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Exploring the Costs of Laboratory Testing for HIV and Major Sources of Funding for Tanzania

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Abstract: Previous studies have shown that the cost of HIV/AIDS on the health care sector will exert impacts on other sectors, thus a big challenge to the country's health system. To determine source of fund and the cost associated with laboratory test of HIV related infections in Tanzania. The cost analysis was limited to seven out of the 26 regions of the United Republic of Tanzania. In each region, the costing process was undertaken at different levels of health facilities in order to cater for any variations in the types and cost of the laboratory services delivered at each level. The total number of 53926 people took HIV related tests which is equivalent of about 6114 people in every laboratory per a year. The financial cost of HIV related test services of the capita assets is estimated at USD 58,000 while annual economic cost on HIV related test services is estimated at USD 9.4 M. It was also found that USD 16,900 was spent on training overall total of 88 staff. The total cost of laboratory supplies and consumables used for testing was USD 550,300 of which USD 504,000 were used on HIV related tests. Recurrent/variable cost claimed 95% of the total cost of delivering HIV test related services of which about 85% was spent on laboratory supplies and consumables while capital cost was only 5%. The findings show that in order to scale up HIV test services putting enough money for lab supplies and consumables is important. The main source of funding for buildings and staff time is the Government because HIV test services take place within the existing structure of health facility in Tanzania while lab equipment, lab supplies and lab consumables are funded mainly by non government agencies.

Key words: Costing, HIV, diagnosis, laboratory, lab equipment, cost analysis, variations

INTRODUCTION

HIV/AIDS is one of the major public health problems with adverse effects on the socio-economic development of many developing countries. Current statistics indicate that over 42 million people worldwide are infected with HIV among whom over 27 million are in sub-Saharan Africa (WHO, 2004). The epidemic has claimed almost 19 million lives over the past 2 decades including 4 million children. Further, the epidemic is one of the contributing factors to orphaned children.

Studies indicate that HIV/AIDS has left over 15 million children orphaned in its wake (WHO, 2004). Sub-Saharan Africa is the world's most severely affected region, with only 10% of the world's population harbouring about two thirds of the global total number of people living with HIV and AIDS (WHO, 2004). It is estimated that one in 12 adults in this region is reported to be infected with HIV. According to Laurent and Diakhote (2002) HIV/AIDS is the leading cause of adult deaths in sub-Saharan Africa. In the year 2000 alone, an estimated 2.4 million out of the global total of 3 million adult and child deaths from HIV/AIDS occurred in the African region. Tanzania is one of the highly affected countries in Sub-Saharan Africa with about 2.5 million people infected with HIV and an estimated prevalence of 9.6% (NACP, 2005).

The impact of the HIV pandemic in Tanzania has been profound and has affected all sectors. Today, HIV/AIDS is recognized not only as a major public health concern but also as social, economic and development problem in Tanzania as in most in Sub-Saharan African

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countries. Since the epidemic is concentrated in developing countries, estimating HIV/AIDS resource allocations and requirements in these countries is key to responding effectively to HIV/AIDS world-wide. However, it is also in these countries that this task is most complicated because their National Health information system required to monitor resource flows is weak or non-functioning and thus lead to limitedness of the data on cost of HIV/AIDS interventions at macro-level crucial for guiding rational national policy decisions. Macroeconomic simulation model estimating the impact of AIDS on the growth path of the economy showed that the GDP would drop between 15-20% by 2010 and would reduce the per capita income by 0-10%. Providing triple ARVs to HIV positive persons would cost 51% of the GDP (UNAIDS, 2004).

Previous studies in South Africa have shown that the cost of HIV/AIDS on the health care sector will exert impacts on other sectors, thus a big challenge to the country's health system (WB, 2003; Gwatkin *et al*., 2000). Globally, estimate made in 1999 indicated that the treatment of a HIV/AIDS case had a financial cost of USD 100-1100. The macro-level analysis done in 1999 reported that the funding for HIV/AIDS for Tanzania was USD 2,292,514 and USD 33,333 from International Donor Agencies and the Tanzanian Government, thus summing up to USD 2,325,847 during that particular year (GOT/MOH, 2003). Previous microeconomic analysis of the impact of this pandemic in Tanzania during the late 1980s up to early 1990s (19) estimated the cost per adult illness episode to range from USD 3.75 for purigo (an allergic skin condition) to USD 237 for tuberculosis. At the same time, pediatric conditions ranged from USD 59 for HIV-associated skin disease to USD 146 for TB. Meanwhile the average lifetime cost per adult TB-AIDS patient was estimated to be USD 59 and for children it was estimated to be USD 51. On the other hand, the average lifetime cost per adult person with all AIDS tracer illnesses was estimated at USD 59. Other estimates for Tanzania indicate that the treatment of one AIDS patient cost Tanzania USD 290 per adult case and USD 195 per pediatric case (WHO, 2004).

