The impact of AIDS on government service delivery: the case of the Zambia Wildlife Authority

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Background: The loss of working-aged adults to HIV/AIDS has been shown to increase the costs of labor to the private sector in Africa. There is little corresponding evidence for the public sector. This study evaluated the impact of AIDS on the costs and service delivery capacity of a government agency, the Zambia Wildlife Authority (ZAWA).

Methods: Data were collected on workforce characteristics, mortality, costs, and number of days spent on patrol between 2003 and 2005 by 76 current patrol officers (reference subjects) and 11 patrol officers who died of AIDS or suspected AIDS (index subjects). The impact of AIDS on service delivery capacity and labor costs and the net benefits of providing treatment were estimated.

Results: Reference subjects averaged 197.4 patrol days per year. After adjustment index subjects patrolled 68% less in their last year of service ($P < 0.0001$), 51% less in their second to last year ($P < 0.0001$), and 37% less in their third to last year ($P < 0.0001$). For each employee who died, ZAWA lost an additional 111 person-days for management, funeral attendance, vacancy and staff replacement. Each death also cost ZAWA the equivalent of 3.3 years' annual compensation for care, benefits, recruitment, and training. In 2005, AIDS reduced service delivery capacity by 6.0% and increased labor costs by 9.3%.

Conclusion: Impacts on this government agency are substantially larger than observed in the private sector. AIDS is constraining ZAWA's ability to protect Zambia's parks. At a cost of US $500/patient/year, antiretroviral therapy (ART) would result in service improvements and net budgetary savings to ZAWA.

Introduction

Many countries in sub-Saharan Africa have seen mortality among working-aged adults skyrocket in recent years as a result of the HIV/AIDS epidemic. In Zambia, where adult HIV prevalence is currently estimated at 17.0% [1], mortality among working-aged men rose nearly fourfold between 1985 and 1995 [2] and continued to increase over the rest of the decade [3].

The loss of working-aged adults to AIDS has been shown to reduce the productivity and increase the costs of labor in the private sector. Case studies of six large private sector firms in southern Africa conducted between 1999 and 2002, for example, showed that HIV/AIDS among employees increased annual wage costs by 0.4–6.3% [4]. There is little corresponding evidence about the impact of the epidemic on government service delivery, however. Haacker [5] provided the best recent analysis of AIDS and the public sector, but was forced to piece together unrelated results of many different studies to draw his conclusions. Government agencies are often locked into providing generous employee benefits that are negotiated for the civil service as a whole. Unlike private sector firms, moreover, government agencies cannot usually raise prices, change their product lines, relocate, or

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outsource non-core activities in the face of rising labor costs, and fixed annual budgets prevent paying for replacement labor [5]. Instead, the typical response by a government agency to rising labor costs is to reduce the quantity and quality of services delivered.

As part of an assessment of AIDS and the tourism sector in Zambia [6], we evaluated the impact of AIDS on the capacity of the Zambia Wildlife Authority (ZAWA) to deliver its core service of patrolling Zambia’s wildlife refuges. ZAWA protects the national parks that are the main attraction for tourists to Zambia, thus providing a service that is critical to economic growth and employment creation in Zambia. Constraints on its capacity to deliver that service may hinder development for the country as a whole, as well as threaten wildlife conservation. This paper presents the results of the ZAWA analysis and uses those findings to model the potential benefits to ZAWA of implementing an effective AIDS treatment programme.

Methods

Study site
ZAWA, a line agency under Zambia’s national Ministry of Environment, Tourism, and Natural Resources, is charged with protecting and managing the country’s national parks and game management areas. Its workforce is widely dispersed, with most employees posted to remote camps for long periods of time. More than two thirds of ZAWA’s 1450 employees are patrol officers whose primary responsibility is to protect the parks and game management areas against poachers. Patrol officers, almost all of whom are men, typically spend 15–20 days per month on patrol, camping in the wilderness for up to 2 weeks at a time in teams of four to eight officers. The work is physically demanding and potentially dangerous, and access to medical care is limited. Patrol officers also perform some non-patrol tasks, such as manning entry gates or operating the radio.

ZAWA provides relatively generous life insurance, death, and funeral benefits to its staff, as well as family housing and other allowances. Most staff have their primary partners and young children with them at the base camps, although officers are away from their families while on patrol. No medical care is provided by ZAWA. All employees are eligible for substantial amounts of paid sick leave, and officers who are not fit to go on patrol are often assigned less strenuous non-patrol duties. As of early 2006, very few ZAWA employees had access to antiretroviral therapy (ART).

