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The cost of HIV/AIDS to businesses in southern Africa

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Background: Information on the potential costs of HIV/AIDS to the private sector is needed if companies are to be given a financial incentive to invest in prevention and treatment interventions.

Objectives: To estimate the cost of HIV/AIDS to businesses in southern Africa using company-specific data on employees, costs, and HIV prevalence.

Methods: Six formal sector enterprises in South Africa and Botswana provided detailed human resource, financial, and medical data and carried out voluntary, anonymous HIV seroprevalence surveys. The present value of incident HIV infections with a 9-year median survival and 7% real discount rate was estimated. Costs included were sick leave; productivity loss; supervisory time; retirement, death, disability, and medical benefits; and recruitment and training of replacement workers.

Results: HIV prevalence in the workforces studied ranged from 7.9 to 25.0%. HIV/AIDS among employees added 0.4–5.9% to the companies' annual salary and wage bills. The present value of an incident HIV infection ranged from 0.5 to 3.6 times the annual salary of the affected worker. Costs varied widely across firms and among job levels within firms. Key reasons for the differences included HIV prevalence, levels and stability of employee benefits, and the contractual status of unskilled workers. Some costs were omitted from the analysis because of lack of data, and results should be regarded as quite conservative.

Conclusions: AIDS is causing labor costs for businesses in southern Africa to rise and threatens the competitiveness of African industry. Research on the effectiveness of workplace interventions is urgently needed. © 2004 Lippincott Williams & Wilkins

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Introduction

HIV/AIDS is a growing concern to businesses worldwide [1]. In the high-prevalence countries of sub-Saharan Africa, AIDS has the potential to raise the cost of labor at the same time that it reduces the number of consumers and impoverishes many of those who remain. It is thus limiting the profitability of businesses and diminishing their competitiveness in the global marketplace. Given the critical role of business in generating and sustaining social and economic development, mitigating the impact of AIDS on business profitability is a high priority.

Although the impact of AIDS on businesses in Africa has long been recognized, little rigorous empirical research on the magnitude of that impact has been published in the peer-reviewed literature. Unpublished case studies in Kenya and Botswana in 1994 found widely varying impacts, with costs ranging from less than 1% of profits to nearly 9% [2]. Studies in the mid-1990s reported low costs to businesses in Zambia [3],

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Malawi [4], and Botswana [5], but a more recent analysis in South Africa estimated a cost of 40% of an infected employee's annual salary in each of the last 2 years of life [6].

All of these studies faced a number of conceptual and empirical difficulties, ranging from unknown HIV prevalence to incomplete definitions of costs. Inconsistent methodologies and scarcity of data make their conclusions difficult to interpret or compare. This paper presents the results of a study designed to overcome these limitations. Using firm-specific HIV prevalence and financial data, the study quantified the direct and indirect costs that six large, formal-sector companies in southern Africa are incurring as a consequence of HIV/AIDS among employees.

Methods

Approach

The analysis was based on the present value of the costs of incident, not prevalent, HIV infections [7]. Because of the long latency period between HIV infection and HIV/AIDS-related symptoms, a company is not likely to see any costs until 5–10 years after an employee is infected. Assuming the company retains the employee in its workforce, however, it acquires at the time of infection a liability for the future costs associated with that infection. Estimating costs on the basis of incident infections allows firms to treat expenditures on HIV programs as potentially profitable investments, rather than solely as recurrent costs, and to determine whether investments in HIV/AIDS programs are competitive with other investment opportunities.

Data collection

A convenience sample of approximately 20 formal-sector firms in South Africa and Botswana, identified primarily through professional networks, was approached by or contacted the study team, and six ultimately participated in the study. Criteria for participation included a computerized human resources database, willingness to assist with data collection, and agreement to cover some costs of the study. Those not chosen either did not have sufficient computerized data or were unwilling to assign staff time to assist with data collection. To maintain the confidentiality of the individual firms, they are referred to as Companies A–F.

At the time of the study, only Company F made antiretroviral therapy available to employees with HIV/AIDS, and even it had very few employees on therapy. Most of the companies maintained on-site occupational health clinics that provided modest levels of palliative care and opportunistic infection management to employees who sought care.

