based care is paid for by the patients. User fees are designed to discourage people to seek care for simple diseases in such hospitals.

- The private health care sector. This is generally staffed by doctors who often hold dual employment, in the public sector and in their private cabinets (Chawla 1997). This includes both traditional healers as well as modern units that provide good but expensive care to high income people. In middle income countries, the private sector caters to patients with health insurance and the staff of large enterprises (Kikumbih et al 1997).

In low income countries, the public sector dominates in term of patients treated (over 90 percent of the total) as well as of funds expended. In Rwanda, for instance, 68 percent of the total health expenditure is allocated to the public, 9 percent to the NGO and the rest to private sector (Schneider, 2001). In Thailand, of the total health expenditure in 1994, 36 percent was spent on purchasing care from public providers, 32 percent from private providers, 6 percent on administration, and 9 percent on all other public health programs. Roughly half of the total financing originated from the public budget and the rest from private sources.

The likely effects of HIV/AIDS on the overall health care system described above have been:

(i) a decline/stagnation in the capacity to supply public health services. Four types of constraints on the ability of the health sector to supply services will be considered: a reduction or slower growth in the supply of labour due to greater mortality-morbidity among health care providers, their declining morale-efficiency, the lower utilization of infrastructure, and constraints on recurrent budgets.

- *A stagnant-falling number of health workers ?* A first source of decline in the supply of health services is the high HIV prevalence among health workers. Epidemiological surveys from sub-Saharan Africa have shown that HIV/AIDS incidence has been disproportionately high among people with high human capital such as teachers and school administrators but also among doctors, nurses and hospital administrators. Indeed, nurses and doctors are part of the 'mobile population' posted away from their families that are exposed to a high risk of contagion. In Kenya, the seroprevalence among academics was 14 percent (Shaeffer 1993, quoted in Decosas and Whiteside 1996). In Zambia, mortality among nurses rose from 2/1000 in 1980-5 to 26.7/1000 in 1989-91 while absenteeism reached 16 percent (Buvé et al 1994). Overall, the World Bank (1999) estimated that a country with a stable 5 percent prevalence rate can expect that each year between 0.5 and 1 percent of its health care providers will die from AIDS. In contrast, a country with a 30 percent prevalence would lose 3-7 percent of its health workers to the epidemic each year (ibid) .

The 60 countries most affected by the epidemic employ about 2.5 million physicians, 2.2 million nurses and 100,000 midwives, the latter mostly in sub-Saharan Africa (WHO 2001b). A number of these staff are infected or dying from HIV/AIDS. Yet, it should be remembered that the impact on the functioning of the health sector is more dependent on numbers of AIDS cases and actual deaths than on that of HIV infections. As infections remain latent for some years, mortality is much lower than prevalence, normally about 10 percent of the latter. Mortality amongst the approximately 5 million staff employed in

the health sector in these countries would then total about 5,000. These are large numbers, but low proportions. But these global figures conceal wide national variations. In sub-Saharan Africa overall, about 8 percent of the staff are infected and mortality could be of the order of 1 percent. In countries such as Botswana, Lesotho, Namibia, South Africa, Zambia and Zimbabwe, the adult prevalence rate is between 20-30 percent. In these countries, one-quarter of the health staff may be infected and 3 percent already dead.

In the short term, a loss of 3 percent of labour time in the health sector is not a binding constraint to sector operations. The medium term implications are however more serious. A shortage of nurses in the Kenyan public health care started to emerge over the last few years (chapter 3). A national infection rate of around 30 percent carries an implication that up to one third of health sector staff may need to be replaced over the next 6-7 years in addition to normal attrition. For this to occur, intake of medical and nursing schools should approximately double in the near future. This has been the case in Uganda where the number of nurses and doctors rose respectively from about 2200 and 1200 in 1990 to 6700 and 4500 in 2000 (see chapter 2). However, increases in the number of health staff of such magnitude is not taking place in other countries and a staff deficit of up to one third of current levels may emerge in some of them in the years ahead.

- *Occupational exposure*. A second possible cause of decline in the supply of health services may be HIV contagion due to occupational exposure among care providers. A study on Zambia (Foster, 1993) finds (on a very small sample) an increase in the mortality of nurses between 1986-8 and 1989-91 and attributes this to HIV/AIDS resulting from occupational exposure. Another study from South Africa (Gounden and Moodley, 2000) evaluated occupational exposure to HIV/AIDS and found that 13 percent of the staff reported injuries with HIV positive patients. Occupational exposure take also the form of 'occupational burnout' due to the stress caused by the epidemic on the health personnel. A four years longitudinal study (Brown et al. 2000) among the doctors, nurses and mental health workers of the Hemophilia Treatment Centres found growing depression and anxiety among the staff treating AIDS patients. At baseline, 25 percent of the providers were emotionally exhausted, 7.4 percent were burned out, and 46 percent reported they would have left the field in a few years. After 4 years, 35 percent of them had left, with enormous implications for the care of patients.

- *Absenteeism and low morale*. The quantity/quality of health services may have also eroded due to greater staff absenteeism, low morale and refusal of staff of being transferred to high-prevalence regions. As a result, rising morbidity/absenteeism among nurses and doctors had serious implications for manpower planning and the ability of the health system to cope. In countries with high prevalence, for many years, there has been a shortage of nurses and even more so of doctors – which is particularly pronounced in remote and rural areas. The decline in salaries and the perceived greater risk of dealing with HIV positive patients has led to demands for 'special AIDS allowances' which – where these have not been met – have led to an exodus to the private sector or to countries with higher salaries (e.g. South Africa and the UK).

(ii) 'differential congestion' due to structural shift in the demand for health services? The demand for HIV/AIDS-related services has been directed mainly to the intermediate and high level of service and not at the primary level. While HIV prevention and treatment need to be carried out at all levels of service, so far HIV testing-counselling, palliative care for TB and other opportunistic infections associated to HIV and treatment with antiretrovirals was carried out at higher levels of care despite the fact that their unit costs are higher than at lower levels of care. For the unsatisfied demand the burden fell on the communities which – while unable to provide adequate medical therapy – provide material assistance and emotional support to poor AIDS infected people (see Nandakumar et al 2000 on Rwanda).

While the primary and secondary levels of health care provision may have been less affected by the new demand for AIDS care, they may have suffered because of the drainage of resources towards higher levels of care engendered by the AIDS scourge. With broadly constant health budgets, the share of the total absorbed by the care of HIV/AIDS patients at hospital facilities may have reached 50 percent of the total and caused a drop in the resources assigned to the primary and secondary levels of care. In Thailand, during the recent economic downturn and budgetary stringency, district hospitals in the northern provinces had to cap drug expenditure on opportunistic infections. Moreover, district hospitals referred to upper levels of care (Pothisiri et al, 1998). The hypothesis of 'differential congestion' needs, however, a stronger empirical validation than feasible at present on the basis of existing data.

2.3. AIDS-induced changes in public and private recurrent expenditure on health

Total health expenditure as percentage of GDP in developing countries is not fundamentally different from that of some advanced countries (Table 4). In 1998, with a share of 4 to 6 percent of GDP allocated to public and private health expenditure, Rwanda, Ghana and Zimbabwe were in a situation not too different from that of the 'low-health expenditure OECD countries' like the UK (UNAIDS 2000). Likewise, health expenditure in Latin America ranges between 3.5 and 6.5 percent of GDP, with more developed countries such as Argentina, Costarica and Panamà allocating up to 9 percent of GDP to it (Avila-Figueroa 1999).

Table 4. Total, public and private health expenditures in late 1990s

	Total health expenditure	Publ. Health expenditure*	Private health expenditure
Ghana	4.7	1.8	2.9
Zimbabwe	6.4	3.1	3.3
Rwanda	5.0	3.0*	2.0
U.K.	6.4	5.4	1.0

Source: Ghana and Zimbabwe: UNAIDS (2000), Rwanda: Schneider (2001)
Note: * includes also international assistance. In Rwanda, for instance, 2.5% of the total public 3% is accounted for by foreign aid.

However, as GDP/C varies sharply between developed and developing countries, US$ health expenditure per capita in the latter is only a tiny fraction of that in the advanced

countries. In 40 HIPCs, health expenditures average at $10 per capita, well below the $60 minimum expenditure suggested by WHO and 20 to 40 percent lower than the cost of the World Bank basic package of health services. To put this $10 expenditure in context, the health sector expenditure required for prevention alone, in poor economies, has been estimated at $5 per capita (Patel 2000). Current expenditure on prevention are about $0.20 per capita, of which government expenditures amount to $0.02. Care services are similarly constrained.

To date, the most common response has been to require patients to cover most of the cost of AIDS care, thus limiting treatment to those who can afford it. In addition, while in advanced countries public expenditure accounts for 80-90 percent of the total health expenditure in the developing countries it oscillates around 40-50 percent (including aid). In Uganda the government spends only US $4 per capita annually on health, while per capita health spending from both public and private sources rose from US $8 in 1993-94 to US $12 in 1996-97 (Table 5). These proportions are verified also at the local level. Tangcharoensathien et al (2001) report that, in Changrai and Phayao provinces in Thailand, 43 and 65 percent of the total spending on the care of AIDS in 1997 was shouldered by the households. Mexico and Brazil show two extreme situations. In Mexico, subsidies cover only 26% of the cost of HIV treatment but cover 76% of the costs of non-HIV treatments. In Brazil, antiretroviral are free while other health services are subsidized only by 33 percent. In Mexico, HIV patients are crowded out. In Brazil, non-HIV patients are crowded in.

Table 5. Recurrent per capita health expenditure in US $, total and by source, Uganda, 1994-8

	1994.5	1995-6	1996-7	1997-8	1998 minus 1994
Total recurrent expenditure	11.22	12.19	13.84	14.27	3.05
- Private	8.00	8.82	9.75	10.79	2.79
- Public	1.94	2.05	2.91	2.38	0.44
- Foreign aid	1.28	1.32	1.18	1.09	-0.19

Source: elaboration on Mirembe et al (1998)

What has been the impact of AIDS on health expenditure? In low income countries, despite its depressive effect on family incomes, the epidemics triggered an increase in private health spending that entailed a reduction in the consumption of basic items. In contrast – with few exceptions like Uganda - public health expenditure stagnated owing to budgetary restrictions and, in some cases, to restrictive adjustment policies and mounting debt service obligations. On average, public health expenditure as a share of GDP stagnated over 1990-6 at 1.1 percent in low-income countries, and rose moderately from 3.0 percent in the middle income ones. This pattern – stable public and rising private health expenditure - is well illustrated by Table 5.

The changes in health spending were less dramatic in the middle income countries with low prevalence rates and health insurance. In these countries, the AIDS epidemics has often been accompanied by an increase in public health expenditure and stagnant private health expenditure. In Brazil, for instance, the federal expenditures on antiretroviral drugs rose from US $34 million in 1996 to 224 million in 1997 and to 332 million in 2000. In

terms of the budget of the Ministry of health, such expenditure rose from 1.18 percent in 1997 to 3 percent in 2000 (Sarna, 2001). In Thailand, the AIDS budget expanded from 6 million Bath (in constant 1995 prices) in 1988 to 218 million in 1991, to 2066 million in 1996 to decline in the wake of the Asian crisis to around 1200 million over 1998-2000 (Tangcharoensathien et al. 2001, see also chapter 7).

2.4 Quality of health care services in the HIV/AIDS era

Another important effect of the trends in demand and supply of health care described above was a lengthening of queues in public institutions, overcrowding, congestion and a drop in the quality of care. The phenomenon might have been particularly intense at the secondary and tertiary level – except where new and efficient home- or community-based approaches to the management of HIV/AIDS were developed. The quality of services might have been affected also by the 'under-management of the health sector' during this period of intense stress and by the lack of specialized personnel. In Mexico, for instance, the quality problem appears to be due not so much to the lack of general practitioners but to the low number of specialists and their poor spatial distribution, as most of them are concentrated in Mexico City, Guadalajara and Monterrey (Saavedra 2000). In some cases, the quality of health care was influenced by the attitude of the health staff vis-à-vis the HIV/AIDS patients. In Pakistan, the care for STD and AIDS was negatively influenced by the limited information of the general practitioners about these diseases (Khandwalla et al 2000). In China, in turn, the perceived risk of contagion reduced the physicians' willingness to treat HIV patients and increased their demand for the adoption of clinical precautions (Lew-Ting and Twu 1997).