Data collection
We obtained individual-level data from ZAWA on the demographic characteristics of the full ZAWA workforce as of late 2005 and of ZAWA employees who died in service between 2003 and 2005. In addition, data were collected from ZAWA’s payroll database on the number of days on patrol per month between January 2003 and September 2005 for all patrol officers assigned to four base camps, including those who had died in service of known or suspected AIDS-related causes and those currently in service. The dataset contained one observation per month for each study subject, indicating either a number of days on patrol, a non-patrol task, or a type of absence.

ZAWA managers estimated the costs to the agency of death and funeral benefits and recruiting and training replacements for those lost to AIDS, and a convenience sample of the supervisors of employees who had died in service completed questionnaires about productivity losses associated with each employee’s death. Data from the 2000–2001 Zambia Demographic and Health Survey (DHS) [3] were used to estimate HIV prevalence and AIDS-related mortality in ZAWA’s workforce. Although the Zambia DHS estimated general population prevalence, rather than that of employed individuals, its findings are not inconsistent with those of published workforce data for Zambia [7].

Ethical review was provided by the Boston University Medical Center and the University of Zambia.

Data analysis
The study aimed to assess three specific outcomes resulting from HIV/AIDS among ZAWA employees: change in the number of days spent on patrol by individual patrol officers; effect on service delivery capacity; and direct costs to ZAWA’s budget. In addition, the net benefits of providing treatment to employees with AIDS were modelled.

For each ZAWA employee who died in service of AIDS-related causes, we estimated the direct costs to ZAWA for morbidity, mortality, and replacement of the lost worker, using a methodology described previously [4]. We then multiplied the consequences to ZAWA of losing one employee to AIDS by the estimated number of employees who terminated because of AIDS in 2005. Cost and mortality estimates were stratified by job level and age group. Zambian kwacha were converted to US dollars at the 2005 average rate of ZMK 4540/US$1.

To estimate the impact of AIDS on the amount of time spent on patrol by wildlife police officers, we compared the number of days on patrol per month by index subjects with the number of days on patrol per month by reference subjects using linear regression and robust standard errors, with adjustment for age and location. Because ZAWA is a public sector agency whose mandate is service delivery, rather than a for-profit company, it does not incur financial costs as a result of diminished productivity among employees. The impact of impaired productivity is instead a decline in service delivery: in ZAWA’s case, a
reduction in the organization’s capacity to protect the national parks and wildlife management areas. We therefore estimated the proportion of potential service delivery that ZAWA cannot provide as a result of AIDS-related morbidity and mortality, and kept the result as a separate indicator, rather than aggregating direct costs and service delivery impacts into a single number.

To estimate the net benefits of providing ART to ZAWA employees, we used parameters from the literature and made assumptions about how the costs of AIDS without treatment will be altered by treatment. The net benefits or costs of providing treatment under these assumptions were then calculated per employee treated and for all eligible employees. Finally, we evaluated how ART would change the cost per unit of services provided, which in ZAWA’s case was labeled ‘cost per patrol day produced’, a metric created for this study. Assumptions and parameter values used for both treatment analyses are reported with the results.

Results

Demographic composition of workforce, HIV prevalence, and mortality

In 2005 ZAWA had 1454 employees. More than two thirds of these were patrol officers and 90% were men. The workforce was relatively old, with an average age of 39 years. The average annual compensation (salary plus allowances) for wildlife police officers was US$2413.

No HIV seroprevalence data are available for ZAWA’s workforce, so prevalence had to be modelled. ZAWA’s camps bring together in remote locations working-aged Zambians from throughout the country. Although most staff have their spouses with them, patrol officers spend much of their time away from their families, either on patrol or visiting nearby towns and home villages. ZAWA’s camps therefore bear greater resemblance to mobile urban communities than to rural villages, and we used the Zambia DHS 2000–2001 prevalence estimates for urban men [3] to represent ZAWA’s risk profile. After adjusting for ZAWA’s age distribution, HIV prevalence across the full workforce was estimated at 25.8%, or a total of 374 HIV-positive employees.