All of the firms in the sample conducted voluntary, anonymous, unlinked HIV seroprevalence surveys of some or all of their workforces. Surveys were implemented by South African researchers or private consultants. Results of the first survey (Company A) were used to stratify the workforces into relatively homogeneous HIV prevalence subgroups on the basis of job level, age, sex, and legally defined racial group (further information can be found in Williams *et al.* [8]). The results of the surveys, supplemented by epidemiological data from other sources, were then used to model HIV incidence for each subgroup of the workforce, utilizing the methodology described in Williams *et al.* [9].

Detailed workforce demographic data and records of sick leave, medical clinic use, and medical aid (health insurance) claims were obtained from each company's human resource database. For former employees, data was also obtained on the type of termination (e.g., death or disability retirement) and cause of death or disability. To supplement these data, managers in the human resources, financial, and medical departments were interviewed, and annual reports, actuarial analyses of benefits funds, and other company documents were reviewed. In addition, a brief questionnaire was administered by company staff to the line supervisors of employees who had died in service or been retired on disability in the previous 2 years. The questionnaire asked the supervisor to indicate to what extent the employee's productivity had been impaired by his or her illness and how many days of the supervisor's own time were needed to manage the sick employee.

Data were collected in 1999 for Companies A and B, in 2000 for Company C, and in 2001 for the remainder. Cost estimates for the first three were inflated at the domestic inflation rates in South Africa (A and B) and Botswana (C) to put them into 2001 terms, and all estimates were converted to US dollars at the average exchange rate for 2001.

Data analysis

Table 1 summarizes the methods used for estimating unit costs. A day of paid absenteeism was valued at the daily compensation (wage plus benefits) of the affected employee. This is a conservative assumption that almost certainly understates the cost of a day of missed work, as it implies that an equally productive substitute for the absent employee is available at the same wage rate [10]. To account for the possibility that absenteeism also reduced output, an alternative scenario was analyzed in which it was assumed that the cost of a day of paid absenteeism also includes a wage-weighted share of the company's net operating income.

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2

Table 1. Methods used to estimate unit costs.

Type of cost	Method	Comments
Indirect costs		
Valuation of all indirect costs	Defined a 'wage multiplier' equal to the ratio of the daily wage plus benefits to the daily wage; 1 day of paid leave was valued at daily wage × wage multiplier. Reduced productivity when at work counted as a fraction of a day	In the alternative scenario, wage multiplier equaled the ratio of daily wage plus benefits plus wage-weighted share of the company's net operating income to the daily wage
Sick leave	Multivariate regression analysis to estimate additional days of sick leave taken in the 2 years prior to termination by a subsample of employees who died in service or were retired on disability during the 3 years preceding data collection	For some companies, the subsample included only diagnosed or suspected AIDS deaths; for others all 'natural causes' deaths were included. For Company B, estimate includes time off to attend medical clinic. HIV/AIDS-related absenteeism other than sick leave was excluded because of lack of data. Similar approach used to estimate number of visits to company clinics (Company B), cost of transport to public hospitals (Company C), medical aid claims (Company F).
Loss of productivity when at work; supervisory time	Average of supervisors' responses to questionnaires about employees who had died or been retired due to AIDS	For some companies, deaths and retirements due to other causes could not be identified and were included in the analysis.
Vacancy	Human resource data or managers' estimates of average duration of vacancies	Some companies provided separate estimates for internal and external hires; in these cases, results were weighted by the probability of each type of hire. For some companies, training cost estimates include time spent in preservice orientation and time spent by provider of on-the-job training.
Learning curve as replacement worker comes up to speed	Managers' estimates of average time required for replacement worker to become fully productive times the gap between full and actual productivity during that period	
Direct costs		
Retirement benefits	Difference between present value of pension payments due upon death or disability retirement and present value of pension payments due upon retirement at normal retirement age	Applicable only to companies A and F. Cost was adjusted for the probability of HIV-negative employees remaining at the company until normal retirement age and the probability of the spouse being HIV positive. Other companies have defined contribution retirement funds that are not affected by premature deaths. Impact of AIDS on cost of long-service awards and gratuities excluded because of lack of data
Death and disability benefits	Amount due to employee or beneficiaries upon death in service or disability retirement, plus average administrative fee for benefits schemes. Assumed that premiums will rise exactly as much as the additional claims resulting from HIV/AIDS	Several companies indicated that they had placed a cap on their premiums for these benefits and would allow benefit levels to fall as AIDS caused claims to increase. For these firms the cost of benefits was 0.
Medical care	Ceiling of HIV/AIDS-related claims for medical aid in last 2 years of service, weighted by probability of being a member of the medical aid scheme, plus administrative fee of scheme	For Company B, costs include use of on-site company clinics, which provided palliative care and basic management of opportunistic infections. For Company C, costs include transport to a city where medical care could be obtained. For Company F, regression analysis used to estimate additional actual claims made by employees lost to AIDS.
Recruitment, training	Human resource data or managers' estimates of the variable costs of recruiting and training a replacement worker	Some companies provided separate estimates for internal hires (promotions) and external hires; in these cases, results were weighted by the probability of each type of hire.