3 The long term impact of HIV/AIDS on the health status of children

3.1 Child mortality trends in the HIV/AIDS era

Most of the recent debate on the mortality impact of HIV/AIDS has focussed on changes in adult death rates and has comparatively neglected the impact on the elderly, infants and young children. While this focus is understandable, it might have obscured our understanding of the dynamics of infant and child mortality in the AIDS era, of the new channels through which the disease affects child mortality, of the moderating effects of child-health interventions and of the policy responses required under the new circumstances. In fact, the impact of HIV/AIDS on children remains controversial. One view is that in countries with moderate adult prevalence, the impact on childhood mortality is negligible. To help disentangling this problem we compiled in Table 6 the trends in HIV prevalence, U5MR and the coverage of basic health services for children (vaccination, delivery care and oral rehydration therapy) for the last twenty years and for 40 countries with adult prevalence greater than 1 percent.

Table 6. Trends over 1980-2000 in HIV prevalence rate, U5MR, vaccination coverage (DPT3), access to delivery care (DC) and coverage of oral rehydration theratpy (ORT) in 41 AIDS affected countries

COUNTRY	HIV 1980	HIV 1985	HIV 1990	HIV 1995	HIV 2000	U5MR 1980	U5MR 1985	U5MR 1990	U5MR 1995	U5MR 2000	DPT3 1980	DPT3 1985	DPT3 1990	DPT3 1995	DPT3 2000	DC 1980	DC 1985	DC 1990	DC 1995	DC 2000	ORT 1980	ORT 1985	ORT 1990	ORT 1995	ORT 2000
Angola	0.7	1.8	5.1	5.6	6.5	265	274	283	295	295	6	8	24	24	45	34	15	18.7	22.5	-	0.1	52	48	34.9	-
Benin	0.0	0.1	0.4	1.4	2.6	214	199	185	172	154	11	17	74	67	79	-	34	45	64	60	0.1	12.5	45	25.8	33
Botswana	0.9	2.7	8.8	28.0	36.2	84	65	58	66	101	71	84	91	76	85	-	77.0	78.3	87.0	98.5	0.1	35.0	44.1	46.5	48.9
Burkina Faso	1.9	5.7	10.0	8.4	5.2	247	218	210	202	198	2	9	62	30	42	12	30	41.5	36.2	31	0.1	15	25	13.5	15.1
Burundi	0.9	2.7	6.8	8.6	14.8	195	181	190	190	190	38	41	85	73	63	12	19.2	21.1	23	24.9	0.1	31.3	33.5	35.7	38
Cambodia	0.1	0.2	0.7	2.1	2.6	190	152	115	120	135	15	23	40	62	47	-	-	47	31	34.7	0.1	-	6	57	17.8
Cameroon	0.2	0.6	1.6	4.9	7.5	173	147	139	150	154	5	33	48	46	48	-	10	58.4	57.2	56.1	0.1	11.5	19.5	20.7	21.9
C A R	1.9	5.8	6.8	10.7	13.8	189	180	180	180	180	13	20	82	53	45	-	66	55.9	45.9	44	0.1	14.6	19.3	24	35
Congo	1.3	3.9	6.7	6.2	6.4	125	82	110	108	108	42	54	79	50	29	-	-	-	-	-	0.1	2	67	41	-
Cote d'Ivoire	1.0	3.3	5.4	12.6	10.9	172	160	155	165	173	42	25	48	56	61	-	20	50	45.4	46.9	0.1	4.3	16	11.1	16.1
DRof Congo	0.9	2.5	4.1	4.2	5.1	210	202	207	207	207	18	37	35	23	25	-	-	-	--	-	0.1	10	46	17.7	-
Dom. Rep	0.1	0.2	0.6	1.5	2.9	92	75	65	56	48	35	39	71	72	73	-	90	92	95.3	99	0.1	37.6	27.3	13.2	28
Ethiopia	0.6	1.8	5.4	6.7	12.0	213	203	193	183	174	3	6	49	56	21	10	58	14	8	9.8	0.1	22.5	68	95	13.1
Gabon	0.3	0.6	1.0	2.3	4.2	105	97	90	90	90	14	48	78	70	31	-	92	80	80	80	0.1	6.8	10	24.8	39
Gambia	0.0	0.1	0.2	0.7	1.9	231	165	154	137	128	80	77	90	92	90	41	80	44	47.5	51	0.1	-	51	42.1	33.3
Ghana	0.3	0.7	2.3	2.1	2.9	155	143	126	112	102	7	22	58	70	72	-	73	40.2	43.8	44.3	0.1	10	34.8	26	29.2
Guinea	0.2	0.5	0.8	1.4	1.4	300	266	240	208	175	15	15	17	54	46	-	25	30.5	32.6	34.8	0.1	1	65	31	34.5
Haiti	1.5	4.6	5.3	6.8	3.8	195	160	150	137	125	3	19	34	42	43	34	40	23	19.5	59.8	0.1	14.1	20	26.3	34.8
Honduras	0.2	0.6	1.7	2.0	3.2	103	74	61	49	40	28	58	84	90	90	-	40.5	45.4	54.2	-	0.1	45	70	29.9	-
Kenya	0.5	1.6	5.9	11.2	13.5	115	105	97	111	120	47	70	84	94	79	-	28	50	45.4	44.3	0.1	26	21.2	31.6	36.9
Lesotho	0.3	1.1	3.4	9.4	25.3	168	144	148	140	133	56	82	76	88	88	-	28	40	49.6	59.7	0.1	27	78	35	-
Liberia	0.2	0.6	1.9	2.7	7.3	235	219	235	235	235	39	11	20	43	43	-	56.5	87	58	-	0.1	6	15	26	0
Madagascar	0.0	0.0	0.0	0.1	0.3	175	173	168	156	139	15	23	46	57	49	62	62	57	51.6	46.2	0.1	2.1	14.9	23.1	22.2
Malawi	0.7	2.1	7.6	15.4	19.7	265	249	241	216	188	58	55	87	89	81	40	59	52.8	60.5	-	0.1	9.9	43.2	49.7	70
Mali	1.7	5.1	1.8	3.3	2.0	295	266	254	243	233	1	2	42	49	52	14	31.9	27.8	23.7	-	0.1	2.2	10	15.7	-
Mozambique	0.4	1.3	3.8	11.3	14.7	230	232	235	215	200	56	29	46	57	61	-	28	25	25	44.2	0.1	13.5	30	49	41.9
Namibia	0.4	1.2	3.6	12.4	19.1	114	97	84	78	69	23	35	53	76	72	-	-	68.2	71.9	75.7	0.1	-	63.5	66	-
Niger	0.1	0.2	0.7	1.2	1.9	320	310	320	295	270	6	4	22	23	21	26	47	14.9	15.3	15.7	0.1	0.6	10.6	12.4	14.3

COUNTRY	HIV 1980	HIV 1985	HIV 1990	HIV 1995	HIV 2000	U5MR 1980	U5MR 1985	U5MR 1990	U5MR 1995	U5MR 2000	DPT3 1980	DPT3 1985	DPT3 1990	DPT3 1995	DPT3 2000	DC 1980	DC 1985	DC 1990	DC 1995	DC 2000	ORT 1980	ORT 1985	ORT 1990	ORT 1995	ORT 2000
Nigeria	0.1	0.3	1.0	2.4	4.7	196	193	190	187	184	24	16	81	34	21	-	40	30.8	36.2	41.6	0.1	10.5	10.8	22.5	34.3
Panama	0.0	0.1	0.2	0.5	0.9	46	38	34	30	26	47	73	86	86	92	80	83	96	86.1	90	0.1	34	55	34.8	-
Rwanda	0.7	2.2	7.7	9.7	8.2	219	187	178	210	187	17	50	84	83	85	20	22	25.8	28.3	30.8	0.1	4	29.5	47	-
Senegal	0.0	0.1	0.3	0.3	0.5	218	173	148	143	139	34	54	51	58	60	-	41.4	47.2	48.8	50.5	0.1	3	6.8	11	15.1
South Africa	0.1	0.3	1.0	7.8	18.3	90	75	60	65	70	74	75	72	72	76	-	-	-	82	84	0.1	-	-	58	51.2
Swaziland	0.5	1.4	4.1	21.4	31.2	143	118	110	110	142	30	61	89	96	82	-	50	37	56	-	0.1	-	-	63	-
Tanzania	1.1	3.3	7.9	13.1	16.1	175	160	163	164	165	59	66	78	85	82	-	58	43.9	38.2	35.8	0.1	10.6	57.6	48.9	54.9
Thailand	0.0	0.1	0.3	0.8	1.6	58	44	40	34	29	49	62	92	96	97	40	69	70	71	-	0.1	36.2	54.7	73.3	95
Togo	0.6	1.8	5.7	5.9	5.3	175	157	152	146	142	9	24	77	58	41	-	15	31.3	40.9	50.5	0.1	5.2	14.3	48.2	-
Uganda	1.8	5.3	14.1	11.3	9.2	180	181	165	145	127	9	14	45	59	53	-	45	38.3	37.8	-	0.1	5.2	14.3	48.2	-
Zambia	2.1	6.2	19.0	18.2	19.1	149	166	192	202	202	65	66	91	86	77	-	38	50.5	46.5	-	0.1	32	54.2	53.9	57
Zimbabwe	1.4	4.4	13.4	31.8	29.9	108	86	80	90	117	39	63	88	88	81	37	69	69.6	69.2	72.5	0.1	1.3	77	79.2	68
Myanmar													69	84	83										

Source: authors's compilation based on UNAIDS (2000), U.S. Bureau of Census (2000), UNICEF and WHO

A review of the trends on U5MR have been carried out[2] [3] Table 6 indicates the surfacing of four child mortality patterns that are summarized in Table 7:

(i) a marked or moderate reversal of the trend in countries with high HIV prevalence. In a first group of eight countries with a high adult prevalence rate (> 6.5 percent), high pre-AIDS coverage of child health services and low pre-AIDS U5MR, there was a reversal of the long term trend towards lower child mortality. Such reversal started in the late 1980s in countries with 'mature epidemics' such as Kenya, and from the early-mid 1990s in countries with 'recent epidemics' such as Botswana, South Africa, Zimbabwe and Zambia that was also affected by a severe adjustment crisis. The average extent of the reversal is of 20-30 percent but is much bigger in the case of Botswana. In this country, U5MR declined from 84 to58 per thousand between 1980 and 1990 to jump to 101 by 2000, recording in this way a 75 percent rise in U5MR in a decade. In other words, HIV/AIDS more than erased the gains in child mortality achieved in the 1980s.

In a second group of four countries characterized by high adult prevalence rate and by a rapid expansion of the coverage of child health services during the 1980s and 1990s, child mortality rose by between 5 and 10 percent, as the increase in child mortality due to perinatal AIDS transmission was in part offset by the decline in non-AIDS causes of death among children.

(ii) a moderate increase in U5MR is observed also in three countries (Angola, Liberia and the D.R. of Congo) where the prevalence of HIV and pediatric AIDS mortality rose only moderately but where there were no or only limited declines in child mortality due to infectious diseases, malaria, diarrhoea and so on. These countries are 'failed states' where the conflicts and social turmoil that affected them during a large part of the 1980s and 1990s constituted a major obstacle to the provision of health services to children.

(iii) a decline of U5MR on trend (11 cases) or slowlier than the trend (7 cases). In countries such as Benin, Burkina Faso, Ghana and Dominican Republic with low pre-AIDS coverage of child health services and high pre-AIDS U5MR, the surge in AIDS-related child mortality was more than offset by a decline in child mortality due to an expansion of the coverage of immunisation, delivery care and other interventions in the 1980s, though such effect was less pronounced in the 1990s as coverage of these interventions levelled off. In a way, because of their initial 'social backwardness', these countries were able to benefit of the 'basic health services dividend' that was already exploited in the past by the countries of the first group;

[2] A similar analysis has been carried out focus on the IMR and yields similar if less pronounced results as U5MR better captures the direct and indirect effects of AIDS on children. For reasons of space the results cannot be presented.

[3] The mortality data used for this review and included in Table 6 have been recently generated by the Statistical Division of UNICEF on the basis of DHS spanning several years and of the recently UNICEF-sponsored MICS surveys. Such data are often considerably higher than those published in the UN Demographic Yearbook or available in the World Bank CD rooms.

(iv) a decline on trend of U5MR in Thailand, a country that was able to control at a low level the HIV prevalence rate through an effective prevention campaign that avoided a large rise in perinatal AIDS cases) while at the same time sustaining the coverage of the usual basic health services for children.

