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The Impact of AIDS on Government Service Delivery: The Case of the Zambia Wildlife Authority

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Abstract

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 capacity of a government agency, the Zambia Wildlife Authority (ZAWA), to patrol Zambia's national parks.

Methods: Data were collected from ZAWA on workforce characteristics, recent mortality, costs, and the number of days spent on patrol between 2003 and 2005 by a sample of 76 current patrol officers (reference subjects) and 11 patrol officers who died of AIDS or suspected AIDS (index subjects). An estimate was made of the impact of AIDS on service delivery capacity and labor costs and the potential net benefits of providing treatment.

Results: Reference subjects spent an average of 197.4 days on patrol per year. After adjusting for age, years of service, 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, $p<0.0001$). For each employee who died, ZAWA lost an additional 111 person-days for management, funeral attendance, vacancy, and recruitment and training of a replacement, resulting in a total productivity loss per death of 2.0 person-years. Each AIDS-related death also imposed budgetary costs for care, benefits, recruitment, and training equivalent to 3.3 years' annual compensation. In 2005, AIDS reduced service delivery capacity by 6.2% and increased labor costs by 9.7%. If antiretroviral therapy could be provided for $500/patient/year, net savings to ZAWA would approach $285,000/year.

Conclusion: AIDS is constraining ZAWA's ability to protect Zambia's wildlife and parks. Impacts on this government agency are substantially larger than have been observed in the private sector. Provision of ART would result in net budgetary savings to ZAWA and greatly increase its service delivery capacity.

Key words: Zambia, HIV/AIDS, antiretroviral therapy, labor productivity, government

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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 percent,[1] mortality among working-aged men rose nearly four-fold between 1985 and 1995[2] and continued to increase over the rest of the decade.[3] As a result, male life expectancy at birth has fallen to just 39 years.[4]

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. A set of detailed case studies of six large private sector firms in South Africa and Botswana conducted between 1999 and 2002, for example, concluded that HIV/AIDS among employees increased annual wage costs by 0.4-6.3 percent.[5] Looking more narrowly at labor productivity, HIV-positive commercial farm workers in Kenya were found to harvest an average of 30-35 percent less crop than other workers in each of the last two years prior to an AIDS-related death.[6]

There is little corresponding evidence about the impact of the epidemic on government service delivery, however. Haacker (2004) provides the best recent analysis of AIDS and the public sector but is forced to piece together results of many different studies to draw his conclusions.[7] Quantitative research on the public sector has generally stopped at the point of estimating AIDS-related attrition rates and budgetary costs.[8] The next logical step is to inquire how losses of public sector employees to AIDS is affecting the core service delivery function of government.

Unlike private sector firms, government agencies usually cannot raise prices, change their product lines, relocate, or outsource non-core activities in the face of rising labor costs. Since most line agencies are given fixed annual budgets by the national treasury, they are also unable simply to pay the higher costs of labor, for example by engaging temporary staff.[7] Instead, the most likely response by a government agency to rising labor costs is to reduce the quantity and/or quality of services delivered.

As part of a broader sectoral assessment of AIDS and the tourism sector in Zambia,[9] 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. We also estimated the increase in labor costs to ZAWA caused by AIDS. ZAWA is Zambia's main conservation agency, charged with protecting and managing 53 national parks and protected areas that cover 65,000 km^2 and are the main attraction for tourists to Zambia. As such, ZAWA provides 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 program.

Methods

Study site

The Zambia Wildlife Agency is a line agency under Zambia's national Ministry of Environment, Tourism, and Natural Resources. It is charged with protecting and managing the country's national parks and game management areas. Although its headquarters are in

Lusaka, the capital city, its workforce is widely dispersed throughout the country, with most employees posted to remote base camps in the national parks for long periods of time.