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It was assumed that HIV-positive employees remain in the workforce until they either die in service or take disability retirement. Normal (non AIDS-related) employee turnover at the companies studied averaged 6–14% per year. This underlying turnover was not taken into account for two reasons. First, replacement workers may also be infected, so turnover would have no effect on workforce HIV prevalence. Second, managers told us that employees who know or believe themselves to be HIV positive are unlikely to resign voluntarily, as they would lose access to medical care and benefits.

For each employee subgroup, the amounts and timing of each of the unit costs associated with a single incident infection were estimated. The costs were then discounted to generate present values in the year the infection was acquired and summed to generate a total cost per infection. A real discount rate of 7%, which was the real prime lending rate in South Africa in October 2001 [11,12] was used; the companies reported their own real discount rates at 4–10%. A median survival period from HIV infection to death of 9 years in the absence of antiretroviral therapy was assumed; therapy was available to only a few employees of the participating companies [13].

Results

HIV prevalence

The companies in the study are described in Table 2. HIV prevalence varied widely. As would be anticipated from antenatal prevalence data, HIV prevalence was very high at two of the firms in KwaZulu Natal (B and D) and the firm in Botswana (C). Prevalence was substantially lower at the firms with operations in multiple South African provinces (A and F), consistent with the lower antenatal rates found in the Western Cape and some other provinces. More surprising is the relatively low prevalence of HIV at Company E, which is also in KwaZulu Natal. This is explained by the demographic profile of Company E's workforce, which is older than those of the other firms and drawn largely from ethnic groups where HIV prevalence appears to be lower than for society at large. Estimated population prevalence from antenatal clinic surveys is shown in the last row of Table 2 for comparison.

Unit cost parameters

The indirect and direct costs of HIV/AIDS to the companies are determined by salaries, human resource and financial policies, and production processes. Key determinants of unit costs are shown in Table 3.

Employees who ultimately terminated because of AIDS took between 11 and 68 more days of paid sick leave in their final year of service than did employees who were still in the workforce. Most companies also experienced increased use of sick leave in the second-to-last year of service. Employees with HIV/AIDS also produced substantially less on the days they did attend work. Supervisors reported that employees who had died or taken disability retirement because of AIDS were 22–63% less productive in their last year of service than before they became ill. This effect was much smaller in the second-to-last year of service. Supervisors also reported spending an average of 7–25 days of their own time in each affected employee's last year of service.

Cost per infection

Summing the direct and indirect costs for each com-

Table 2. Companies in the study.