Table 7. Taxonomy of changes in U5MR trends according to the increase in HIV infection rate, the initial coverage of basic health services for children in 1980 – and their evolution between 1985-2000

	Low 1980-5 coverage of health services for children	Low 1980-5 coverage of health services for children	High 1980-5 coverage of health services for children
	Health service coverage stagnates over 1985-2000	Health service coverage expands over 1985-2000	Health service coverage remains high over 1985-2000
Low-Medium HIV prevalence in the 1990s (< 6.5%)	**(ii) U5MR trend rises moderately** Angola, D.R. of Congo, Liberia	**(iii) U5MR falls on trend** Benin,Gambia, Ghana , Guinea, Honduras, Mali, Madagascar, Panama, Niger, Nigeria*, Uganda *, ---------- **(iii) U5MR falls slowlier than the trend:** Burkina Faso, CAR *, Dominican Rep., Gabon, Haiti, Namibia *, Senegal,Togo ---------- [**U5MR trend rises moderately:** Cambodia*],	**(iv) U5MR falls on trend** Thailand
Medium-High HI V prevalence in the 1990s (> 6.5 %)		[**U5MR falls on trend** Ethiopia*, Mozambique*], ---------- **(i) U5MR trend rises moderately** Burundi, Cameroun, Cote d'Ivoire, Rwanda	[**U5MR falls on trend** Lesotho*,Malawi*] ---------- **(i) U5MR trend rises rapidly** Botswana, Congo, Kenya, S.Africa, Swaziland,Tanzania *,Zambia,, Zimbabwe

Source: compilation by the authors on the basis of Table 6. Notes: * indicates a trend behaviour that is apparently inconsistent and that might be due to errors in the measurement of the U5MR due to the lack of recent surveys.

3.2 Causal analysis of changes in child mortality in AIDS affected countries

The four-way classification proposed above in Table 7 sheds some light on the factors explaining the child mortality changes during the last twenty years but needs to be complemented by a more rigorous approach that takes into account all factors influencing child mortality. To this end, hereafter we discuss the factors and pathways through which AIDS affects child mortality, as well as the other factors whose influence needs to be controlled in order to disentangle the net effect of AIDS on child mortality.

(i) impact of HIV/AIDS on child mortality. U5MR can be affected by HIV/AIDS through three main channels. First, infants borne to an HIV positive mother have a 30 percent probability of being infected by the virus, contracting AIDS and dying in 1-2 years. The impact of this phenomenon ought to be captured by a rise in child deaths due to pediatric AIDS. Obviously the impact of pediatric AIDS can be offset by the treatment of the newborn with nevirapine or other programs to prevent mother to child transmission, an effect that can be captured by the coverage rate of PMTCT programs. Second, child mortality due to infectious and waterborne diseases may increase over the short term if – as argued in section 2 – the increasing demand for palliative care and the care of opportunistic infections crowds out the current expenditure on immunisation, oral rehydration therapy and delivery care, as well as the expenditure on the maintenance and development of health infrastructure[4]. AIDS could also affect U5MR because of the decline in the stock of doctors, nurses, paramedics and PHC workers due to an AIDS-induced rise in mortality, attrition, out-migration and burnout among them and because of an inadequate response in the training of new staff. The weakening of the overall health care sector ought to be captured by an increase in child mortality due to infectious and waterborne diseases. Third, mortality among children may also increase because of the AIDS- induced impoverishment of the family in which the child lives. Chapter 10 shows that average incomes drop by up to 40-50 in the families whose head died by AIDS during the prior 18 months. This effect ought to be captured by a rise in U5MR due to malnutrition and other poverty-related diseases. Finally, it is worth noting that all these effects are exacerbated if the virus is of the HIV2 type more than the HIV1 type.

(ii) changes in the traditional determinants of U5MR. Especially in countries with high pre-AIDS U5MRs, the upward shift in aggregate U5MR may have been more than compensated by changes in the 'traditional determinants' of child mortality, i.e. income per capita, income distribution, female education, access to fresh water supply and coverage of basic health services. Hereafter we comment on each of them:

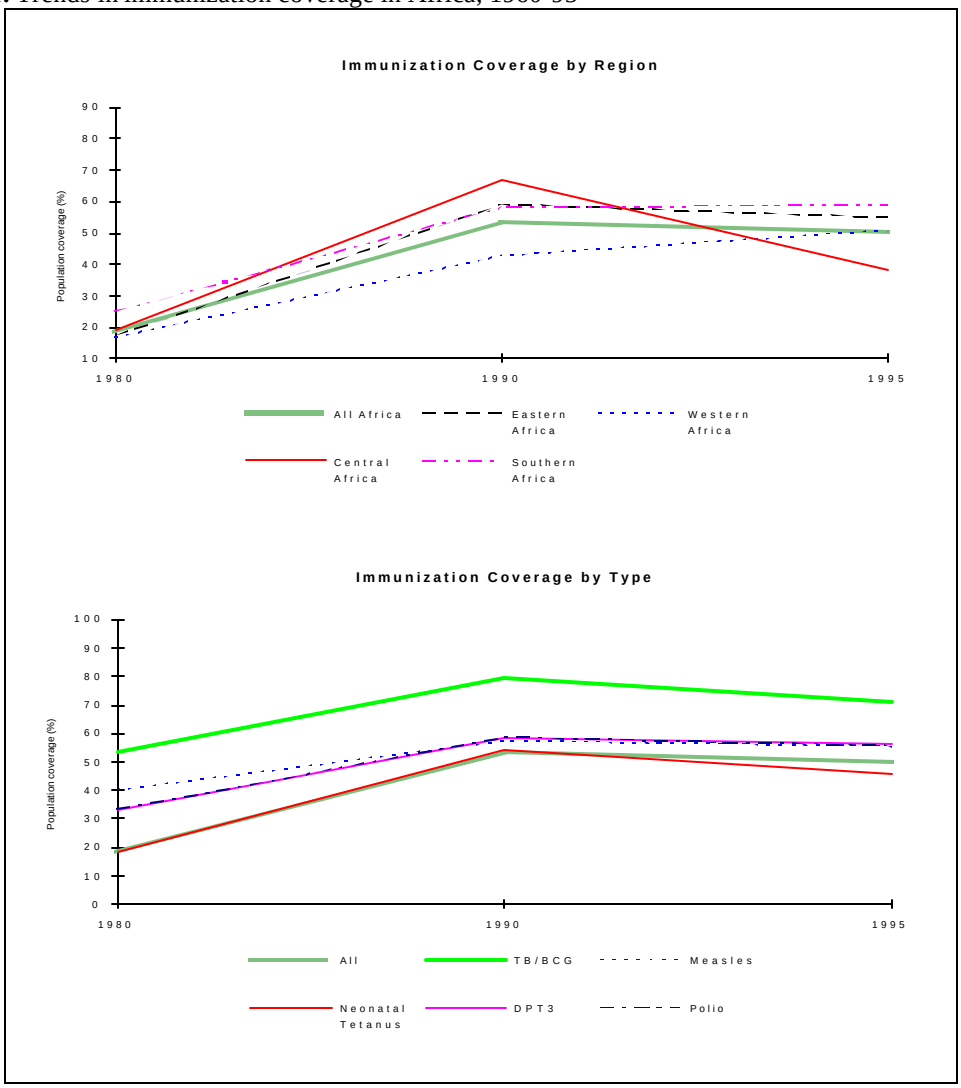
Income per capita over 1980-2000 stagnated in most AIDS affected economies, and in a few it fell for several years. In those affected by large falls (as Zambia), low income groups and their children reduced food intake and thus become less resistant to infection. Acceptable growth was recorded in contrast in Thailand, Ghana and Burkina Faso (where U5MR fell on trend) as well as in Uganda (where it first stagnated and then fell) and Botswana (where it rose sharply from 1990). A worsening distribution of income (proxied by changes in the Gini coefficient) may have also contributed to the changes in U5MR in AIDS affected countries. Here too, however, the limited information available suggests that this is unlikely to be a key factor in explaining the changes in U5MR in the AIDS affected countries. For instance, inequality rose in Kenya over 1982-92 while U5MR declined. The opposite applies to Cote d'Ivoire. And in Thailand, while inequality steadily worsened during the last twenty years, U5MR fell steadily on trend.

Meanwhile, female literacy (FL) – a key determinant of U5MR - changed slowly in most AIDS affected countries and is therefore unlikely to explain much of the observed

[4] A review of public expenditure changes during periods of budgetary stringency (Andersen, Jaramillo and Stewart 1987) shows that, of all types of expenditures, capital expenditure is invariably cut the most.

changes in U5MR. Finally, the coverage of fresh water supply (WS) and of highly effective pro-child interventions such as delivery care (DC), child immunisation (IMM), oral rehydration therapy (ORT), the promotion of breastfeeding (BF) and micronutrient and food supplementation (MFS) expanded rapidly during this period. However, in several countries, progress in these areas slowed down or was reversed in the late 1990s either as result of the 'crowding out' of primary health care by the increasing demand for AIDS care or because the fiscal crisis affecting many AIDS affected countries. For instance, vaccination coverage against immunisable diseases rose from 20 to about 50 per cent between 1980 and 1990 for Sub-Saharan Africa as a whole, but in the 1990s such increase levelled off or was reversed (Figure 1).

Figure 1: Trends in immunization coverage in Africa, 1960-95



(iii) new confounding factors. U5MR was also affected by a surge in the number of armed conflicts, humanitarian emergencies and natural disasters (CONF) that have not spared the AIDS affected countries (Table 8). Major food shortages, often reaching famine proportions, have been common in Sub-Saharan Africa, particularly over the

1983-85 and in the early 1990s. Since the mid 1980s, the number of full-fledged wars in many AIDS affected countries – especially in Sub-Saharan Africa - steadily escalated. By 1994 there were no less than 14 full-fledged wars in these countries including Angola, Cambodia, Ethiopia, Liberia, Mozambique, Rwanda, South Africa, Uganda, Burundi, Sierra Leone and the D.R. of Congo. Such conflicts increasingly involve armed clans and expose civilian populations, and children in particular, to greater suffering than the traditional wars and cause a rise in the number of refugee and internally displaced children with no access to food, fresh water and health care.

Table 8: Refugees and internally displaced people (IDPs) in 1995

	Refugees	IDPs	Total	Share
Rwanda	1,545,000	500,000	2,045,000	25.7
Angola	313,000	1,500,000	1,813,000	16.4
Liberia	725,000	1,000,000	1,725,000	56.7
Sierra Leone	363,000	1,000,000	1,363,000	30.2
Ethiopia	500,000	111,000	611,000	1.1
Mozambique	97,000	500,000	597,000	3.7
Eritrea	325,000	200,000	525,000	14.9
Burundi	290,000	216,000	506,000	7.9

Sources: Cornia and Mwabu (2000).

(iv) measurement error. Finally, any empirical analysis of the causes of changes in child mortality is influenced by the quality of the data on U5MR that – in the absence of recent data on child mortality derived from survey data - are obtained by extrapolating the pre-AIDS trend, an approach that in most cases leads to an underestimation of child mortality. Yet, when estimating through regression the influence of the various determinants of child mortality, the distortion caused by lack of recent child mortality surveys can be tackled by introducing a dummy variable (NOSURVEY) that takes the value of 1 in case there is no survey for the years of rapid increase in HIV prevalence.

(v) regression analysis. To disentangle the relative impact of these favourable and unfavourable impacts on U5MR we use the results of a study by Cornia and Zagonari (2002) who built an eclectic model of child mortality comprising four sets of explanatory variables e.g. (i) AIDS related variables, e.g: the prevalence of HIV/AIDS, the type of virus (whether HIV1 or HIV2) and the coverage of PMTCT; (ii) the usual determinants of child mortality: family income per capita, income distribution, female literacy, access to fresh supply; (iii) the coverage of the main health programs for children; (iv) the impact of large scale conflicts, disasters and humanitarian emergencies affecting 10 percent or more of a country's population; (v) the lack of recent survey data on child mortality. In other words, the model can be written as follows:

$$U5MR = f\{(HIV, DUMMY\ HIV2, PMTCT), (GDP/C, GINI, FL, WS), (DC, IMM, ORT, BF), (CONF), (NOSURVEY)\} \quad (1)$$

Before proceeding to the estimation of the parameters of this model by means of regression analysis[5], Cornia and Zagonari (2002) tested (i) if a break in mortality trends due to HIV/AIDS has occurred in 1995 and 2000 as suggested to some extent in Table 6, (ii) if the lack of recent surveys affects systematically the estimates of U5MR, and (iii) if there are structural differences in IMR and U5MR levels in the countries where the virus HIV2 (more lethal than HIV1) is prevalent. The test allows to accept the first hypothesis, as there appears to be a systematic upward shift in both child and infant mortality during the period 1995-2000. As for the underestimation of the HIV impact on U5MR in countries lacking recent survey data, the test shows that such effect is significant only for the countries without surveys after 1994. Finally, HIV-2 appears to have a statistically significant grater impact on U5MR than HIV-1.