As the cost and impact models are based on AIDS-related mortality, rather than HIV prevalence, an estimate of mortality was also needed. ZAWA lost 49 employees to death in service in the 12 months of 2005. The average age at death was 41 years. Of the 49 deaths, 47 were from natural causes. Death certificates reported that 23 of these were caused by AIDS or AIDS-related infections, such as tuberculosis and pneumocystic pneumonia. A further 22 were attributed to ‘long illness’, in Zambia typically a reference to AIDS. The proportion of observed deaths likely to have been AIDS related, 45 of 49, although high, is not outside the range that could be expected, given the very high prevalence of HIV in this population [8].

The number of observed AIDS-related deaths ZAWA experienced in 2005, 45, as explained above, was equal to 12.0% of the number of HIV-positive employees we estimated (374) and was thus consistent with expected mortality from AIDS. In an untreated, male, HIV-positive population in a country with a mature AIDS epidemic, such as Zambia, UNAIDS recommends assuming an 8.6-year median interval between infection and death [9]. Approximately 11.6% of the population can thus be expected to die each year. We therefore estimated an annual AIDS-related mortality rate of 3.0% (25.8 × 11.6%). Death was the most common reason for termination from ZAWA in 2005; in recent years, death has accounted for approximately 80% of all terminations from ZAWA.

Impact of HIV/AIDS on days on patrol

Patrolling data were collected for 242 patrol officers. After removing records for 11 female officers, who are not usually assigned to field patrols, six officers who resigned, retired, or were dismissed during the study period, and 123 officers for whom data appeared incorrect or incomplete, the analytical dataset contained records for a total of 87 patrol officers. Of these, 11 had died in service of AIDS or suspected AIDS during the study period (index subjects) and 76 were still in the workforce at the time of data collection (reference subjects).

Reference subjects spent an average of 197.4 days on patrol per year. After adjusting for age and worksite, index subjects spent 62.8 days on patrol in their last year of service (68% decrease, \( P < 0.0001 \)), 96.8 days on patrol in their second to last year of service (51% decrease, \( P < 0.0001 \)), and 123.7 days on patrol in their third to last year of service (37% decrease, \( P < 0.0001 \)). Over the course of the 3-year period, index subjects lost an average of nearly 1.6 person-years of service delivery compared with reference subjects.

In interpreting these results, it should be kept in mind that the estimate above captures only the quantity of missed patrol days; it does not take into account differences in the quality of work while on patrol. Patrol officers who are fit enough to go on patrol but not to perform all the tasks required in the field may be assigned lighter duties, such as cooking or guarding the patrol unit’s temporary field camp, rather than seeking poachers. As with other instances of team production [10], a patrol unit composed of six officers may be able to absorb one sick member; more than one or two may cripple the entire unit. On the other hand, days when an officer is not on patrol are not necessarily unproductive, as officers who are not fit for patrol can perform other essential tasks, such as manning park entry gates, freeing up healthier staff for patrolling duties.
Service delivery impacts
As reported above, patrol officers who died of AIDS-related causes spent 309 fewer days on patrol in their last 3 years of service than did other officers. There are also productivity losses incurred by other employees as a result of a co-worker’s illness and death. Supervisors and managers reported spending an average of 11 days taking care of the sick employee, interacting with their family, providing transport, adjusting the patrol schedule, processing paperwork, arranging the funeral, and interviewing replacement candidates. An average of 30 employees attend each funeral, losing one workday each. Positions are typically vacant for 2.5 months, and ZAWA estimates that new employees are only approximately 75% productive during their first 3 months on the job, as they settle into the camp, become familiar with procedures and learn their jobs. Taken together, these losses add up to 2.0 person-years of lost productivity per AIDS-related death. Total AIDS-related deaths in 2005 are estimated to have reduced ZAWA’s service delivery capacity by 6.0%.

Direct costs
ZAWA incurs four types of direct costs when it loses an employee to HIV/AIDS. First, although ZAWA does not pay for medical care, managers report spending an average of US$441 on other types of care and support for a sick employee and his family, such as transport to the hospital, lodging for visiting family members, etc. Second, all employees belong to a group life insurance scheme, which provides beneficiaries with an amount equal to 3 years’ annual base salary. For the average patrol officer, this comes to US$4254. Third, ZAWA also contributes funds for the funeral, including a grant to the family, purchase of a coffin, hiring of transport for funeral guests, and relocation of the body or family to the deceased employee’s home community. The average cost to ZAWA per funeral is US$1557. Finally, ZAWA must pay to recruit and train a replacement worker. Recruitment costs an average of US$1100 per new employee; training of new patrol officers averages US$550. The total average direct cost per death comes to US$7869, or 3.3 times the annual compensation averaging US$550. The total average direct cost per death is US$272 860. Even if the costs of treatment were doubled, to US$1000/patient per year, ZAWA would save US$827 860. Even if the costs of treatment were doubled, to US$1000/patient per year, ZAWA would save US$120 000/year, with net benefits at all job levels. This outcome has not prevailed for all organizations we have studied; for private sector firms that rely heavily on unskilled labor, it is difficult to demonstrate positive financial returns to the treatment of junior staff [12].