Variable	Company					
	A	B	C	D	E	F
Study year[a]	1999	1999	2000	2001	2001	2001
Location	South Africa[b]	KwaZulu Natal	Botswana	KwaZulu Natal	KwaZulu Natal	South Africa[b]
Sector	Utility	Agribusiness	Mining	Mining	Retail	Media
Workforce size	> 25 000	5000–10 000	500–1000	500–1000	< 500	1000–5000
Non-permanent workers included in study?[c]	No	Yes	None	No	Yes	Yes
Estimated HIV prevalence in study year (%)[d]						
Unskilled workers	12.4	26.7	39.4	34.5	12.9	15.6
Skilled workers	9.3	22.7	39.2	18.55	2.5	7.2
Supervisors/managers	4.2	8.2	14.3	6.23	2.3	4.2
Non-permanent	n.a.	31.2	n.a.	n.a.	17.6	18.4
Company average	7.9	23.7	29.0	23.6	10.5	10.2
Country or province antenatal prevalence in study year (%)[e]	22.4	32.5	38.2	33.5	33.5	24.8

n.a., not applicable. [a]Year in which baseline cost and seroprevalence data were collected. [b]Locations in more than one South African province. [c]Non-permanent workers included casual, fixed-term contract, and seasonal staff. Company C had no non-permanent workers; for Company A and Company D, no data about non-permanent workers were available. [d]Prevalence estimates are a combination of voluntary, anonymous, unlinked seroprevalence testing and modeling as described in the methodology section. [e]Source: UNAIDS [16].

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4

Table 3. Cost variables and values.

Type of cost[a]	Variable measured	Variable values for companies					
		A	B	C	D	E	F
Indirect costs							
Additional sick leave[b]	Days in last 0-365 days on job	49.0	68.4	30.4	36.0	11.2[c]	17.1
	Days in last 366-730 days on job	15.3	20.2	0.0	14.0	n.a.	10.4
Loss in productivity when at work	Percentage lost in last 0–365 days	29	42	36	63	22	36
	Percentage lost in last 366–730 days	5	31	12	33	3	4
Supervisory time	Days required	n.a.[d]	6.6	11.5	24.6	12.7	14.5
Vacancy	Skilled workers (months)	2.0	0.25	3.1	2.0	0.55	2.0
	Managers (months)	3.0	2.0	3.8	3.0	0.64	3.0
Reduction in productivity due to new employee's learning curve	Skilled workers (months)	3.0	3.0	1.5	1.5	2.2	4.0
	(Percentage reduction)	30	50	50	25	50	60
	Managers (months)	6.0	3.0	3.0	3.0	2.6	2.0
	(Percentage reduction)	30	50	20	25	50	55
Wage multiplier	Ratio of wage + benefits to wage	1.26	1.20[e,f]	1.58	1.12	1.20[e,f]	1.46[e]
Direct costs							
Retirement benefits	Benefits level fixed or linked to contributions	Fixed	Linked	None	Linked	Linked	Fixed
Death/disability benefits	Benefits stable or premiums stable (leading to declining benefits)	Benefits stable	Premiums stable	Benefits stable	Premiums stable	Premiums stable	Benefits stable
Medical care	Percentage of workforce covered by insurance	100	8	100	22	28	100

n.a., not applicable.
[a]See Table 1 for an explanation of types of cost. [b]All results statistically significant at 5% level. [c]Employees who apply for disability retirement are automatically placed on an additional 3 months of paid sick leave. Only 1 year of sick leave data were obtained from Company E. [d]Data on supervisory time were not collected at Company A. [e]Benefits rate assumed to equal 20% of base wages and salaries. [f]Multiplier of 1.0 used for non-permanent employees.

pany generated the cost-per-infection estimates shown in Table 4. For each company and job level, the first row shows the discounted sum of costs that will be incurred as a result of losing one employee to AIDS, including hiring and training a replacement worker, while the second row presents the same value as a multiple of the median annual wage or salary at that job level.

Absolute costs were substantial but varied widely, both within and between firms. Costs rose consistently with job level. Since job level serves as a proxy for salary, the differences across job levels within a given company almost vanish when costs are expressed as multiples of median salaries. For permanent employees, the cost per incident infection ranged from 0.5 to 3.6 times median salary.

The cost-per-infection estimates effectively sort the firms into two groups: high cost (Companies A, C, and F) and low cost (Companies B, D, and E). The distribution of the cost components differed widely between the two groups, as shown in Table 5. For the high-cost group, direct costs dominated, with end of service benefits accounting for half or more of the total. For the low-cost group, indirect costs accounted for more than 85% of the total. The main reason for this difference was the absence of end of service benefits for this second set of companies. All of the low-cost firms had capped their own contributions to employee benefit funds, holding costs rather than benefits levels constant in the face of rising benefits claims. Replacement of an employee lost to AIDS accounted for a substantial share of the total for all the firms, but never more than a third. Medical care did not exceed 10% of the total for any firm.