Their regression analysis was carried out on a quasi-panel of 200 observations concerning the 40 countries with HIV prevalence above 1 percent (see Table 6) and the years 1980, 1985, 1990, 1995 and 2000. The regression results reinforce several of the findings well established in the microeconomic and aggregate literature on the impact of the traditional determinants of child mortality. The constant term was found to explain a considerable share of the overall variance in child mortality levels, thus stressing the strong inertial component of U5MR in the countries included in the sample. Consistent with the ex-ante expectations, the factors that appears to have the strongest impact on child mortality are (in descending order of importance) female illiteracy, access to fresh water, DPT coverage[6] and income per capita. The result confirm that income per capita does not appear to be - as often argued - the most important determinant of child health and that female literacy has the greatest impact on child mortality. As expected, immunisation has a greater impact on child mortality than on infant mortality.

Interestingly, the HIV prevalence rate and – to a lesser extent - the frequency and intensity of natural and man-made disasters are strongly significant. The coefficient of the HIV adult prevalence rate was found to be 1.93. This means that in countries where the adult prevalence rate has risen by 10 percentage points U5MR rose – ceteris paribus - by 19.3 points per thousand. This result confirms also that the effect of HIV on U5MR is scarcely perceived in countries where the adult prevalence rate remained below 2-3 points[7]. In turn, expanding the coverage of delivery care and oral rehydration therapy by 10 percentage points was found to reduce U5MR by 5.4 and 0.2 points per thousand. The impact of such programs is thus considerably less pronounced than that of a similar

[5] The paper then builds a quasi-panel comprising data of U5MR (and IMR) for the 40 countries identified and for the years around 1980, 1985, 1990, 1995 and 2000, which altogether gives 200 observations. The quasi-panel also includes endogenous and policy variables (identified below) affecting IMR and U5MR as well as a dummy variable that takes into account with considerable precision the mortality impact of conflicts and natural disasters. Finally, the database includes also dummies indicating which of the 40 countries is affected by the virus HIV2 and the year in which the last survey was undertaken so as to account for possible underestimation of the dependent variable.

[6] The use of measles, polio or BCG coverage – instead of DPT coverage - yields practically identical results.

[7] It is interesting to note here that the impact of HIV/AIDS is significantly greater in the case of child mortality. We interpret this as the effect of mortality due to mater-to-child-transmission in children and not only due to the disruptions imposed by an AIDS-induced decline or stagnation in income on the socio-economic conditions of the family.

improvement in female illiteracy (that would reduce U5MR by no less than 11 U5MR points), coverage of fresh water supply (reduction of 2.6 U5MR points) and DPT (reduction in 5.8 U5MR points). But the impact on U5MR of delivery care and oral rehydration therapy improved markedly when the these were administered to literate women better able to understand and benefit from such programs (i.e when the relevant variable was interacted with the level of female education), confirming prior findings about the enhancing effect of higher moternal education and awareness on the impact of a broad range of health interventions.

The regression analysis by Cornia and Zagonari (2002) has attempted to measure also the impact of breastfeeding during the first three months and between 6 and 9 months of age. The issue of breastfeeding in AIDS affected countries is a much disputed one, as the suckling by the infants tends to increase the risk of mother-to-child-transmission. In poor countries, abstaining from breastfeeding is often associated, however, with an even greater risk of mortality due to diaorrhea and under nutrition. The results of the regression estimates show that breastfeeding between 0-3 months of age (but not between 6 and 9 months) was found to reduce significantly child mortality. For instance, an increase in 10 percentage points in the 0-3 breastfeeding rate reduces U5MR by 2.6 points per thousand, and this effect increases in case of literate mothers.

Table 9. Impact on U5MR of a variation in the selected variables

	Impact on U5MR of a 10% increase in HIV adult prevalence, or of the presence of conflicts or the HIV2 virus		Impact on U5MR of a 10% increase in selected programmes
HIVrate	19.29	GDP/C	- 0.09
CONF	15.50	FEM. ILL.	- 11.00
HIV2	13.11*	DPT	-5.76
		WATER	-2.64
FIL -9,9453		DC	-5.44
		ORT	-0,22 *
		BF 0-3	-2.63

Source: calculation by the authors.
Notes: * indicates that the parameter is not statistically significant though it has the correct sign.

The above analysis allows to reach a few conclusions: first, child mortality rose in all countries where the adult prevalence rate exceeds 6.5 percent and in few 'failed states' with lower prevalence rate but stagnant coverage of child health services. At the margin, a one percent increase in the adult prevalence rate raises U5MR by 1.3-1.5 points per thousand. Lack of data on pediatric AIDS did not allow to separate the effects of mother-to-child-transmission from that of the impoverishment induced by AIDS – though it is evident that most of the observed increase in U5MR is to be attributed to the first factor. This finding provides a strong rational for stepping up programs to provide universal coverage of nevirapine to the newborns. Second, the effect of ethnic conflicts on mortality affects significantly but moderately child mortality while child-health interventions such as immunisation, oral rehydration therapy, delivery care, breastfeeding

and child nutrition appear to have a perceptible effect on child mortality, especially when they are directed to educated mothers. Third, the favourable impact of these programs is more than offset in countries with high rates of HIV adult prevalence. A ten percent rise in HIV adult prevalence rate offsets by more than a third a similar percentage expansion in coverage of DPT, fresh water supply, ORT, delivery care and breastfeeding 0-3. A greater protective effect on U5MR is offered by maternal education but this variable changes marginally over the medium term. While waiting for an enlargement of antiretroviral programs targeted at infants, at present a ten percent rise in adult prevalence requires an expansion of 15 points in all the child targeted programs discussed above. This is certainly a difficult objective in the economies impoverished by HIV/AIDS, but one that should absolutely be given top priority by the policy maker.

4. Health sector responses to the HIV/AIDS challenge

The response to the HIV/AIDS pandemics has varied substantially across countries. Some – such as Thailand and Senegal (see chapters 4 and7) – launched a nation-wide HIV prevention program in the early stages of the epidemics and were so able to control and then reduce its prevalence. Even these 'model' countries, however, are only now beginning to deal with the treatment of the HIV positive people. Other countries – as Uganda (see chapter 2) – prevented in an equally successful the spread of the epidemics but only when the prevalence rate had reached 10 percent. Instead, other nations – such as Cote d'Ivoire, South Africa and China (see chapters 5, 6 and 9) – recognized the implications of HIV/AIDS with considerable delay, are still unable to control its spread and will have to face a rise in both the HIV adult prevalence rate and, possibly, in U5MR in the years ahead. The policy response to HIV/AIDS has thus varied from country to country. Yet, in a sense, all countries introduced a few measures reviewed hereafter though in some of them these measures were implemented on a limited scale, in a poorly co-ordinated way, with inadequate political leadership and within an inconsistent administrative, institutional and funding framework.

4.1 Prevention

The main policy response to HIV/AIDS has so far been in the prevention of the spread of the epidemics. Until the development of the antiretroviral therapy this was the only available way to fight the disease. Based on current growth rates of the epidemic, each infected person is currently infecting 2.4 other people, on average, before dying. To control the epidemic, the number of people infected during the lifetime of each case has to be reduced to 1. To eliminate HIV/AIDS, the number of transmissions should be reduced to less than 1 per case, a reduction in current levels of transmission of 60% at a national level. There exists quite a wide range of effective techniques to interrupt or reduce transmission of HIV.

(i) main prevention programs. These have generally taken the shape of:

- *Information and awareness raising campaigns*. These include a variety of communication campaigns carried out through radio and TV spots, popular theatre and peer education that aim at increasing awareness of the way HIV is transmitted and at

modifying sexual and other risky behaviours such as high alcohol consumption. Such programs do not focus only on the passive transfer of knowledge but also on teaching empowering life-skills to avoid the reproduction of the circumstances leading to the adoption of risky behaviours (ESAR 2001).

- *Provision of condoms* especially among target groups (commercial sex workers, IDU, the youth, people with high mobility an so on). Condoms afford almost complete protection against the risk of transmission and so qualify as a means of stopping the epidemic. The experience of Thailand, Uganda, Senegal and – more recently – Zambia suggest that condom adoption rates can increase substantially and reduce HIV prevalence rates. Bought in bulk, a condom costs $0.03. Supplying an average of 25 condoms per year to the 800 million sexually active men in HIV affected countries would require 20 billion condoms, at a cost of $600 million. This is a cost of $0.20 per capita or about 0.03 percent of the GDP of those countries[8].

- *Safe Blood Transfusion.* In Tanzania, it has been demonstrated that safe blood transfusion can be achieved for an annual expenditure of $0.07 per capita. Blood testing is labour intensive and so costs would be higher in high wage countries. At a cost of $0.10 per capita this measure would cost 0.02 percent of GNP. The order of magnitude of this cost indicates that this service is affordable in all countries. Unfortunately, achievement of safe blood transfusion, while an important component of a prevention campaign, cannot be the main way to stop the epidemic as infection through blood contamination is a small fraction of total transmission.

- *Testing and Treatment of Sexually Transmitted Diseases (STDs)*, i.e. diseases that – by causing lacerations and wounds in the sexual organs – substantially increase the risk of HIV transmission. Treating all STDs would reduce the risk of transmission by about half. So testing and treating STDs is a strategy that has the potential to reduce risk of transmission enough to at least stabilize prevalence and perhaps reduce it. In Tanzania, it was estimated that STD testing, treatment and counselling could be provided for $1 per capita. While Tanzania is a low income nation, it would seem feasible that these services could be provided on a large scale for $1.50 in most countries. The total cost of covering all population in the 60 most affected countries would be $ 2.25 billion a year, or 0.2 percent of their GNP. While this large scale approach is still to be introduced, STD therapy is mainly provided at the hospital level according to a full treatment that in Kenya in 1999 costs 30 $ for a simplified treatment and 200 $ for an expensive treatment (Rachier 1999).

- *Circumcision.* It has been widely noted that the HIV/AIDS epidemic has failed to take-off as rapidly in countries in which full male circumcision is widely practiced, including many countries in west and north Africa. It is now accepted that circumcision has a

[8] If a good carries very high public health externalities, as is the case for vaccines for infectious diseases, it is normally assumed that the correct price for that commodity is zero. Perhaps a similar conceptual framework should be applied to condoms. It is hard to imagine that the campaign to eliminate smallpox would have been successful if people had been charged for the vaccine.

protective effect of the order of 50 percent. In terms of cost-effectiveness, there is probably no other single intervention which is as low in cost ($1, perhaps, with no recurrent costs), as unambiguous in its impact. In other words, universal male circumcision could probably more or less stop the epidemic, on its own, at a one-off cost of $500 million – or 0.2 percent of the GNP of the countries affected. Responses to this information would probably vary between those cultures in which circumcision is normal and those in which it is not. It is considered very difficult to change culture in this respect, though there are some who consider this a viable strategy. Having a foreskin removed could be likened to donating blood for payment, for example. Certification of circumcisers would then also be a potentially relevant issue. It has been asserted that modest fee for service payments to providers and the provision of certificates would greatly increase circumcision rates. The danger that risky behaviour would increase is probably negligible, as condom use rates are anyway still very low.

-*Prevention of mother to child transmission (PMTCT).* Mother to child transmission can be greatly reduced by a short course of AZT or, more recently, nevirapine that is estimated to reduce such risk by 30 to 50 percent. Such measure is particularly useful in countries with high HIV prevalence among pregnant women. In 1997, the Ministry of Public Health of Thailand started a program to give AZT every year to an estimated 20.000 HIV positive pregnant women who – given a probability of transmission of around 30 percent - were likely to give birth to some 6.000 infected children a year (see chapter 7). The program was expected to reduce transmission to 8 percent, thus avoiding 4.400 births of HIV positive infants.

Implementation of such programme requires that all pregnant women be screened and counseled and, if necessary, treated with a short course of nevirapine. Screening costs only about $2 per test. With the recent price reductions of drugs, treatment for those affected is only about $4 per infective pregnancy. The cost of counselling can be estimated at $1 in a low-income economy. Such programs are seen by many as the most cost-effective way to contain losses of life expectancy in an affordable way. A study by Wood (2000) shows that the universal coverage of short-course prophylaxis with an assumed median unit cost of 8US$ would be able to avoid 110.000 HIV-positive births as well as a decline in life expectancy at birth of one year – for a cost of 54 million $ a year for sub-Saharan Africa as a whole. He compared this number with a cost of $ 19 billion a year for triple combination therapy covering 25 percent of the HIV-positive population, assuming a unit cost of 2900 $ a person/year and leading to a gain in 3.1 years in life expectancy.