Cost per patrol day produced
We examined the cost per patrol day produced under three scenarios: (i) a hypothetical ‘no AIDS’ scenario in which all patrol officers are assumed to be healthy; (ii) the status quo, in which many patrol officers have HIV/AIDS but few are receiving treatment; and (iii) an intervention scenario, in which a specified proportion of eligible patrol officers receive treatment with ART. We first estimated the total number of days on patrol per year provided by 1000 patrol officers under each scenario, using the findings reported above. We then estimated the total organizational budget under each scenario using a set of assumptions about operating costs and treatment costs, uptake, and outcomes. Finally, we divided the budget for each scenario by the total number of patrol days provided, to generate a measure of average cost per patrol day produced. As the total number of individuals on treatment under the intervention scenario is cumulative, we estimated costs for the intervention scenario after 5 years of the intervention. Key assumptions are shown in Table 1.

Results of the scenario analysis after 5 years of the intervention are shown in Table 2.

Table 2 concludes that in the presence of AIDS, and without treatment (scenario 2), the cost of a patrol day produced by ZAWA is almost 11% higher than it would be if all workers were healthy (scenario 1). As scenario 1,
ART, Antiretroviral therapy; ZAWA, Zambia Wildlife Authority.

AIDS-related termination parameters

The findings in Table 2 are robust to reasonable changes in input parameters, including doubling the variable cost of treatment to US$1000/patient per year, reducing the uptake of treatment to just 25% of medically eligible patrol officers, or reducing the productivity of treated patrol officers to 50%. Even the combination of all three changes together (low uptake, higher costs, and poorer productivity outcomes) generates a cost per patrol day produced that is almost identical to the status quo, after 5 years of the treatment intervention.

### Discussion

The analysis in this paper suggests that the capacity of ZAWA to achieve its mission of protecting and managing Zambia’s parks and reserves is being compromised by HIV/AIDS. ZAWA is already struggling to fulfill its responsibilities, with an annual budget that keeps staff numbers well below the established target. By preventing existing employees from working productively, HIV/AIDS is effectively diminishing those numbers by another 6%, or the equivalent of more than 85 employees. The money spent in 2005 on direct costs, moreover, would have paid the salaries and allowances of approximately 135 additional employees. Taken together, this represents a total of 220 person-years of service delivery lost as a result of AIDS every year, or the equivalent of 15% of ZAWA’s current workforce.

In some respects, ZAWA represents an extreme case among government agencies. Most of its staff are located as far from healthcare facilities as is possible in Zambia, and the work they do is more demanding physically than is that of most government employees. For these reasons, both HIV prevalence and the impact of AIDS may be greater for ZAWA than for other government agencies. A study conducted among public sector healthcare professionals in 2004 found similarly high levels of natural cause mortality: 2.8 and 3.5% for clinical officers and nurses, respectively. It estimated that the cost to the Ministry of Health was only 3.6% of annual compensation, but the estimate excluded the costs of training and the reduced quantity and quality of healthcare services provided. Were these included, the costs in that agency would probably have been much higher, although

### Table 1. Parameter values used for the cost-per-patrol-day analysis.

<table>
<thead>
<tr>
<th>Parameters</th>
<th>Values</th>
</tr>
</thead>
<tbody>
<tr>
<td>No. of patrol officers employed by ZAWA</td>
<td>1000</td>
</tr>
<tr>
<td>Average days on patrol/office/year when healthy</td>
<td>197.4</td>
</tr>
<tr>
<td>Patrol labor costs as proportion of ZAWA’s total annual budget (estimated)</td>
<td>40%</td>
</tr>
<tr>
<td>Fixed costs and non-patrol labor as proportion of ZAWA’s total annual budget</td>
<td>60%</td>
</tr>
</tbody>
</table>