More than two thirds of ZAWA's roughly 1,450 employees are patrol officers, including Wildlife Police Officers, Senior Wildlife Police Officers, and community scouts, whose primary responsibility is to patrol the parks and game management areas and protect against poachers. Patrol officers, almost all of whom are male, typically spend 15-20 days per month on patrol, camping in the wilderness for up to two weeks at a time in patrol units comprised of 4-8 officers. The work is physically demanding and potentially dangerous, and access to medical care is limited. ZAWA routinely records the number of days spent on patrol per month by each officer. Patrol officers also perform some non-patrol tasks, such as manning entry gates, providing security for ZAWA facilities, 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 at least some family members, such as primary partners and young children, with them at the base camps, though officers are away from their families while on patrol. Larger base camps maintain primary schools and primary health clinics on site. No other medical care or medical benefits are provided by ZAWA.

A workplace HIV policy has been developed by ZAWA, and the organization has undertaken some education and awareness activities. It does not yet have a proactive or sustained workplace AIDS program, however. All employees are eligible for substantial amounts of paid sick leave, and officers who are not fit to go on patrol are often assigned non-patrol duties, which are less strenuous than patrolling. Chronically ill employees may be transferred out of the base camps to regional offices, where living conditions are less harsh and there is access to public sector medical facilities. As of early 2006, very few ZAWA employees had access to antiretroviral therapy or other dedicated HIV/AIDS care.

Data collection

Five types of data were collected. First, we obtained individual-level data on the demographic characteristics of the full ZAWA workforce as of late 2005 from the agency's headquarters in Lusaka. Demographic data and cause of death, as reported on death certificates, were also obtained for all ZAWA employees who died while in service in 2005. Second, data were collected from ZAWA's payroll database on number of days on patrol per month between January 2003 and September 2005 for all wildlife police officers assigned to four base camps in ZAWA's Western and Lower Zambezi management regions. These included patrol officers who had died in service of known or suspected AIDS-related causes (index subjects) and officers currently in service (reference subjects). The data set contained one observation per month for each study subject, indicating either a number of days on patrol that month or a non-patrol task or status, such as absent. Reference subjects for whom more than 25 percent of the monthly observations were reported as zero, with no other task or status indicated, were excluded from the analytic data set, as were subjects who were missing an observation for the last month of the study period, September 2005.

Third, we interviewed ZAWA managers to obtain estimates of the costs to the agency of death and funeral benefits and recruiting and training replacements for those lost to AIDS. Fourth, a convenience sample of the supervisors of specific employees who had died in service completed questionnaires about productivity losses associated with each employee's

death. Finally, we used data from the 2000-2001 Zambia Demographic and Health Survey[3] to estimate HIV prevalence and AIDS-related mortality in ZAWA's workforce.

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 number of days spent on patrol by individual patrol officers; direct cost to ZAWA of HIV/AIDS-related morbidity and mortality; and impact on service delivery capacity. In addition, the net benefits of providing treatment to employees with AIDS were modeled using two approaches: a standard benefit-cost analysis and an analysis of "cost per patrol day produced," a metric developed for this study.

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 of reference subjects using linear regression and robust standard errors, with adjustment for age and location (base camp). No adjustment for sex was needed, as all officers on field patrol duty are male. Tobit regression yielded similar results to linear regression, so the linear results were used because the coefficients are directly interpretable as differences in productivity (days on patrol) between index and reference subjects.

We adapted methods from earlier private sector research to estimate the direct or budgetary cost to ZAWA of AIDS-related morbidity and mortality in the workforce.[5] For each ZAWA employee who dies in service of AIDS-related causes, we estimated the direct costs that ZAWA incurs at three stages: while the employee is ill, when he or she dies, and while a replacement is being hired and trained. We then multiplied the direct cost to ZAWA of losing an employee to AIDS by the estimated number of employees who terminated due to AIDS in 2005. Cost and mortality estimates were stratified by job level and age group. Zambian kwacha were converted to U.S. dollars at a rate of ZMK 4540/$1, the average exchange rate in 2005.

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. Specific direct costs and service delivery impacts at each stage are shown in Table 1.