- *Volountary counseling and testing* among selected populations (pregnant women, commercial sex workers). Volountary counseling and testing is normally considered an essential component of behavioural change prevention programmes. In Uganda, VCT costs $14 per client. Those attending this service tend to self-select and the clientele has included a useful proportion of youths undergoing testing prior to marriage. Per capita costs at a national level would be under $1, since re-testing is not required on an annual basis. VCT is a kind of service that could probably be expanded relatively rapidly wherever some rudimentary health service infrastructure exists and, if effective in changing behaviour, could certainly reduce transmission. But there is insufficient

evidence of impacts on behaviour change and on transmission to rely on it as the key to prevention, though some promising results are available (Kaleeba et al 1997).

- *Quarantine*. Such measure has been applied much less frequently. Cuba's compulsory testing of 13 million people and the establishment of *sidatorios* are an important but isolated exception. As a result of these measures, HIV prevalence remained very low. But quarantine and compulsory testing remain highly controversial as they entail a systematic discrimination of the rights of HIV-affected patients.

(ii) limitations of these programs. So far, no effective prevention technique has been implemented on the necessary scale to stop the epidemic in a developing country, though countries such as Thailand and Uganda (see chapters 7 and 2) made visible progress in some of the above areas. A review of the literature identifies a number of problems which are either intrinsic to a 'prevention only' approach, or which reflect insufficient application of a valid approach due to lack of funds and leadership or to the poor design of the interventions. While the problems due to a shortage of resources can be solved, those resulting from intrinsic limitations require a change in the HIV/AIDS health strategy. The main problems identified in the prevention programmes are the following:

- *Information campaigns and promotion of condom use*. Evaluations of information and condom distribution campaigns show that the level of awareness about HIV and its transmission modes is rising over time. Such result is achieved however with substantial time-lags from the inception of these programs. In addition, such approach suffers from a number of limitations. In Cote d'Ivoire, for instance, the information campaigns were focused on the urban areas, were of temporary nature (thus entailing the risk of relapse into old habits) and seldom targeted the high-risk groups or potentials actors of change (see chapter 5). In addition, in several countries it is still difficult to ensure an adequate distribution of condom, not least because of the resistance of religious groups to their use. In Cote d'Ivoire, for instance, despite a ten-fold increase in the number of condoms sold through the NGOs during the 1990s, in 1999 their average number per person/year was of only 4. Finally, it has proved extremely difficult to persuade people to use them and, indeed, sexual behaviour does not appear to change easily in response to public information campaigns (Caldwell 2000). Without the necessary changes in attitudes it seems unlikely that the promise condoms hold will be fulfilled.

- *PMTCT and tratment of STD.* The use of nevirapine is cost efficient but its coverage remains generally limited, with the result that the number of pediatric AIDS cases remains high and that U5MR rose markedly in countries with high seroprevalence rates. For instance, in Cote d'Ivoire U5MR rose from 155 per thousand in 1990 to 173 in 1998. Even in Thailand, possibly the country where such program is most advanced, only a modest percentage of the target population is being treated. The program was gradually expanded over 1998-2000 in half of the country and 75 percent of the women who received antenatal care underwent voluntary HIV testing, and 64 percent of those testing positive were given AZT. Voluntary HIV testing remains an obstacle to the expansion of the program. The same consideration apply to the prevention and treatment of STD. One difficulty is that it is hard to imagine that such treatment could be provided at a national

level when even basic services such as antenatal care have not yet achieved 100% coverage. While useful, especially in countries with good health service coverage, STD treatment is not a magic bullet in the countries with a weaker overall health system.

- *Voluntary testing* is often affected by cost, availability and incentive problems. While the evidence shows that voluntary testing does indeed reduce the contagion of sexual partners, in the absence of an affordable HIV/AIDS treatment, testing remains little attractive to many patients who are afraid of discovering to be infected and without any hope for recovery. As noted earlier, physicians frequently choose not to test patients for HIV out of fear that they would be traumatised (Gibney et al 1999).

4.2 Mitigation

Measures in this area are introduced to moderate the effects of the opportunistic infections responsible for the death of HIV positive patients, to improve the quality and duration of their life and to minimize the impact of HIV on the health sector. They pivot around palliative care that can entail "a total approach to care and support to people who have terminal conditions and are nearing death" or be limited to "relief of pain symptoms such as headache, pain, diarrhoea and shortness of breath" (World Bank, 1999). There has been a wide variety of therapeutic responses to HIV/AIDS. UNAIDS (2000) refers for instance to the three packages classification i.e.:

(i) The essential package includes voluntary HIV testing and counselling, psychological support for HIV-positive people and their families, treatment of pneumonia, oral thrush, vaginal candidiasis and pulmonary TB (DOTS), and prevention of infections for symptomatic HIV-positive people. Such package is delivered through home-based care, hospice-based care, or by subcontracting NGOs. The home-based care can be delivered through the community or hospital- instituted schemes. These interventions tend to cover a low proportion of the target populations (e.g. less than 10 percent in Zambia and Zimbabwe). The psycho-social support and counselling is organized through peer-support for PLWA, family and community (Gilks, 1998).

(ii) The intermediate package includes all interventions included in the essential package plus the active case-finding and treatment and preventive therapy for TB for HIV-positive people, systematic antifungals treatment, treatment of Kaposi sarcoma with essential drugs, surgical treatment of cervical cancer, treatment of extensive herpes. Such package is relatively widespread and relatively cost-effective. The inclusion of TB in the above package is essential as it is the leading HIV-associated opportunistic disease in developing countries. Since HIV so clearly fuels the TB epidemic and because so many TB patients live with HIV, many TB programs believe they should be working hand-in-hand with the fight against AIDS because prevention of new HIV infections will, in turn, prevent additional TB cases.

Success in TB control has been largely dependent on the strength of the whole health care system. In fact, effective intervention against opportunistic infections requires not only the appropriate medications for a given condition, but also the infrastructure necessary to

diagnose the condition, monitor the intervention and counsel the patients (UNAIDS, 1998). The total costs reflects thus the cost of drugs and of care of common symptoms associated with HIV in Africa which vary depending on whether they are administered as inpatient care or outpatient care. A review of some 30 published cost-studies from low-income sub-Saharan Africa estimates that the costs of palliative care together with care for opportunistic infections per patient per year ranges between $247 and $359 depending on the level of coverage. But O'Malley (1998) notes that in Burkina Faso community group rallied to deliver care to AIDS patients in highly underserved areas for only US $20 per month. In contrast, in middle income African countries such as Botswana, Mauritius, Namibia, South Africa and Swaziland the cost of the basic package would be $471 to $698 in middle-income African countries (ADF 2000).

(iii) The advanced package includes all interventions included in the essential and intermediate packages plus ARV therapy, diagnosis and treatment of opportunistic infections difficult to diagnose or expensive to treat.

(iv) measures to contain the negative impact of HIV/AIDS on the health sector, by accelerating the training of health staff to deal with the rising demand for health care, to provide specific training on new therapeutic procedures or approaches to the management of HIV patients.

4.3 Treatment with antiretrovirals

Triple combination therapy, (known also as Highly Active Anti-Retroviral Therapy - HAART), entails a combination of three different drugs based on an individual's disease progression and response. To ensure continuation of benefits, HAART has to be followed for the duration of an individual's life. In addition to drugs, HAART requires the intensive monitoring of viral load, blood chemistry, and CD-4 counts carried out in a health facility as, often, patients have side effects that require clinical management.

While such therapy has been common for over a decade in the industrialised nations, where it raised substantially the survival and quality of life of AIDS patients, it is still rare in low income countries. In Uganda (a country that achieved considerable progress in the field of prevention), in the year 2000 only 1 percent of the HIV positive people had access to it (Wendo 2001). In Cote d'Ivoire, despite some cost-cutting agreement with the pharmaceutical companies, the total number of people covered by this programme between July 1998 and late 2001 was 1013 (see chapter 5). In Mali, 130,000 people are infected with HIV but only 600 will receive such treatment (Ssemakula, 2001). Senegal has an estimated 180,000 infected people and agreed in November 2000 a low cost deal with the pharmaceutical companies but the number receiving treatment rose only from 100 to 200 (chapter 4).

The situation is better in countries with medium GDP/capita, greater coverage of health insurance, lower prevalence rates and the capacity to manufacture ARV drugs. In Thailand, in 1992 the government initiated the distribution of ARV mono-treatment to the people living with AIDS. In 1995 3.600 individuals or 17 percent of the target

population were covered by such a programme at a cost of 20 million dollars. The program was however halved in the subsequent years due to problems of funding, drug compliance and therapeutic effectiveness (see chapter 7). Brazil's experience has been the most successful. In 1991 the Government started to distribute free AZT through the public health system. In 1996, it extended the free distribution to all essential HIV medications and protease inhibitors. The National Network of Laboratories now supports the drug distribution program with 133 testing and counselling centres and 424 drug dispensing units. In 1992 the Brazilian authorities decided to manufacture their generic ARV drugs (Sarna, 2001). In this way, they were able to deliver cheap home-produced drugs to 90.000 people, a decision that reduced AIDS mortality by 50 percent between 1996 and 1999, permitted to save over 1997-9 506 million dollars on hospitalisation and treatment of opportunistic infections and reduced their incidence by 60-80 percent (chapter 14, Sarna, 2001, Teixeira 2000). In Mexico, in 1999, around 55 percent of the people living with AIDS had access to ARV. Of these, 50 percent were covered by the social insurance schemes, 2 percent through national funds and 3 percent by private means (Saaverda 2000).

The main perceived obstacles to the extension of the coverage of the antiretroviral therapy are identified in:

(i) its high cost. In the past, the cost per patient/year in the advanced countries ranged between 10.000-20.000 USD, but steadily declined since then. A review of 30 published cost-studies (spanning up to 1999-2000) from SSA countries show that in low income developing countries, the costs of HAART per patient/year ranged between $1,930 and $3,468 depending on the level of coverage. In medium-income SSA countries such as Botswana, Djibouti, Mauritius, Namibia, South Africa and Swaziland the price range was $2,393 to $4,049 (ADF 2000). These values clearly render the ARV treatment out of the reach of governments and individuals and according to many, under conditions of financial stringency, it does not make sense to invest in HAART, as this would subtract resources to other more efficient interventions such as prevention. However, the introduction of generic drugs has caused a substantial decline in the price of both generic and branded products. In March 2001, CIPLA of India offered to provide a yearly course of ARV therapy for 350 dollars. This offer was shortly preceded and/or followed by an even cheaper offer by the Sri Aurobindo of India, as well as by the introduction of large discounts and donations by the pharmaceutical companies (Table 10).

Table 10. Trend over time in the cost of branded and generic ARV package

Year	Yearly Cost of triple therapy (branded products)	Yearly Cost of triple therapy (generic products)
1990	20.000	
1998	1930-3468	
2001		350 (CIPLA)
2002		290 (Sri Aurobindo)

Source: authors compilation from various sources

(ii) the complexity of its therapeutic protocol. So far, the ARV therapy has been administered in a skills- and capital-intensive way, requiring a fairly sophisticated health

infrastructure. The drugs have to be administered following strict protocols and under close medical supervision, and require an advanced lab infrastructure to control the possible side-effects of the therapy, assess at regular intervals the virological load in the blood, an so on. In view of the inadequacy of the health infrastructure in most developing countries, it would be impossible to administer the therapy, even assuming a zero cost of the drugs.

(iii) problems of drugs compliance and side-effects. Even assuming adequate availability of drugs and health infrastructure, some patients appear either not to tolerate the ARV drugs or to comply only occasionally with the daily drug-taking routine, thus reducing the effectiveness of the therapy.

5. Best-practice policy responses

Best practice policies clearly vary from country to country. Countries with low GDP per capita, no health insurance mechanisms, high prevalence rates and no ability to manufacture or import generic ARV drugs face a more difficult task than countries in more favourable conditions. Yet, some components of such best practice policy package – such as those illustrated below - are common to most countries: a first policy priority concerns the strengthening of the overall PHC system so as to avoid the 'crowding out' of non-AIDS health programs due to the increased demand for AIDS related health care. Malaria, tuberculosis, diarrhoea and other diseases remain major killer for the under-five – and it is essential that the EPI, ORT and other health programs are protected in the AIDS era. A well functioning PHC system can help as well in the screening, testing, referral of HIV patients as well as for the home-based therapy of palliative care. Second, as far as specific AIDS-related programs are concerned, there is a need to intensify the traditional efforts at prevention, PMTCT ahead of all, and the treatment of opportunistic infections while increasing the number of patients treated with ARV in parallel to the reduction in the price of drugs and the development of simpler treatment protocol. Third, there is a need to mobilize additional funds for the implementation of the above and other activities. Fourth and final, the overall physical, human and administrative health infrastructure needs to be strengthened through the training of health personnel and the solution of the coordination and under-management problems of the health sector that have mounted in the recent period of acute stress.