Aggregate costs

To obtain aggregate cost estimates, the cost per infection was multiplied by the estimated number of incident infections in the study year. Table 4 shows the aggregate amounts in US dollars and as a percentage of each company's annual wage bill for each employee group, plus the total for the whole workforce as a percentage of annual operating expenditures. Although these figures compare a present value estimate to an annual recurrent cost, they allow the aggregate values to be scaled to the sizes of the workforces involved and thus facilitate comparisons across firms.

The percentages in Table 4 can be thought of as the long-run 'AIDS tax', or the increase in wage or operating costs resulting from the epidemic. As with cost per infection, results varied widely by job level

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Table 4. Cost of incident HIV infections at each job level in base scenario, 2001[a]

Cost at varying job levels	Company A	B	C	D	E	F
Unskilled workers						
Cost per infection ($)[b]	15 331	2131	7516	2371	2094	18 188
Multiple of median wage	3.23	0.75	3.33	0.69	0.46	2.82
Aggregate cost ($)	2 486 404	102 964	25 758	32 376	9986	305 065
Percentage of wages	7.8	3.3	11.0	3.1	0.8	5.2
Skilled workers						
Cost per infection ($)	20 290	2718	12 306	3719	4262[c]	34 035[d]
Multiple of median wage	3.26	0.86	3.69	0.86	0.44	2.94
Aggregate cost ($)	5 143 061	235 103	90 699	18 003	623	213 694
Percentage of wages	5.5	2.8	11.9	2.0	0.2	2.4
Supervisors						
Cost per infection ($)	34 014	7102	31 007	11 499[d]	4262[c]	34 035[d]
Multiple of median wage	3.17	0.90	3.89	1.11	0.44	2.94
Aggregate cost ($)	3 369 879	78 980	83 318	6275	623	213 694
Percentage of wages	2.4	1.3	5.6	0.9	0.2	2.4
Managers						
Cost per infection ($)	64 338	9424	54 918	11 499[d]	8736	54 929
Multiple of median wage	3.15	0.63	3.18	1.11	0.47	3.19
Aggregate cost ($)	1 022 573	52 192	7939	6275	1290	202 726
Percentage of wages	1.7	0.6	0.8	0.9	0.1	1.4
Non-permanent employees	n.a.		n.a.	n.a.		
Cost per infection ($)		1075			592	6037
Multiple of median wage		0.38			0.28	0.76
Aggregate cost ($)		130 673			943	75 401
Percentage of wages		1.9			0.6	1.9
Entire workforce						
Average cost per infection for permanent employees (multiple of median wage)	3.23	0.82	3.63	0.76	0.46	2.90
Aggregate cost ($)	12 021 916	599 913	207 713	62 930	13 465	1 010 580
Percentage of wages	3.7	1.8	5.9	1.9	0.4	2.4
Percentage of annual operating expenses	0.62	0.22	0.60	0.04	0.01	0.64

n.a., not applicable.
[a]Costs from 1999 and 2000 were inflated to 2001 levels using the CPI for South Africa (Companies A and B) and Botswana (Company C). Exchange rates used were averages for 2001 (Rand 8.6 = US$1; Pula 5.7 = US$1). [b]Cost per infection estimates shown are for African males aged 35–49 for the South African firms and Botswana national males aged 35–49 for the Botswana firm. [c]Skilled workers and supervisors were analyzed as a single category at this company. [d]Supervisors and managers were analyzed as a single category at this company.