Table 1. Costs and service delivery impacts included in the analysis

Stage	Budgetary (direct) costs	Service delivery (indirect) impacts
Illness	• Medical and other care	• Reduction in patrol days due to illness • Supervisor's time to manage sick employee
Termination	• Group life assurance • Funeral benefits	• Funeral arrangement and attendance
Replacement	• Recruitment and training of replacement	• Vacancy and time to interview job candidates • Productivity loss due to replacement's inexperience

To estimate the net benefits of providing antiretroviral treatment to ZAWA employees, we used parameters from the literature and a set of assumptions about how the costs of AIDS without treatment will be altered by treatment. Parameter values and assumptions are reported with the results of the analysis. Care and treatment, including ART, was assumed to cost $500/patient/year. The net benefits or costs of providing treatment under these assumptions were then calculated per employee treated and for all eligible employees at each job level. For this analysis, lost service delivery time was valued at the average compensation rate at each job level. Future costs and benefits were not discounted; the effect of discounting would be to reduce the real costs of treatment and increase the net benefits.

Finally, in addition to the cost-benefit analysis described above, 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." We first estimated the total number of days on patrol per year provided by all 1,000 patrol officers under three scenarios: a hypothetical no-AIDS scenario in which all staff are healthy; a status quo scenario, in which AIDS-related mortality is as observed in 2005; and an intervention scenario, in which staff have access to care and treatment, including ART. 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. Since the total number of individuals on treatment under the intervention scenario is cumulative, we estimated costs for the intervention scenario after five years of the intervention.

Results

Demographic composition of workforce, HIV prevalence, and mortality

In 2005, when data for the study were collected, ZAWA had 1,454 employees. More than two thirds of these were patrol officers, at the level of senior wildlife police officer, wildlife police officer, or community scout. Almost all (90%) were male. The workforce is relatively old, with an average age of 39. The average annual compensation (salary plus allowances) for wildlife police officers was $2,413.

There are no HIV seroprevalence data available for ZAWA's workforce. We therefore estimated HIV prevalence as follows. Although ZAWA's camps are located far outside urban areas, they are also far from resembling traditional rural settings. The camps bring together in remote locations working-aged Zambians from throughout the country. Although most staff have their spouses and young children with them, there is a good deal of travel to nearby towns and home villages. They thus bear greater resemblance to mobile urban communities than to rural villages. We therefore used the Zambia DHS 2000-2001 prevalence estimates for urban males[3] to represent ZAWA's risk profile. After adjusting for

ZAWA's age distribution, we estimated HIV prevalence across the full workforce to be 31.2 percent, or a total of 454 HIV-positive employees.

Since the cost and impact models are based on AIDS-related mortality, rather than HIV prevalence, an estimate of mortality was also needed. We initially assumed that approximately 10 percent of HIV-positive individuals in a typical population will die of AIDS-related causes in any given year, in the absence of antiretroviral therapy and assuming a 10 year median interval between infection and death. This led to an estimate of 45 AIDS-related deaths per year. We then compared this estimate to the observed number of natural cause deaths in 2005. ZAWA lost 49 employees to death in service in the 12 months of 2005. The average age at death was 41 years. Table 2 shows the causes of death reported on death certificates and our judgment as to whether a cause was likely to have been AIDS-related.

Table 2. Causes of death of ZAWA employees in 2005

Reported cause of death	Number of deaths	Likely to have been AIDS-related?
Natural causes		
"Long illness" or "natural illness" (no clear diagnosis)	22	Most or all
Pulmonary TB	6	Most or all
TB due to AIDS or with other AIDS-related illness	6	All
AIDS or immunosuppression	7	All
Pneumonia (PCP)	1	All
Cryptococcal meningitis	3	All
Viral encephalitis	1	Probably not
Malaria	1	No
Total natural causes	47	
Non-natural causes		
Accident (road accident)	1	No
Violence (shooting by poacher)	1	No
Total non-natural causes	2	
Total deaths	49	≤ 45

Our estimate of the number of AIDS-related terminations in 2005 (45) closely matched the actual number of natural cause deaths ZAWA experienced that year (47). The proportion of observed deaths likely to have been AIDS-related—up to 92 percent as shown in Table 2—while high, is not outside the range that could be expected, given the very high HIV prevalence in this population.[10] We thus estimated an annual AIDS-related mortality rate of 3.1 percent. Death was the most common reason for termination from ZAWA in 2005, accounting for 46 percent of all terminations. ZAWA managers reported that an unusually large number of employees retired in 2005; in a typical year, death in service accounts for roughly 80 percent of all terminations.