5.1 Sustaining and intensifying efforts at prevention

In all countries – with low/high prevalence, rich/poor, able/unable to manufacture ARV, etc. – prevention remains the pillar of the overall health policy. It requires strong political commitment (as in Uganda and Senegal) and social mobilisation (as in Thailand) and demands – to start with – a clear recognition of the HIV/AIDS problem and of its impact on society.

Information campaigns aiming at behaviour modification and condom use need to be institutionalised and sustained over time. The evidence of the last 4-5 years in countries

that were successful in controlling the epidemics in the past – USA and Thailand in particular – show that there has been a relaxation in prevention (including in condom use) and that prevalence rates have soared again. Such campaigns need also to be better targeted at high-risk groups and at rural and remote areas where the contagion is low but still rising. It is also necessary to understand the best way to modify the sexual behaviour of many groups that appear resilient to prevention messages. Preventative activities can improve strongly when they are accompanied by a capillary treatment of STD.

The initial successes recorded in the field of PMTCT and other preventative programs – such as blood screening and the introduction of mono-use syringes - need to be consolidated and extended. Their cost is comparatively low and the benefits very high both in terms of lower IMR and U5MR and savings on the costs of treating pediatric AIDS cases. PMTCT is affordable even in low-income economies with high prevalence. The main problem in these economies is implementation in a context of declining budgets and the limited coverage of the health care infrastructure. For instance, while about three-quarters of women receive some antenatal care during pregnancy, less than half have trained staff present during delivery.

Voluntary testing for HIV has been shown to reduce transmission, but in many cases it is hampered by the patient's fear of the results of the test, that in case of a positive outcome are tantamount to a death sentence, by the doctors attitude that fear to traumatize the patients if these are found to be positive, and by the social stigma that surrounds HIV status (such obstacle can however be reduced if ARV treatment is made available, see later). This is an activity which requires supporting efforts in the fields of privacy protection, counselling and treatment with palliative care. In the absence of the prospects for treatment, the incentives to test – and therefore to limit the spread of the contagion - are much less.

5.2 Intensifying efforts at mitigating the impact of HIV/AIDS on people and the health system

These measures have the advantage of lengthening life expectancy, improving the quality of life and the social usefulness of HIV positive people by treating those infections that most frequently kill them.

(i) An overall effort at strengthening the Primary Health Care. In parallel with the spread of the HIV virus, several countries have experienced a weakening of the PHC system. Vaccination rates and maternal and child health services, for instance, have eroded in several African countries (Table 6 and Figure 1). And so has the coverage of other key health programs. The literature provides limited evidence of such crowding out effect, but there is considerable indirect evidence showing a correlation between the spread of HIV/AIDS and the decline of the coverage of vaccination and other health programs benefiting children.

A first priority objective is thus be to 'shelter' the essential activities that are part of PHC, while at the same time seeking synergies between the treatment of HIV/AIDS and non-HIV/AIDS related ailments, for instance by strengthening those programs, such as the

Essential Drugs Program, that play a key role in the fight against HIV/AIDS and other diseases. In view of their limited development, such programs need to be sustained and, in many cases, expanded as indicated by Table 11 below that provides a somewhat optimistic estimate of the percentage of people covered by (but not necessarily able to afford) a basic supply of essential drugs. The human and physical infrastructure of the essential drug program would also be crucial for the acquisition, storage, control and expanded coverage of an ARV treatment program.

Table 11. Estimated number of HIV infected people and their access to essential drugs in 1999 in some African countries

Country	Number of HIV infected people	Access to essential drugs *
Burkina Faso	350,000	60%
Côte d'Ivoire	760,000	80%
Kenya	2,100,000	35%
Nigeria	2,600,000	10%
South Africa	4,200,000	80%
Uganda	820,000	70%
Zimbabwe	1,500,000	70%

Source. UNAIDS 2000 and World Bank 2000
Note: * Access to minimum of 20 most essential drugs continuously available at public or private health facilities within 1 hour walk.

(ii) enhancing the coverage of the essential and intermediate package. Much relief and comfort can be provided with inexpensive essential drugs that are generally supposed to be available – though frequently they are not - through the primary health care system (Foster, 1991). Palliative care is already affordable in several low income countries. The World Bank (1999) estimated the cost of palliative care at $20 per patient/year. The African Development Forum (UNECA 2000) reviewed about 30 cost-studies on sub-Saharan Africa and estimated that the costs of palliative care per patient/year ranges between $21.5 and $25.8 for the lowest and highest levels of coverage, respectively. The treatment of opportunistic infections is more expensive. The World Bank (1999) estimated the cost for inexpensive and expensive treatment of opportunistic infections per patient per year to be, respectively, $30 and $200.

The treatment of opportunistic infections has so far been carried out in an hospital setting and is, for this reason, rather costly. This requires a redefinition of the management of TBC and similar diseases through the development of community and home-based care and greater use of the district health care infrastructure (Floyd et al. 2000). Such approaches are as or more effective than the hospital based one but are, at the same time, cheaper for both the patients and the public health care system. In South Africa and Malawi, for instance, the private cost to be borne in hospital wards was reduced respectively by 24 and 71 percent with the introduction of home-based care.

The cost of delivering various health interventions in this field can thus be reduced substantially through the adoption of innovative delivery mechanisms. Barnett et al (2001) discuss, for instance, the contracting of NGOs in Brazil and Guatemala as a mechanism to deliver essential components of HIV care such as VTC and palliative care. They show that - in the presence of local leadership and ownership of the program and

the establishment of a patient oriented administrative unit and given some precautions in the selection and solicitation of NGOs, the terms of the contract and the monitoring and evaluation of results - contracting NGOs allows to deliver HIV services at lower cost, while improving the quality of care and extending the coverage to high-risk and under-served populations.

(iii) Safeguarding the overall functioning of the health care sector during the HIV epidemics. The strengthening of the entire health care system is also an essential objective as, as discussed in section 2.2, one of the impacts of AIDS is to weaken public and private health institutions by killing health personnel, subjecting them to considerable risk and high stress and so on. So, a first response must be in the field of manpower supply and training. Manpower requirements will be influenced also by the evolving pattern of palliative and opportunistic care – and by the hoped for simplification of the antiretroviral protocols administered to HIV positive people. Put simply, in some countries there is a need for replacing dying, sick or out-migrating doctors and nurses (this is however not the case in Uganda, for instance, where the newly graduated doctors seem to satisfy most of the existing demand, see chapter 2). Even more, there is a need to train nurses to administer a home-based simplified ARV therapeutic protocol.

A second step concerns the deployment and organisational structure of the health services. Rural health services are less available than in urban area, especially in the capital. Regional imbalances also exist and need to be corrected as well. Binswanger (2001) suggests, for instance, that in Uganda the number of patients on ARV therapy can rise fivefold from 1,000 to 5,000 by better using the existing infrastructure, while the establishment of three regional centres can increase access to ARV treatment for 10,000 patients at US $100-150 per patient. Obviously, the strengthening of the health system will be influenced by its existing coverage and by how well the initial program works. Table 12 illustrates the average cost of strengthening the administration and management of the health care system under different hypotheses on its initial strength and the level of its coverage for the SSA countries.

Table 12. The marginal cost per capita of institutional strengthening

Initial level of program strength	Lowest levels of health coverage	Intermediate levels of health coverage
very low	0.021	0.026
Low	0.015	0.019
Medium	0.010	0.013
Strong	0.006	0.008

Source. UNECA (2000).

5.3 Gradually making ARV <u>treatment</u> accessible to all

Despite many obstacles, a gradual expansion in ARV coverage would bring notable benefits. Indeed there is a solid rationale for treating people with antiretrovirals. The main arguments in its favour are the following: first of all, lack of treatment would abandon 36 million infected adults and children to certain death. It is ethically imperative

that their plea is addressed. For sure, there are many other diseases that are endemic in the developing world, but none of them has the lethality of AIDS. Second, treatment is necessary to optimise prevention, as – as argued above – in the absence of a cure there are no incentives to take a HIV test. In addition, treatment reduces the viral load and thus minimizes the probability of transmitting the virus to others, including in the case of vertical transmission from the mother to the child. Third, treatment reduces massively the hospitalisation and drugs costs for palliative care and the treatment of opportunistic infections. Fourth, a gradual expansion of the treatment with antiretrovirals would involve the strengthening of the overall health system thanks to an upgrading of the medical and pharmaceutical infrastructure. Finally, treatment with antiretrovirals would avoid a number of devastating effects that cripple AIDS-affected economies. Among the problems that would be avoided one should mention the death of people in the productive age, including costly, difficult-to-replace and highly skilled professionals; the impoverishment of a large section of society, and the ensuing increase in the demand for sickness, orphan and early retirements allowances; high mortality and attrition rates among the staff of the health and education ministries, a fact that affects all children, whether in families affected by AIDS or not; and the social stigma and deprivation experienced by a mounting number of orphans who lack the parental love and guidance they need for their upbringing. In addition, treatment with antiretrovirals is becoming increasingly rational as its main obstacles (high cost, and lack of medical infrastructure) are being slowly overcome.

(i) Reducing the cost of ARV drugs. Such cost varies substantially depending on the capacity to manufacture domestically or to import generics from other developing countries[9]. For instance, the countries that recorded the fastest success in expanding treatment with ARV are Brazil, Thailand and India, i.e. countries that can produce most of these drugs and that distribute them through the public health care sector or pharmacies specialising in the sale of generic drugs (Saavedra 2000).

The price of both branded and generic antiretrovirals shows a declining trend over time (Table 10; Figure 1 of chapter 11). The fall is a slow one at first and a more pronounced one in recent times owing to strong competition among producers of generics and the matching discounts practiced by the pharmaceutical companies (Floyd and Gilks 1997, Forsythe 2000). By mid 2001, the cost of the yearly cycle of combination therapy was about 350 $ and by mid 2002 it had declined further, if marginally. And it is possible that it will fall to around 200$ in a few years as competition by generics intensifies (3rd mtg of the Contact Group, 29-05-01). The UN can help in reducing costs by assisting with international procurement, quality assurance, and certification, as done in the past by the UNICEF-WHO Essential Drug Program that purchased in bulk generic drugs on the international markets at prices up to one 50 times less the price of branded products.

Chapter 11 in this collection illustrates some of the main options necessary to sustain the current decline in the price of antiretrovirals. Of all strategies – drugs donations from the pharmaceutical companies, large discounts by the same (as in Senegal), the adoption of

[9] Such capacity depends on the ratification of the TRIPS agreement by a country, and on the special deals it may have agreed with the pharmaceutical companies.

dual pricing systems (as proposed in Durban by some TNC), or production and parallel imports of generics competing in the open market with the branded products – a combination of the latter two is the most convenient. Success in reducing the cost of antiretroviral drugs could mean that even some low income countries could start to gradually expand the number of adults being given an antiretroviral therapy. The economics of it is as follows. With the spread of the generics drugs and the simplification of therapeutical protocols the target for a reduced price is 300 $ a year. Quite a high proportion of the population of the affected countries earns about the same amount of money. This need not necessary matter, from an economics and public health perspective. If prevalence is low, then risk-pooling arrangements can be used to spread the cost of HIV/AIDS treatment through health insurance, public spending or community mechanisms. The impact that such risk pooling arrangements would have on the proportion of the national GDP required to treat all people infected is a function of prevalence, drug price and GDP per capita in the state or community concerned, and can easily be calculated using the following formula:

$$\% \text{ of GDP required} = \frac{\text{prevalence rate (for the entire population) X drug cost per year}}{\text{GDP per capita}}$$

For instance, if the prevalence rate among the entire population (i.e. not the population 15-59 years of age) is one percent, the treatment costs $300 per year[10], and average GDP per capita $300 per year, then only one percent of GDP would need to be expended on antiretroviral treatment. Similarly, if 10 percent of the community is infected, and the drug costs $300 per year, and average per capita income is $300, then 10 percent of the GDP would be required. A few prototypical situations give a more concrete idea of the feasibility of extending the treatment of anti-retrovirals to all or part of the infected population (Table 14). In Brazil, which has a low HIV population prevalence and a relatively high GDP per capita, all cases could be treated for less than 0.05 per cent of GDP as, indeed, they are for free by the health service. In Botswana, the population prevalence is one of the highest in the world. At a drug price of $300 per year, treatment of all cases would require an expenditure of about 2 percent of GNP. This is a bit more than Botswana's total present public expenditure on health. An important and difficult, but yet feasible, national effort would be required to provide treatment for all cases. The situation is more problematic in countries such as Kenya with medium prevalence but a low GDP per capita. In Kenya, for instance, about 10 of the national GDP would be required to cover all infected people (Kimani 2000). This figure comes pretty close to the total government expenditure in Kenya and it is clearly impossible to allocate such an amount of money to treatment of just one disease. With a massive mobilisation of international assistance for HIV/AIDS equal to, say 3 percent of Kenya's GDP, and the mobilisation of an additional one percent of GDP from national public and private sources, one may be able to treat 40 percent of the population infected. But, in the absence of a massive external and domestic effort about 10% of the population of Kenya

[10] this is clearly a very optimistic assumption. A more realistic assumption about the cost of the treatment would be 500 $ a year, 200 $ for the drugs (not far from the 2001 offer of the yearly treatment at 290$ made by the Sri Aurobindo from India) and 300$ for personnel and lab costs.

will have died from HIV/AIDS within 6-7 years. The reality is even more sombre as – at the moment - the current cost of a yearly treatment with ARVs in Kenya, is close to $1,200 a year, under the Glaxo patent that expires in the year 2014. At an annual cost of $1,200, treatment of all currently infected Kenyans would cost about 40% of GNP.