Recently, political commitment to respond to the HIV/AIDS pandemic has increased substantially. Hence, the importance of information on resource level and flow of current allocations for HIV/AIDS prevention and care has increased. It is also important to know the services and commodities that are purchased with these funds and the population coverage of implemented interventions (WHO, 2003).

Tanzanian National Aids Control Program reported that AIDS patients account up to 50% of the hospital bed occupancy rate (NACP, 2005). So far, no sound analysis has been done at national level to establish the magnitude of HIV/AIDS cost on the provision of health services from the perspective of public (government) and private health-care providers. However, all these estimates assumed a 100% drug availability situation under the referral system.

Most of the studies which have been conducted so far in Tanzania have focused more on the cost of treatment of AIDS (Makundi *et al*., 2001). However, treatment of AIDS happens only when the patient has been diagnosed with the disease. So the focus of this study, was to determine source of fund and cost associated with laboratory test of HIV related infections. Estimation of this cost will be an important indication of the cost involved in scaling up HIV related test all over the country.

MATERIALS AND METHODS

We conducted a cross sectional study that covered 7 government laboratories from 7 regions of mainland Tanzania namely Dodoma, Mtwara, Tabora, Mwanza, Arusha, Moshi and Morogoro. All four referral laboratories (Muhimbili, Mbeya, Bugando and KCMC referral hospitals) were included. Other three laboratories (Tumbi, Nkinga and Peramiho) were selected based on their geographical location and public ownership in Tanzania mainland. A catalogue and checklist were prepared in which the cost data for physical capital goods and recurrent resources were filled and only research scientists from NIMR collected the data. The catalogue was pre-tested in Dar es Salaam and Coast regions.

In each region, the costing process was undertaken at different levels of health facilities with laboratory units in order to cater for any variations in the types and cost of the lab services delivered. The analysis include laboratory services delivered at government/public, private-for-profit and other non-government health facility organizations such as Faith/Mission health facilities in order to cater for any variations in the types and cost of the lab services delivered at each level. The analysis has tried to determine the cost of running 8 laboratories in 8 regions in 2004 and the costs are based on adjusted 2004 prices as base year.

The annual Average Total Cost (ATC), annual Average Fixed Cost (AFC), annual Average Variable Cost (AVC) for HIV related were established. The HIV related services were considered because of the common opportunistic infections that are normally accompanied by HIV/AIDS like Tuberculosis, Cryptococcus meningitis, Karposis Sarcoma and these related tests included radiology (X-ray, CT-scan, Ultra sound scan), histopathology, bacteriology and chemistry. Also the

capita/fixed (See my comments above) and recurrent/variable cost of keeping these laboratories function in 2004 was analyzed. A standard discount rate of 3% was applied in the computation of the value of capital items allocated/used on the activities under study using the recommended economic formula (Drummond *et al*., 1997). Financial cost was assessed separately from economic cost

RESULTS

Equipment and buildings: Table 1 below shows that there is whole range of capital assets including vehicles, buildings, furniture and other various laboratory equipments used in HIV related test services. All these items are of various models. The financial cost of HIV related test services of the capita assets is estimated at USD 58,000 while annual economic cost on HIV related test services is estimated at USD 9.4 million and these figures incorporate both purchase and distribution costs (Table 1).

Staff training: Medical officers, laboratory personnel and nursing staff received training on HIV related activities between year 2004 and 2005. The average number of days for training ranged between 7 and 18. The overall number of staff trained was 88 at an estimated total financial cost of USD 16,900. Again the sources for training sponsorship were various ranging from government to non government organizations.

Lab supplies and consumables: Consumable items used in HIV laboratories test are indicated in Table 3. The total cost of laboratory supplies and consumables used for testing was USD 550,300 of which USD 504,000 were used on HIV related tests. Various sources donated or funded these items-government and non government. Lab supplies and consumables constitute a big portion of recurrent cost of HIV lab services (Table 2).