Impact of HIV/AIDS on days on patrol

Patrolling data were collected for 242 patrol officers, including Wildlife Police Officers, Senior Wildlife Police Officers, and Community Scouts. After removing records for 11 female officers, who are not usually assigned to field patrols; 6 officers who resigned, retired, or were dismissed during the study period; and 123 officers for whom data appeared incorrect or incomplete, the analytic data set 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 three-year period, index subjects lost an average of nearly 1.6 person-years of service delivery, relative to 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,[11] a patrol unit comprised 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 there are a few essential non-patrol tasks that must be performed, such as manning park entry gates. Officers who are not fit to go on patrol but can function in camp can be assigned to these other tasks, freeing up healthier staff for patrolling duties. Although we were not able to capture such shifts of responsibility in our analysis, ZAWA managers reported a substantial increase in the number of officers assigned to non-patrol tasks, beyond the number actually needed.

Service delivery impacts

As reported above, patrol officers who died of AIDS-related causes spent 309 fewer days on patrol in their last three 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. First, among the 26 camp-level supervisors who completed questionnaires, the average time the supervisors reported spending taking care of the sick employee, providing transport, adjusting the patrol schedule, and processing paperwork came to 4 days. Regional office and headquarters staff reported spending an additional 2 days visiting the employee in the hospital, interacting with his family, and providing transport. Arranging the funeral requires another 2 days. An average of 30 ZAWA employees attend each funeral, losing one workday each. Positions are typically vacant for 2.5 months, and managers must spend an average of 3 days interviewing job candidates. Finally, ZAWA estimates that new employees are only about 75 percent productive during their first three 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. The employee's own illness accounts for more than three quarters of this time through on-the-job productivity loss (reduction in patrol days); funeral attendance and the time the position is vacant comprise most of the rest.

The aggregate impact of AIDS on service delivery capacity is the product of the impact per death and the estimated number of deaths. AIDS-related deaths in 2005 are estimated to have reduced ZAWA's service delivery capacity by 6.2 percent.

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 $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 to the beneficiaries of an employee who dies in service an amount equal to three years' annual base salary. For the average patrol officer, this comes to $4,254. 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 and/or family to the deceased employee's home community. The average cost to ZAWA per funeral is $1,557. Finally, ZAWA must pay to recruit and train a replacement worker. Recruitment costs an average of $1,100 per new employee; training of new patrol officers, which takes place over a ten-week period, averages $550. When these costs are summed, the total average direct cost per death comes to $7,869, or 3.3 times the annual compensation of a typical officer.

The total direct cost to ZAWA is arrived at by multiplying the cost per AIDS-related death, stratified by job level, by the estimated number of such deaths at each job level per year. In 2005, we estimate that AIDS-related deaths cost ZAWA approximately $385,000 in direct costs, or 9.7 percent of its total labor bill. It should be noted that this cost is additional to the loss of service delivery quantified above: as a result of AIDS, ZAWA both spent more and achieved less than it otherwise would have.

Returns to investment in treatment

Modeling the potential returns to ZAWA of providing effective treatment to HIV-positive employees required that we make several assumptions about how treatment will alter the costs of the illness. Specifically, we assumed that an HIV-positive employee would begin ART two years before he would otherwise have died of an AIDS-related cause and would remain on ART and fully productive in his job for a total of seven years (i.e. a five-year survival extension). At the end of seven years, treatment was assumed to fail and the employee to retire on medical grounds. We assumed that there would be some additional absenteeism, reduced productivity, supervisory time, and medical care costs associated with initiating therapy, which we set equal to one quarter of the costs attributed to untreated HIV/AIDS. In the model, once treatment failed, an employee could be retired for medical reasons immediately, avoiding the rest of the high absenteeism and low productivity that characterizes AIDS-related deaths now. Upon medical retirement, no further benefits were provided by ZAWA, on the premise that the employer had substituted provision of ART for these benefits. The model thus eliminated the costs of life insurance and funerals. Because ZAWA managers would have ample lead time to plan for AIDS-related attrition, the loss of productivity related to vacancies and to the inexperience of replacement employees would cost one half of what they do in the absence of treatment. Direct costs of recruitment and training would remain the same.