Table 14. Simulation of the percentage of GDP required to treat the HIV population under a given assumption about the cost of the treatment, prevalence rate and GDP/capita

Country	Population prevalence %	Hypothetical "low" drug price for one year	GDP per capita	%of GDP required for ARV treatment of all infected
Brazil	0.5%	$ 300	$ 3,000	0.05%
Botswana	20%	$ 300	$ 3,000	2%
Kenya	10%	$ 300	$ 300	10%

Source: author's calculations.

Notes: figures used here are rounded off for ease of calculation. Except for the drug price, which is still significantly higher than $300 for a year of treatment, the data closely approximates the true situation in the countries considered. If the drug price in the country is double the figure used here, then the proportion of GNP required should also be doubled.

These figures are purely conjectural but help identifying the conditions in which treatment can gradually be extended. While cost sharing in various forms, including risk pooling and social insurance arrangements may be of assistance in low prevalence-high income countries, the necessary total economic resources are simply not available in high prevalence-low income countries. This applies at current drug prices and will still continue to apply even if costs fall to $300 per year. While this analysis does paint a rather bleak picture for some countries, it can also serve to give some indication of what an affordable price might be. In a country such as Kenya, treatment of all cases would require that the cost of one year of treatment with ARVs must be reduced to 30$ and probably to about $20. Under these circumstances, there is some justification for focussing on "care and support" and for implementing effective measures to prevent further transmission from taking place as the cost of a package of prevention measures would be approximately 1 percent of GDP.

(ii) Introducing simpler therapeutic protocols. The second obstacle to the diffusion of HIV/AIDS treatment is the complexity of the treatment protocols. At present, the patients have to take several tablets a day, be followed by a doctor and undergo regular laboratory controls to check for the virological load in the blood and other side effects of the therapy. In view of this and of the chronic scarcity of qualified health staff in most of Africa, it is difficult to plan an increase in antiretroviral treatment without a substantial simplification of the related protocols. Considerable experimentation is already going on in this area. For instance, innovative attempts to implement HIV/AIDS treatment with a community-based 'barefoot doctor approach' in Haiti (Farmer et al 2001; see also chapter 11) entailing a simplification of the tablets-taking cycle, possibly reducing the cure to a low-toxicity simple tablet a day, better if with structured interruptions that would reduce costs and negative side effects. Some brand names – such as Glaxo's Trizivir – already combine three drugs (zidovudine, lamivudine, abacavir) into a single tablet taken twice a day. Shifting to different drug types may also be a source of simplification and cost reduction. A second change required concerns the replacement of highly specialized doctors and sophisticated laboratories with specialised nurses with a few months of

specific training backed by an adequate referral system for complicated cases and with an approach to the monitoring of virological load, CD4 count and side effects based on clinical examination.

Finally, there is a need to develop a simpler health delivery systems pivoting around outpatient care, home-based care and hospice care. At the moment, more than 90 percent of the health care costs are incurred for inpatient care, with the remaining allocated to outpatient and home-based care. Such distortions could be corrected by improving the quality of community or home-based care, with hospital being used more effectively for referral and other forms of care. The vast literature on this aspect of care provision generally shows that community- and home-based care – particularly if carried out in interactive mode with provincial hospitals - is as effective as hospital based care while being considerably less costly. Especially in urban and peri-urban areas, this approach reduces noticeably administrative and hospital costs and other price and non-price barriers (Haile 2000, Drew et al 1997) including private costs for transport, meals and other items paid for by the patients. This saving would thus allow to raise the coverage of eligible people, increase the continuity of care. Finally, patients included in this program would count also on the psychosocial support of the families and communities to which they belong. Some discordant voice suggests however that home-based care is not effective when dealing with HIV patients living in scattered hamlets in rural areas. In this case, the supposed advantage of home and community care are less. Hansen et al (1998) show for instance that the cost of a visit in a rural home-based care program in Zimbabwe was equal to the costs of 2.7 inpatients days in a district hospital as two thirds of the cost of the home-based care analysed was spent just by getting to the patient.

(iii) Improving resource mobilisation – and diversifying the sources of funding. While drug procurement policies and simplifications of the therapeutic protocols may help reducing the unit cost of treatment, the proposed gradual expansion of ARV treatment entails the mobilisation of additional health resources. As noted in section 2.3, in low-income countries, the increase in total health expenditure during the last 10 years was borne by the household sector, a fact that may have entailed the exclusion of the poor from health care.

The current estimate of the global cost of dealing with AIDS is 7-10 bn, an amount far greater than that mobilizable at the moment and well in excess of the 1 bn US$ yearly international aid to the health sector. But the range of the plausible estimates varies a lot (see Cost of Scaling HIV Programmes toa national Level in SSA: Methods and Estimates). While this is a huge sum, the problem of financing AIDS care will be particularly intense in low income countries. In countries such as Argentina, Brazil, and Mexico, in fact, the cost of an ambulatory service package would represent 0.02, 0.11 and 0.06 percent of GDP. These resources have been and will be likely mobilized in the future.

The situation in low-income African countries is more complex. Examples of different health financing approaches are available (Contact Group mtg 20-05-01; see also the case studies by Abt Associates on Senegal, Guatemala, Rwanda). Except for a few growing African economies – such as Uganda - the increase in AIDS resources care

cannot come from individual patients. Greater efforts ought to be placed therefore on increasing resources in ways that would distribute more equitably the burden of AIDS within the countries affected and internationally. This objective could be reached by means of: co-payments by well-off individuals; the development of risk-pooling arrangements at the local level; the development of health insurance for those employed in the formal economy; the re-allocation of public expenditures from low to high priority sectors; and an increase in earmarked taxation. International resources need also to be increased through debt-for AIDS swaps or fresh money raised from the Global Health Fund adopted by the G-8.

An important component of the financing strategy against AIDS are risk-pooling arrangements to spread the cost of AIDS treatment among a broad pool of people and to avoid the impoverishment of AIDS affected families. Such arrangements include the national health insurance (fairly developed in South Africa and Zimbabwe) and municipal or provincial pre-payment schemes (common in Thailand). Public funding is the broadest form of collective insurance and several countries subsidize the treatment of AIDS to some extent. Mexico covered 76.1 percent of the total health expenditure but only 49 percent of the AIDS expenditure. The state of Sao Paolo in Brazil and Thailand in contrast subsidized 36 and 76 percent of the cost of the AIDS treatment but only 20 and 55 percent of the general health care.

Traditionally, the private companies have turned a deaf ear to the possibility of ensuring their staff against HIV/AIDS. Things are starting to change, however. The power company of Côte d'Ivoire for instance realised that it can be cheaper to cover the cost of ARV treatment than that of extended illness and hospitalisation of HIV-positive employees. Also, inability of entering an ARV treatment program can result in higher payments for disability allowances or survivor benefits, and in high costs of recruiting and training replacement employees (Binswanger, 2001). Moreover, a private insurance company working in East Africa has been able to cover treatment for enrolees in the early stages of the disease (Feeley, 2000). Insurance companies in Mexico took interest in a re-insurance program for asymptomatic HIV-infected people. Be that as it may, it is clear that extending health insurance holds a considerable potential for making the ARV treatment available to many infected people in middle income countries though in these countries, the spread of health insurance will be limited by a high unemployment rate and the size of the informal sector.

In low income countries, risk-pooling arrangements have to expand massively. Mutual Health Organisations are a form of community-based and non-profit health insurance which enable members to pay dues when they are well and little or nothing when sick. From 1999 to 2000 the Project of Health Reform team developed performance indicators for projects undertaken in Ghana, Côte d'Ivoire and Senegal. They showed that these health insurance schemes can represent a short-run solution (until viable national solutions emerge), but for priority services only. Also such scheme seem unable to reach the extremely poor.

Finally, in low-income countries, the public budget has a key role to cover the poor and, especially, the extremely poor. And this brings us back to the decade-long debate on taxation levels and public finance priority in low-income countries. Nothing new can be said here in relation to the debate of the 1980s and 1990s which has highlighted the overall benefits of a pro-poor allocation of public expenditure and the importance of generating adequate levels of revenue. The only additional argument that can be made here is that the cost of inaction is far bigger than in the case of low expenditure in health and education.

5.4 Balancing prevention and prevention in countries with different infection rates

The prior sections have suggested that the fight against HIV/AIDS requires simultaneous efforts in the fields of prevention, mitigation and treatment. Given that public resources assigned to such fight are extremely limited in most countries, the policy maker has to choose how best to allocate them among competing alternatives. The choice of the optimal mix of interventions is obviously conditioned by the HIV prevalence rate of a country, its GNP per capita and distribution; the strength of its health infrastructure; the relative cost and efficacy of various interventions; the coverage of health insurance; the strength of pressure groups aiming at diverting public expenditure to their advantage; and the time horizon within which any program has to be implemented.

So far, the literature has recommended to concentrate the response to AIDS on prevention, palliative care and the treatment of opportunistic infections, especially in countries with high prevalence rates. The main reason adduced to justify this position is the higher unit cost of treatment. This approach is rational when policy is guided by the objective to 'minimize the HIV prevalence rate'. Even in this case – however – a truly rational decision must take into account the interaction between prevention and treatment. In fact, treatment helps optimising prevention, as in the absence of a cure people have no incentives to undergo voluntary testing and to modify their sex behaviours. In addition, treatment reduces the viral load and thus minimizes the probability of transmitting the virus to others.

The optimal mix of interventions may also change if the dominant policy objective is the 'maximizing the years of life'. In this case, the benefits of ARV treatment would emerge more clearly as such therapy lengthens the life of those already infected. Prevention also lengthens the life of those reached by preventative messages, though these do not always entail a behavioural modification. The average cost per person who effectively modified sex behaviour is thus much higher. If those who are reached by prevention and change their behaviour are half of those exposed to the message the costs per capita of prevention raise to $ 20-100 per capita.

Finally, the benefits of ARV treatment would be even more evident if the dominant policy objective were the full evaluation of all costs and benefits of an anti-AIDS strategy. In this case, one should include among the benefits of ARV treatment a slower rise in the number of orphans lacking parental guidance; the lower demand for sickness and orphan allowances and early retirements; the savings on palliative care and the cure

of opportunistic infections; the loss of income by the working age population infected or dead. Finally, as repeatedly noted, the cost of the antiretroviral treatment has been falling rapidly during the last 2-3 years, while the international aid targeted to the treatment of AIDS is rising (as suggested by the International Health Fund of $1.3 billion launched in 2001).

All these arguments suggests that the policy response to AIDS may change depending on whether the effects of treatment on improving the efficacy of prevention is taken into account, the choice of the objective function – whether minimize HIV prevalence, or maximizing the years of life, or valuing all costs and benefits of interventions. The choice of the best policy mix can typically be represented as an optimisation problem and to that effect we have developed for illustrative purposes a simple model illustrated in annex 1 to identify the optimal combination of prevention and treatment measures given different assumptions concerning their costs and effectiveness, the choice of policy objective and the interactions between prevention and treatment.