Staff time: A range of medical personnel spend some of their time on HIV related services. Staffs included in HIV related services were medical officers, counsellors,

Table 1: Capital cost-equipment and buildings

Item	Estimated purchased price (USD)	% financial cost on HIV (USD)	Annual economic cost (USD)	Annual total economic cost on HIV (USD)	Source/funding
Vehicles	150.000	20.385	5.630	1.198	Donated
Buildings	545.000	12.551	25.438	7.027	Government
Furniture	13.611	6.005	892.000	593.000	Government
Laboratory equipments	83.495	19.059	1.240	545.000	Donated
Total	792.106	58.000	33.200	9.363	

$$\text{Annual econ. cost} = \frac{\text{Purchse price} - \text{Present value of the scrap value}}{\text{Annualization factor}}$$

Source: Calculated from the survey data

Table 2: Recurrent cost-laboratory supplies and consumables

S/n	Item	Quantity obtained in year 2004	Quantity used in year 2004	Estimated purchase price in (USD)	Estimated cost of total used in HIV in (USD)	Estimated cost of total used in HIV in (USD)
1.	Biochem/sterile tubes	16,934.00	9,423.67	4,819.65	2,371.00	104,654.12
2.	Capilus	798.00	798.00	183,540.00	183,540.00	183,540.00
3.	Capilus control kits	56.00	56.00	952.00	952.00	952.00
4.	Capilus flow sol.	128.00	128.00	952.00	952.00	952.00
5.	Carbon fuschin	881.00	577.00	26.43	17.31	10.38
6.	CD4 Count Reagent	3,226.00	3,226.00	50,406.25	50,406.25	50406.25
7.	Cotton wool	7,331.00	5,953.14	14,783.48	12,695.00	3488.01
8.	Determine	1,870.00	1,870.00	263.00	263.00	263.00
9.	Developer (powder)	5,025.80	7,107.00	16,080.67	23,975.80	9740.01
10.	ELISA	346.80	346.80	587.24	587.24	587,248.00
11.	ESR Tubes	1,252.08	1,129.20	9,285.60	7,731.50	2,085.3
12.	Film (935×43 CM)	835.40	795.40	48,619.80	46,120.80	21,629.68
13.	Fixer (powder)	29,617.75	7,694.00	59,235.50	15,388.00	5273.28
14.	Gloves	1,509,676.00	1,376,056.00	12,761.50	11,878.00	5937.35
15.	Gram stain	3,089.14	1,702.14	617.82	340.42	
16.	Haemat tubes	15,991.00	15,980.00	2,899.20	2,870.50	1984.20
17.	Methylene blue	590.00	275.00	28.90	44.68	10.85
18.	Microscope oil 1m.	1,963.00	1,743.00	12,743.40	10,233.80	2029.10
19.	Slides (AFB and CSF)	4,066.00	3,899.00	2,637.00	2,255.50	1115.52
20.	Spirit	940.00	606.00	8,554.00	5,514.60	2130.03
21	Sulphuric acid	572.00	530.00	3,432.00	3,180.00	1086.18
22	Syringes/needles	31,418.00	27,172.00	13,612.00	10,927.39	3740.56
23	Vacutainer needles	29,253.00	24,174.00	232,978.80	158,140.63	102406.66
	Total	1,665,859.97	1,491,241.35	679,876.26	550,385.89	504021.77

Source: Calculated from the survey data

Table 3: Recurrent cost-staff time designated to HIV laboratory test related activities

S/n	Designation	No. of staff	Basic salary/ month (in USD)	Total annual salary in (USD)	Employers' pension/ year in (USD)	Employers' pension/ year in (USD)	Total annual benefits (salary and pension) in (USD)	Fin. Cost on HIV in (USD)
1.	Medical officers	9	3,150.00	37,800.00	477.35	5,728.20	435,528.2	264,621.00
2.	Councellors	4	620.00	7,440.03	93.03	1,116.03	8,566.07	4,278.03
3.	Lab personnel	25	3,498.67	41,984.04	517.05	6,204.6	48,188.64	25,726.41
4.	Nurse personnel	12	2,111.47	25,337.74	3,077.64	3,691.78	29,029.53	25,708.23
	Total	50	9,380.15	112,561.82	139.50	16,740.62	129,302.44	82174.82

Source: Calculated from the survey data

Table 4: Test related to HIV

Type of test	No. of kits brought	No. of kits used	No. of patients tested	Total HIV clients
ALAT	130	63	9247	6292
ASAT	130	63	7988	6292
Bilirubin	236	97	15999	11604
FBP-autolytic reagents	19	13	14461	2218
FBP-detergent	23	13	55542	13119
FBP-diluent sheath	47	22	56622	2218
FBP-other reagents	45	5	56622	7171
S/creatine	126	45	15682	5012
Total			232163	53926

Source: Calculated from the survey data

laboratory personnel and nursing staff. Table 3 shows that annual financial cost of time spent on HIV related services is USD 82,200. Most of this time is funded by the government through salary and pension payments. Little amount of this time is also paid by non government agencies especially laboratory facilities which are not owned by the government (Table 3).

HIV clients: Table 4 indicate that about 216,481 people from the 7 regions undertook some laboratory tests of which 48,914 people undertook HIV related tests. Types of the tests conducted are as indicated in the same table. The total number of HIV clients is an important input in calculation of the average costs of HIV laboratory test and overall cost indication for scaling up this service to other regions of the United Republic of Tanzania (Table 4).