At a treatment cost of $500/patient/year, provision of AIDS care and treatment, including ART, to ZAWA employees would result in net benefits (savings) to the organization at all job levels. Table 3 presents the results of this modeling exercise for individual employees and for the workforce as a whole, assuming 100 percent uptake of treatment services.

Table 3: Net benefits of providing treatment to ZAWA employees

Job level	Net benefit per employee treated	Annual net benefits for treating all medically eligible employees
Junior staff	$3,591	$45,601
Senior staff	$5,329	$151,568
Managers	$18,737	$87,701
Total	n.a.	$284,871

Because of the high cost to ZAWA of losing even a junior employee to AIDS, the benefits of treatment would exceed costs at all job levels if treatment could be provided under the conditions outlined above. It should be noted that this has not been the case 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 treatment of junior staff.[12]

Cost per patrol day produced

As explained above, we estimated the "cost per patrol day produced" under three scenarios: 1) a hypothetical "no AIDS" scenario in which all patrol officers are assumed to be healthy; 2) the status quo, in which many patrol officers have HIV/AIDS but few are receiving treatment; and 3) an intervention scenario, in which a specified proportion of eligible patrol officers receive treatment with antiretroviral therapy. We used the service delivery impact and cost per death results presented above and, as in the cost-benefit analysis, combined these results with a number of assumptions about the treatment intervention and other parameters. Key assumptions are shown in Table 4.

Table 4: Parameter values used for the cost-per-patrol-day analysis

Parameters	Values
Baseline parameters	
Number of patrol officers employed by ZAWA	1,000
Average days on patrol/officer/year when healthy	197.4
Fixed cost parameters	
Patrol labor costs as proportion of ZAWA's total annual budget (estimated)	40%
Fixed costs and non-patrol labor as proportion of ZAWA's total annual budget	60%
AIDS-related termination parameters	
# patrol days produced in year before death	62.8
# patrol days produced in second year before death	96.8
# patrol days produced in third year before death	123.7
# patrol days lost for supervisor's time	6.0
# patrol days lost per funeral	32.0
# patrol days lost per new hire (vacancy and training)	73.0
Weighted average direct costs per death (multiple of average annual compensation)	3.31
% of patrol officers becoming eligible for ART or dying of AIDS-related causes/year	3.1%
Treatment parameters	
Uptake of treatment (% of those becoming eligible for ART/year)	75%
Untreated patrol officers (% of those becoming eligible for ART/year)	25%
Fixed costs of treatment program	$20,000
Variable cost of treatment/patient/year	$500
Productivity of treated patrol officers (% of patrol days produced when healthy)	80%
Mortality, resignations, and other terminations among treated patrol officers	0%