Two numerical examples illustrate this point. In the first case, the objective is to minimize the prevalence rate. Given the real (i.e. observed) values of the parameters measuring the effectiveness of prevention and treatment activities, the public health expenditure for AIDS will be almost entirely assigned to prevention, with ARV treatment receiving residual funds only (see Table 15). Furthermore, even if the relative cost efficiency of ARV treatment improves because, for instance, of a moderate fall in the cost of ARV (under hypothesis A the unit cost of treatment c_t is 15 times greater than the unit cost of prevention, while under hypothesis B it is 10 times greater), the allocation of public resources does not change, with ARV treatment receiving residual funds only. Likewise, even if the relative efficacy of preventions falls sharply, the percentage allocation of public expenditure assigned to prevention still does not decline.

Table 15. Percentage distribution of public expenditure between prevention and treatment with antiretrovirals under the assumption the policy maker aims at minimizing the HIV prevalence rate

Objective function: minimize the prevalence rate	Percentage of health expenditure assigned to preventative activities	Percentage of PLWA treated
Hypothesis A: unit cost of treatment is 15 times that of prevention	86%	10%
Hypothesis B: unit cost of treatment is 10 times that of prevention	81%	20%
Hypothesis C: unit costs of treatment is 10 times that of prevention - and – efficacy of prevention falls to one quarter of its original value (from z =5 to z=1)	81%	20%

Note: in Hypothesis A, B and C all parameters of the model are unchanged (.e. z_t=2, z_t^e=0, z_t^p=5, c_p=1, r_0=0.1, e_0=1.1, d=0.1) except that under hypothesis C in which it is assumed that z_t^p=4

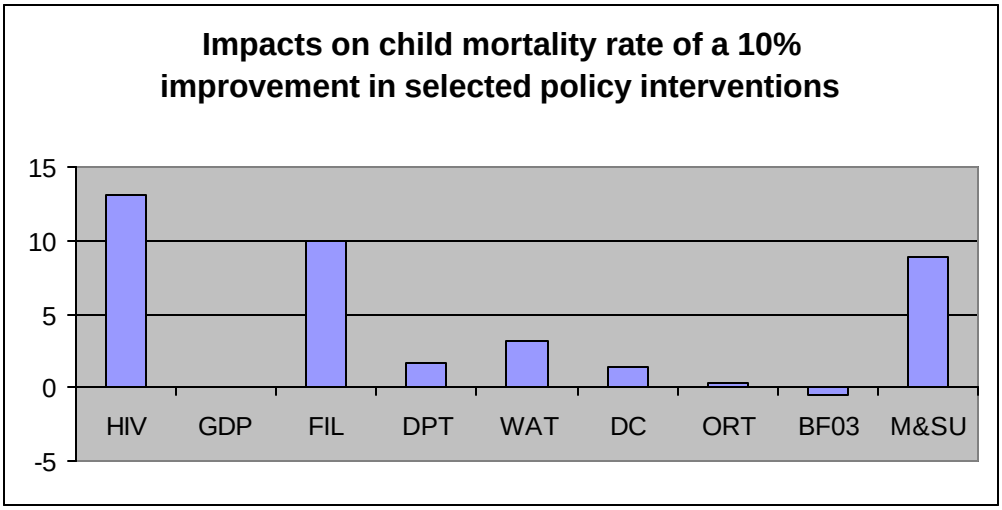
By contrast, if the objective of the policy maker consists in maximizing the numbers of years lived (either through prevention or through care) then, given the same realistic value of the parameters currently relevant costs and effectiveness of prevention and treatment activities, the allocation of public resources will not be entirely assigned to prevention to a smaller extent (see Table 16). Furthermore, if the relative cost efficiency of treatment improves (because, for instance, of a fall in the cost of ARV), then the

proportion of public resources allocated to treatment will reach a consistent amount. Likewise, if the efficacy of prevention falls, the share of resources to be assigned to the therapy with antiretrovirals rises further.

Table 16. Percentage distribution of public expenditure between prevention and treatment with antiretroviral under the assumption the policy maker aims at maximizing the numbers of years lived

Objective function: maximize the number of years lived	Percentage of health expenditure assigned to preventative activities	Percentage of PLWA treated
Hypothesis A: unit cost of treatment is 15 times that of prevention	79%	14%
Hypothesis B: unit cost of treatment is 10 times that of prevention	33%	72%
Hypothesis C: unit cost of treatment is 10 times and the efficacy of prevention falls to one quarter of its original value (from z =5 to z=1)	24%	82%

Note: in Hypothesis A, B and C all parameters of the model are unchanged (.e. z_t=2, z_t^e=0, z_t^p=5, c_p=1, r_0=0.1, e_0=1.1, d=0.1) except that under hypothesis C in which it is assumed that z_t^p=4



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ANNEX 1:
A SIMPLE MODEL TO CHOOSE THE OPTIMAL POLICY MIX BETWEEN PREVENTION AND TREATMENT

(i) modelling the effects of treatment on prevention and viceversa. The purpose of this model is to discuss the choice of the optimal mix of prevention and treatment policies. For the sake of simplicity we will compare the effectiveness and costs of two alternative policies only: a combination of the several preventive policies (condom, MTCT, circumcision, blood screening programmes, information campaigns promoting a decline in the number of sexual partners, a more consistent condom use, and an increase in the age of sexual debut) and a policy focussing on the treatment of HIV positive people with antiretrovirals. We first normalise the population size to 1. For the sake of simplicity, we will compare the effectiveness of the two policies chosen only at time 0 and time 1 where the difference between time 0 and time 1 is equal to the average number of years gained by an infected person undergoing treatment with antiretrovirals.

The evolution over time of the HIV prevalence rate can be described by a continuous nonlinear function where its value at time 1 depends on its value at time 0. At time 1, the HIV prevalence rate would increase (or decrease) with respect to time 0 at a given inertial rate d representing the endogenous dynamics of the epidemics (called "the HIV natural dynamics", hereafter) in the absence of any policy measure. Let denote with r_0 ($0< r_0 <1$) and r_1 ($0< r_1 <1$) respectively the HIV/AIDS prevalence rates at time 0 and time 1. Prevention policy reduces HIV prevalence at time 1 by a factor ($z_p\ x_p$) where x_p ($0 < x_p < 1$) is the percentage of the population reached by the prevention campaign and z_p represents the effectiveness of the prevention policy in terms of its impacts on awareness improvements and behavioural change. Similarly, the treatment policy reduces the HIV prevalence rate at time 1 by the factor ($z_t\ x_t$) where x_t is the percentage of the AIDS infected treated and z_t depicts the effectiveness of the treatment policy in terms of its effects on virus loads and behavioural change. Therefore, at time 1 the *HIV/AIDS prevalence rate* is formally given by:

$$r_1 = r_0(1+d)(1 - z_p x_p - z_t x_t r_0) \qquad (1)$$

At time 1, the proportion of the population still surviving is the proportion of the population not infected at time 1 plus the percentage of people living with AIDS under treatment at time 0. Therefore, at time 1 the *overall surviving rate* is given by:

$$1 - r_1 + x_t r_0 = 1 - r_0(1+d)(1 - z_p x_p - z_t x_t r_0) + x_t r_0 \qquad (2)$$

Both prevention and treatment policies have costs that are borne at time 0. The costs per year per capita of prevention and treatment are c_p and c_t respectively. However, the health expenditure to be borne at time 0 (e_0) is influenced by the two following effects. First, treatment increases the effectiveness (or reduces the average unitary cost) of prevention. We will depict this feature by assuming that c_p decreases by z_t^p for each person with AIDS under treatment at time 0. Moreover, a treatment policy improves the perceptions

among donors of the robust response to AIDS by the national government and so triggers an increase in international aid earmarked to HIV/AIDS which softens the domestic budget constraints. We will represent this feature by assuming that e_0 decreases by z_t^e for each person living with AIDS under treatment at time 0. Therefore, at time 0 the health expenditure to be borne in order to implement the chosen combination of prevention and treatment policies is given by:

$$e_0(1+z_t^e x_t r_0) = c_p(1-z_t^p x_t r_0)x_p + c_t x_t r_0 \qquad (3)$$

Given these three relations, the policy maker can choose two different policy objectives i.e. minimise the prevalence rate at time 1 or, alternatively, maximise the number of years lived at time 1. For each of them, we can identify the optimal combination of prevention and treatment measures given a fixed health budget.

(ii) Solving the model given different objective functions at time 1. If the objective function is to minimise the prevalence rate at time 1, the optimal solution of equation (1) subject to the constraint (3) is given by:

$$\min_{x_p, x_t} \quad r_1 = r_0(1+d)(1-z_p x_p - z_t x_t r_0)$$
$$s.t. \quad e_0(1+z_t^e x_t r_0) = c_p(1-z_t^p x_t r_0)x_p + c_t x_t r_0$$

In contrast, if the objective function chosen aims at maximizing the number of life years saved at time 1, the (dynamic and discrete) the optimal solution of equation (2) subject to the constraint (3) is given by:

$$\max_{x_p, x_t} \quad 1-r_1 + x_t r_0 = 1-r_0(1+d)(1-z_p x_p - z_t x_t r_0) + x_t r_0$$
$$s.t. \quad e_0(1+z_t^e x_t r_0) = c_p(1-z_t^p x_t r_0)x_p + c_t x_t r_0$$

(iii) some general analytical results. The solutions to the first and the second optimisation problems (see Cornia and Zagonari, 2002b) allows to reach the following general insights. If the optimal proportion of the general population reached by prevention (x_p^*) and the optimal proportion of PLWA undergoing treatment (x_t^*) are represented as functions of the effectiveness of prevention (z_p) and of the other parameters introduced above to represent the feed-back effects between treatment and prevention, three qualitatively different patterns emerge in three subsequent ranges. If z_p takes low values (below a specified L), then the general population reached by prevention activities (x_p^*) should be constant at a non negative percentage, while the optimal proportion of PLWA reached by care activities should be 100% ($x_t^*=1$); if z_p takes intermediate values (between specified L and H), then x_p^* is an increasing and concave function, while x_t^* is a decreasing and convex function; if z_p takes high values (above a specified H), then the general population reached by prevention activities should be 100% ($x_p^*=1$), while the optimal proportion of PLWA reached by care activities (x_t^*) should be constant at a non negative percentage. Thus, whichever objective function is adopted, the relative costs and effectiveness could lead to a corner solution where a single

optimal policy is implemented or to an intermediate solution where both policies are implemented.

Next, comparing the solutions of the two optimisation problems led us to deduce that the three relevant subsequent ranges of the effectiveness of prevention activities (z_p) for the maximisation problem are shifted forward with respect to those for the minimisation problem so that L (MAX) > L (MIN) and H (MAX) > H (MIN). Thus, for given relative costs and effectiveness of prevention and treatment, a movement from minimising the HIV prevalence rate to maximising the years of life for the general population and for PLWA could lead to decrease the optimal proportion of the general population reached by prevention (x_p^*) and to increase the optimal proportion of PLWA treated with antiretrovirals (x_t^*). In other words, a greater share of the PLWA should undergo treatment if the objective function is the maximisation of the years of life lived than in the case in which it is the minimisation of the prevalence rate.

(iv) some numerical examples. The analytical results sketched above lead us to deduce that relative rather than absolute values of both costs and effectiveness of prevention and care activities are the relevant factors driving the allocation of public health expenditure on AIDS. Let us normalise both c_p and z_p to 1 so that c_t becomes the relative unit cost of care with respect to prevention, e_0 becomes the health expenditure per capita per year over the unit cost of prevention, and z_t becomes the relative effectiveness of care with respect to prevention. Numerical simulations are then carried out by assigning to the variables expressing the costs and effectiveness of prevention and treatment activities their values currently observed in the real life. In particular, we assume that treatment is twice as effective as prevention, that a 1% increase in the coverage of treatment reduces prevention costs by 50% at 10% HIV prevalence rate, that available resources do not depend on the coverage of treatment, and "the HIV natural dynamics" is 10% in the period under consideration. The analytical results combined with the numerical simulations allowed us to draw the following conclusions:

- Treatment of a positive proportion of the population is an optimal policy only in case the objective function consists of maximising of the number of years lived
- Resources required to achieve a consistent coverage rate for treatment are lower than usually stated: the tables in the text assume an health expenditure per capita per year only 10% larger than the unit cost per capita per year of prevention
- A reduction of one third in the unit cost of treatment with respect to prevention (from 15 to 10 times) will make treatment of a positive proportion of the population be an optimal policy also at large prevalence rates.