Table 5. Distribution of costs per incident infection (skilled workers aged 35–49 years)

	Company A	B	C	D	E	F
Type of cost (%)						
Indirect	28	91	25	94	86	43
Direct	72	9	75	6	14	57
Cost component (%)						
Sick leave	9	21	3	13	14	5
Productivity loss[a]	12	44	13	72	43	19
Medical care	10	5	9	0	10	2
End of service benefits[b]	52	0	57	0	0	50
Replacement[c]	16	29	18	15	32	24

[a]Includes reduction in productivity when sick employee is at work and cost of supervisor's time. [b]Includes retirement, death, and disability benefits. [c]Includes costs of vacancy and recruitment, training, and learning curve of replacement employee.

and firm. Company E, with a relatively low prevalence of HIV and the lowest cost per infection, faced an increase in its wage costs of < 0.5%. Company C, with an extremely high HIV prevalence and a high cost per infection, saw its wage costs escalate by nearly 6%. Although the cost per infection for unskilled and skilled workers was low, the large numbers of these workers in most workforces and the high prevalence of HIV at these job levels means that they accounted for the largest share of the total cost for most firms. Even for the high-cost companies, the increase in total operating expenses was less than 1%, reflecting the relative capital-intensity of these firms.

Scenario analysis

All of the companies studied relied on some level of team production in which perfect substitution of absent workers is difficult. Under conditions of team production, an individual employee's absence from the workplace results in other inputs (labor or capital) being deployed less efficiently [10]. The real cost to the company of a day of paid sick leave in such cases should include a share of profits, in addition to the employee's daily compensation. Therefore, the wage multiplier used, which assumed perfect substitution for absent employees, likely understated the indirect costs of HIV/AIDS.

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To determine the potential magnitude of the underestimate, a second set of results was calculated under the opposite extreme assumption, that no labor substitution was possible. For the low-cost companies (B, D, and E), in which indirect costs dominate, the cost per infection under the no substitution (alternative) scenario was 59–123% higher than under the perfect substitution (base) scenario; for the high-cost companies (A, C, and F), it was only 5–32% higher, because most of the total cost for these companies comprised direct costs. We speculate that our base scenario approaches the lower bound on true costs, while the no-substitution scenario approaches the upper bound.

Discussion

AIDS is raising the cost of labor in southern Africa and diminishing the competitiveness of African business in the global marketplace. Many of the continent's economic development goals depend on its ability to diversify its industrial base, expand exports, and attract foreign investment [14]. By making labor more expensive and reducing corporate profits, AIDS limits the ability of African countries to attract industries that depend on low-cost labor and makes investments in African businesses less desirable. It therefore threatens the foundations of economic development in Africa.

HIV/AIDS is adding between 0.4 and 5.9% to the annual wage bill of large companies in South Africa and Botswana, under a conservative set of assumptions. There was a high degree of variation in costs. Variation in cost per infection resulted largely from differences in end-of-service benefits. Variation in aggregate costs was driven by two additional factors. First, estimated HIV prevalence and incidence varied widely. Second, in our low-cost companies, many unskilled or semi-skilled workers served as day laborers or on renewable short-term contracts. These workers, who tend to be at high risk of HIV infection, are not eligible for most of the benefits provided to permanent employees, nor do the companies invest substantial resources in training them. This group of workers, therefore, imposes few costs on the companies when they become ill or end their service due to AIDS.

Some comparisons among the firms in the study illustrate these differences. Companies C and D were both relatively small mining firms with very high HIV prevalence, but the costs they faced from the epidemic differed widely because of differences in end-of-service benefits. In contrast, Companies B and E, although representing very different sizes and sectors, faced relatively similar costs on a per-infection basis. Comparisons of this type underscore the danger of generalizing across firms or industries on the basis of size and sector.

The study had several limitations. First, with only six companies in the study, we cannot be certain of the geographic or sectoral representativeness of our sample. Moreover, the companies that opted to participate in the study were likely more concerned about the potential impact of HIV/AIDS than were other firms, which could indicate that they had already encountered rising costs. Second, all of the costs we measured are associated with single cases of HIV/AIDS, not with the cumulative impact of multiple cases, such as diminishing workforce morale and experience, deteriorating labor relations, and use of managerial time. We could not obtain data to measure these 'organizational' costs. Third, we also lacked data on the costs of AIDS-related changes in workplace injury rates or in absences other than recorded sick leave, and data for non-permanent workers were incomplete. Fourth, because the HIV status of most employees of the study companies was not known, we derived many of unit cost parameters by comparing the experience of known HIV-positive employees with those of unknown status. This is likely to have understated the true difference. Finally, we could not take into account any future actions by the companies to reduce the costs of AIDS, either by implementing prevention and treatment interventions or by cutting benefits, mechanizing, outsourcing, or taking other steps that shift the costs onto households or government [15].