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

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

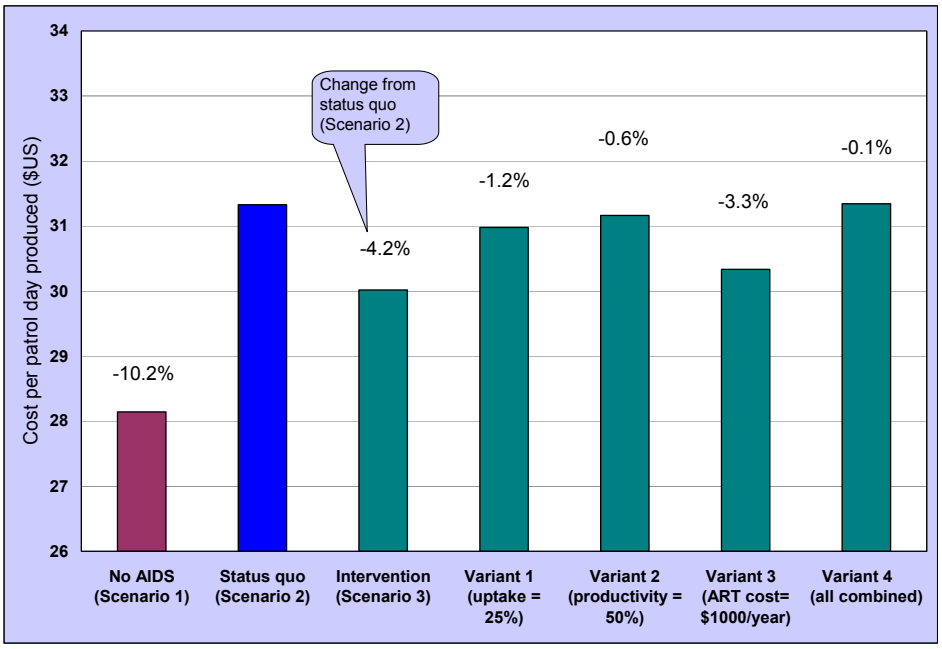
Variable	Scenario 1 (no AIDS)	Scenario 2 (status quo)	Scenario 3 (intervention)
Number of patrol officers by status			
Last year before AIDS death	0	31	8
Second year before AIDS death	0	31	8
Third year before AIDS death		31	8
On treatment	0	0	117
Healthy	1,000	906	859
Total patrol officers	1,000	1,000	1,000
Total patrol days produced/year	197,400	184,651	189,590
Average cost per patrol day produced	$28.14	$31.33	$30.02
Compared to scenario 1 (all patrol officers healthy), cost per patrol day is *higher* by:	n.a.	11.3%	6.7%
Compared to scenario 2 (status quo), cost per patrol day is *lower* by:	10.2%	n.a.	4.2%

Table 5 concludes that in the presence of AIDS, and without treatment (Scenario 2), the cost of a patrol day produced by ZAWA is 11 percent higher than it would be if all workers were healthy (Scenario 1). Since Scenario 1—no AIDS—is not obtainable, however, the choice for ZAWA is between Scenario 2 and Scenario 3. After five years of a treatment program (Scenario 3), with nearly 12 percent of the entire workforce on ART, the cost per patrol day produced is still 4.2 percent *lower* than under the status quo (Scenario 2).

The findings in Table 5 are robust to reasonable changes in input parameters, including doubling the variable cost of treatment or reducing uptake to just 25 percent of eligible patrol officers. Figure 1 shows the cost per patrol day produced under several alternate parameter values, presented as the following variations on Scenario 3:

- Variant 1: Uptake of treatment is reduced to 25 percent of medically eligible patrol officers per year.
- Variant 2: Productivity of treated patrol officers is reduced to 50 percent.
- Variant 3: Variable cost of treatment/patient/year is doubled to $1,000.
- Variant 4: All variants combined (1, 2, and 3).

Figure 1: Cost per patrol day produced under alternate treatment assumptions (year 5)



Even the combination of all three variants—low uptake, poorer productivity outcomes, and higher costs—generates a lower cost per patrol day produced, relative to the status quo, after five years of the treatment intervention.

Discussion

The analysis in this paper suggests that the capacity of the Zambia Wildlife Authority 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 percent, or the equivalent of some 90 employees. The money spent in 2005 on care, benefits, funerals, recruitment, and training as a result of AIDS, moreover, would have paid the salaries and allowances of roughly 140 additional employees. Taken together, this represents a total of 230 person-years of service delivery lost as a result of AIDS every year, or the equivalent of 16 percent of ZAWA's current workforce. These losses are far greater than we have seen in most private sector workforces around Africa.[13] Very high HIV prevalence, large illness-related productivity losses, substantial training investments, and generous benefits have combined to make the costs of AIDS to ZAWA unusually high.