Overall cost: The total cost for all 7 laboratories stood at USD 612,500 which includes annual capital/fixed cost of USD 26,300 and recurrent/variable cost of USD 586,200. The annual average PER PERSON cost FOR all 7 laboratories stood at USD 11.3 which includes annual average capital/fixed cost of about USD 0.48 and annual average recurrent/variable cost of about USD 10.87. Note that annual total recurrent/variable cost, annual average recurrent/variable cost and annual average cost will slightly go up as data on cost of tests critical to HIV, tests related to HIV, maintenance and utilities expenses become available in the country. The total fixed cost is also expected to change slightly as data on the estimated purchase price of laboratory equipment like Centrifuge and Elisa Reader which were also missing. The change in total capita/fixed cost will also affect the annual average capital/fixed cost and annual average total cost.

DISCUSSION

There are several things emerging from the analysis of the cost for the HIV test related services ranging from the cost side and the demand of the service by the HIV client. Firstly, demand for the HIV test related services is noted. Demand for HIV test services shows that for only one year (2004) about 53926 people took HIV related tests in the 7 laboratories which is equivalent of about 6114 people in every laboratory per a year. Since all regions have HIV test related services at regional/district level there is a need to extend the service to lower levels of health facilities including dispensaries and health centres. Extending the service to dispensaries/health centres will increase the number of people tested as distance and related expenses on the part of the client will be reduced significantly though it may not be cost effective approach from the provider's perspective.

Secondly, the analysis shows that 95% of the total cost of delivering HIV test related services in 2004 in the 7 laboratories under study was recurrent/variable cost while about 5% was capital cost. Capital cost claimed a small share because in most case capital investment live in a long period of time and a same time they already exist before the introduction on the service. The same laboratories used to conduct other tests are also used for HIV test related service. One needs to add equipment which carter for HIV test specific.

Thirdly, laboratory supplies and consumables claim a very large share of recurrent/variable cost. About 85% of the recurrent cost is on laboratory supplies and consumables. However, this percentage may change as data on maintenance and utilities become available. Staff time is also a big component in recurrent cost but in most cases it is paid for by the Government. The analysis

shows that in order to scale up HIV test services putting enough money for laboratory supplies and consumables is important.

Lastly, sources of funding HIV test related services are diverse ranging from the Government to non government agencies. The main source of funding for buildings and staff time is the Government while laboratory equipment, supplies and consumables are funded mainly by various non government agencies. The Government is a main funder for buildings and staff time because HIV test services take place within the existing structure of health facility in Tanzania.

However, in a country like Tanzania where health information keeping has numerous weaknesses, it becomes difficult at times to accomplish every step the costing study/process was intended to cover. In this study, it was not possible to calculate/estimate the cost of some fixed capital assets such as buildings due to lack of records intended to be collected at health facility level as it has been the case in other cost studies on major assets such as buildings in many developing countries (Shepard *et al*., 1998).

Similarly, some furniture items were reported (and physically appeared) being very old with their initial establishment cost unrecorded anywhere. This means that even determining the scrap value of such items was really difficult. As a matter of having at least some cost estimates at hand, anecdotal estimates of how their costs were in the past had to be made by the researchers in consultation with the health workers at the health facility visited. Likewise, a realistic discounting capital items to determine their present value and project the possible future cost would only be possible if the initial cost of the item concerned were known, as was the case with other capital items such as vehicles.

Also the analysis and costs computation was hampered by lack of some data in some areas where alternative measures were used. Computation of Annual Average Total Cost, Annual Average Fixed Cost and Annual Average Variable Cost for laboratory service related to HIV test required utilization data of laboratory reagents, utilities and other consumables and need how much in terms of space and cost of the lab buildings or rooms and other major capital assets within the laboratory. Data on all these were not available at each level for 2004 and therefore, assumptions were used in estimating the cost of such materials and resources as reasonably as possible.

CONCLUSION

Sources of funding HIV test related services are diverse ranging from the Government to non government agencies. The main source of funding for buildings and staff time is the Government while laboratory equipment, supplies and consumables are funded mainly by non government agencies. Recurrent/variable cost claimed 95% of the total cost of delivering HIV test related services in 2004 in the 7 laboratories of which about 85% was spent on laboratory supplies and consumables while capital cost was only 5%.

In conclusion, the two major economic effects due to HIV pandemic mainly reduction in the labor supply and increased costs were observed. In labor supply, it means more health care workers are needed as some of them will be working either partly of fulltime with HIV/AIDS programs while in terms of increased costs, there is a direct cost including salaries and expenditure on maintaining health care services. These costs lead to a significant reduction in already weakened economic growth.

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