Throughout sub-Saharan Africa, progressive firms are experimenting with a wide range of HIV/AIDS prevention, care, and treatment programs. The methodology and findings presented here can be used to understand the potential financial benefits of those programs to the firms. Better information on the effectiveness of the interventions in obtaining the outcomes that matter to employers – infections averted, morbidity avoided, additional years of productive working life gained, and employees retained in the workforce – is urgently needed, however, to complete the benefit–cost analysis and make a strong case for more, and more efficient, investment by businesses in HIV/AIDS.

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Note: All authors participated in study design, data analysis, editing of the manuscript and reviewed the final manuscript. S. Rosen, J. Simon, and D. Thea identified the study sites. S. Rosen drafted the manuscript.

Note: The opinions expressed herein are those of the authors and do not necessarily reflect the views of the U.S. Agency for International Development.

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References

1. Global Business Council on HIV/AIDS. *Business Action on HIV now Crucial, as AIDS Crisis Deepens.* New York: Global Business Council on HIV/AIDS; Press release, 30 November 2001.
2. AIDSCAP Project. *African Workplace Profiles.* Washington, DC: Family Health International; 1995.
3. Smith J, Whiteside A. *The Socioeconomic Impact of HIV/AIDS on Zambian Businesses.* London: BEAD Group and Commonwealth Development Corporation; 1995.
4. Jones C. The microeconomic implications of HIV/AIDS. Dissertation, School of Development Studies, University of East Anglia, Norwich, UK; 1996.
5. Greener R. **Impact of HIV/AIDS and options for intervention: results of a five company pilot study.** *Working Paper No. 10.* Gaborone: Botswana Institute of Development Policy Analysis; 1997.
6. Morris CN, Burdge DR, Cheevers EJ. **Economic impact of HIV infection in a cohort of male sugar mill workers in South Africa from the perspective of industry.** *International AIDS Economics Network Symposium.* Durban, July 2000.
7. Rice DP. **Cost-of-illness studies: fact or fiction?** [Editorial] *Lancet* 1994, **344**:1519–1520.
8. Williams BG, Gouws E, Colvin M, Sitas F, Ramjee G, Abdool Karim SS. **Patterns of infections: using age prevalence data to understand the epidemic of HIV in South Africa.** *S Afr J Sci* 2000, **96**:305–312.
9. Williams B, Gouws E, Wilkinson D, Karim SA. **Estimating HIV incidence rates from age prevalence data in epidemic situations.** *Stat Med* 2001, **20**:2003–2016.
10. Pauly MV, Nicholson S, Xu J, Polsky D, Danzon PM, Murray JF, *et al.* **A general model of the impact of absenteeism on employers and employees.** *Health Econ* 2002, **11**:221–231.
11. South African Reserve Bank. *Current Market Rates and Selected Data.* Pretoria: South African Reserve Bank; 2001.
12. South African Reserve Bank. *Quarterly Bulletin.* Pretoria: South African Reserve Bank; September 2001.
13. UNAIDS Reference Group on Estimates, Models and Projections. **Improved methods and assumptions for estimation of the HIV/AIDS epidemic and its impact: recommendations of the UNAIDS Reference Group on Estimates, Modelling and Projections.** *AIDS* 2002, **16**:W1–W14.
14. NEPAD. *The New Partnership for Africa's Development.* http:»www.nepad.org [accessed 26 July 2002].
15. Rosen S, Simon JL. **Shifting the burden: the private sector's response to the AIDS epidemic in Africa.** *Bull World Health Organ* 2003, **81**:131–137.
16. UNAIDS. *Epidemiological Fact Sheets by Country: South Africa, Botswana.* http://www.unaids.org/hivaidsinfo/statistics/fact_sheets/index_en.htm [accessed 9 June 2003].

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8