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, with the exceptions of soldiers and possibly agricultural extension workers, construction crews, and the like. For these reasons, both HIV prevalence and the impact of AIDS may be greater for ZAWA than for other government agencies.

Although other types of agencies may not suffer losses as great as ZAWA's, the results presented here are still cause for alarm. In Zambia, and in many other developing countries, budgets for line ministries—education, health, housing, environment—are often too small to provide basic services to all those in need even without the impact of the AIDS epidemic. The epidemic increases demands for government services like healthcare and social welfare, while skills shortages and budget shortfalls combine to keep the service delivery agencies persistently understaffed and inadequately experienced. High HIV/AIDS-related morbidity and mortality in government workforces thus intensify the 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. As mentioned earlier, compared to private sector companies, government agencies have relatively little recourse for mitigating these losses in the short term, and output of services declines instead. This conclusion highlights the value of looking at budgetary (direct) costs and service delivery impacts separately when considering public sector agencies: a single financial cost estimate is useful for private sector companies interested in their bottom line, but governments must take into account both budgetary costs and service delivery outcomes.

In the longer term, several strategies may lessen the impact of AIDS on government. Greater investments in training, and a longer planning horizon, 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 still 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. And, 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 effort. The dispersed location of ZAWA's workforce will pose a challenge to all kinds of service delivery, as will the unusual conditions under which ZAWA staff live and work, such as remote field sites, physically rigorous jobs, and intensive work schedules. Developing mobile services that can be taken to the field camps is one option for addressing this problem; subsidized transport to existing services is another. Work schedules and team composition may have to be adjusted to accommodate those with HIV/AIDS. An analysis of the costs and benefits of different options should be conducted as soon as possible.

An active workplace HIV prevention and destigmatization campaign is also needed. Because of their remote locations, it is likely that few ZAWA staff have been tested for HIV or have ready access to prevention-related services such as education and STD treatment. Managers report that a high degree of stigma still prevails within ZAWA's camps; neither prevention nor treatment is likely to succeed if workers fear being identified as HIV-positive. Given ZAWA's budget constraints, external support is likely to be needed for these activities.

Even without external funds, structural interventions could strengthen HIV prevention efforts. In ZAWA's camps, large numbers of mainly male employees frequently spend nights away from their families. Long periods of field duty are interspersed with multi-day breaks. Salaries are paid on Fridays, creating an opportunity to travel and spend money on weekends. This schedule seems a recipe for high-risk behavior. ZAWA could consider structural

changes such as paying salaries on Mondays rather than Fridays; depositing salaries directly into bank accounts rather than distributing cash; or providing transport vouchers to encourage employees to take their partners with them when they travel.

The study presented here had a number of limitations, resulting mainly from reliance on existing workplace data collected for non-research purposes. The data set we obtained for the analysis of the impact of AIDS on productivity (patrol days) was incomplete in several ways. First, most employees included in the data set 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 due to missing observations. It is likely that the missing observations are a result of record-keeping problems and are not related to our outcome of interest, but it is also possible that recording of months in which an officer is not on patrol, in some cases due to illness, is less complete than recording of months on patrol. A second, related limitation is that for a substantial number of reference subjects in the original data set, 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 analytic data set any reference subject for whom more than 25 percent of monthly observations were zero. A third limitation stemming from use of existing workplace data is that ZAWA records only one activity or task per employee per month. In many cases, only a small number of patrol days was shown. We do not know what these workers were doing during the rest of the month, when they were presumably either on non-patrol duty or absent, either of which could indicate illness.

Two other limitations pertain to the HIV status of study subjects. First, we know that HIV prevalence in ZAWA's workforce is high and that many current employees will already have developed HIV/AIDS-related illness. We had no way to remove most of these employees from the reference group. And second, we did not know with certainty the precise cause of death of all index subjects. As indicated in Table 2, however, the great majority of deaths appear to be AIDS-related, so this limitation is unlikely to affect our results.

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Author Contributions

All authors contributed to developing the ideas presented in this paper and edited the manuscript. S Rosen drafted the manuscript.

Competing Interests

The authors have no competing interests.

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