### Table 2. Cost per patrol day produced with and without a treatment intervention (year 5).

<table>
<thead>
<tr>
<th>Variable</th>
<th>Scenario 1 (no AIDS)</th>
<th>Scenario 2 (status quo)</th>
<th>Scenario 3 (intervention)</th>
</tr>
</thead>
<tbody>
<tr>
<td>No. of patrol officers by status</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Last year before AIDS death</td>
<td>0</td>
<td>30</td>
<td>7</td>
</tr>
<tr>
<td>Second year before AIDS death</td>
<td>0</td>
<td>30</td>
<td>7</td>
</tr>
<tr>
<td>Third year before AIDS death</td>
<td>0</td>
<td>30</td>
<td>7</td>
</tr>
<tr>
<td>On treatment</td>
<td>0</td>
<td>0</td>
<td>112</td>
</tr>
<tr>
<td>Healthy</td>
<td>1000</td>
<td>910</td>
<td>866</td>
</tr>
<tr>
<td>Total patrol officers</td>
<td>1000</td>
<td>1000</td>
<td>1000</td>
</tr>
<tr>
<td>Total patrol days produced/year</td>
<td>197.400</td>
<td>185.201</td>
<td>189.927</td>
</tr>
<tr>
<td>Average cost per patrol day produced</td>
<td>US$28.14</td>
<td>US$31.18</td>
<td>US$29.94</td>
</tr>
<tr>
<td>Compared with scenario 1 (all patrol officers healthy), cost per patrol day is lower by</td>
<td>n.a.</td>
<td>10.8%</td>
<td>6.4%</td>
</tr>
<tr>
<td>Compared with scenario 2 (status quo), cost per patrol day is lower by</td>
<td>9.8%</td>
<td>n.a.</td>
<td>4.0%</td>
</tr>
</tbody>
</table>
perhaps not reaching the 9.3% of compensation that we estimated for ZAWA [13,14].

Although other types of agencies may not suffer losses as great as ZAWA’s, the results presented here are still cause for alarm. Throughout Africa, skills shortages and budget shortfalls combine to keep service delivery agencies persistently understaffed and inadequately experienced. High HIV/AIDS-related morbidity and mortality in government workforces intensify this problem in three ways: skilled and experienced employees die prematurely; many of those still in the workforce are sick and unproductive; and the costs of care, benefits, and replacement drain the operating budget.

ZAWA’s losses are far greater than we have seen in most private sector workforces around Africa [15]. Compared with private sector companies, government agencies have relatively little recourse for mitigating AIDS-related losses in the short term, and output of services declines instead. In the longer term, several strategies may lessen the impact of AIDS on government. Greater investments in training can offset the loss of skilled workers. Employee benefits schemes can be re-designed to address the immediate needs of HIV-positive employees and their families, while ensuring that HIV-negative employees, who still constitute the vast majority of the workforce, retain the longer-term benefits they will need. Medical retirement procedures can be streamlined to encourage chronically ill workers to retire before incurring large costs for sick leave. Work schedules can be adjusted to accommodate workers who need to seek medical care or cannot manage night shifts or strenuous conditions. Perhaps most feasibly, effective treatment for AIDS can be provided to those who need it.

One of the main conclusions emerging from this analysis is that targeting care and treatment to HIV-positive ZAWA employees is clearly justified, as is an enhanced HIV prevention and destigmatization effort. The dispersed location of ZAWA’s workforce and unusual conditions under which ZAWA staff live and work will pose a challenge to all kinds of service delivery. An analysis of the costs and benefits of different options for providing services should be conducted as soon as possible. Given ZAWA’s budget constraints, external support is likely to be needed to pay for services.

The study presented here had some limitations, resulting mainly from a reliance on existing workplace data collected for non–research purposes. The dataset we obtained for the analysis of the impact of AIDS on patrol days was incomplete in several ways. Most employees included in the dataset were missing one or several monthly observations (i.e. calendar months in which the employee did not appear in the ZAWA database or had no task or status reported). Some reference subjects were excluded from the analysis as a result of missing observations. For a substantial number of reference subjects in the original dataset, the number of days on patrol per month was reported as zero for a large number of months, with no other task or status indicated. We were unable to interpret these zeros, which could have indicated illness, assignment to non–patrol tasks, or poor record keeping. Instead, we excluded from the analytical dataset any reference subject for whom more than 25% of monthly observations were zero. Finally, ZAWA records only one activity or task per employee per month. In many cases, only a small number of patrol days was shown. During the rest of the month these workers were presumably either on non–patrol duty or absent, either of which could indicate illness.

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