COMMUNICATIONS SUPPORT FOR HEALTH (CSH) PROGRAMME

SAFE LOVE COST-EFFECTIVENESS REPORT

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I. Introduction

1.1. HIV/AIDS Context in Zambia

While HIV prevalence has been on the decline in Zambia since around 2001, the country still has one of the highest prevalence rates in the world at around 12.5% (1,2). The predominant mode of HIV transmission among Zambian adults is through heterosexual contact (3). According to modelled data, 71% of new infections are a result of sex with non-regular partners, including being the non-regular partner or having one, or having a partner who has one or more sexual partners (4). Small-scale qualitative studies also suggest that the prevalence of adults engaging in multiple concurrent sexual partnerships is high in Zambia (5,6). This occurrence is coupled with overall low condom use. For example, as of 2009, amongst adults aged 15–49 years who were sexually active within the past 12 months, only 12.2% reported using a condom with their most recent sexual partner (3). Thus, while the country has been experiencing an overall decline in HIV prevalence over the past decade, it is evident that HIV continues to be a huge burden in the country, and efforts to reduce concurrent partnerships and improve overall condom use are needed.

1.2. *Safe Love* Campaign Background

To address the key drivers of HIV in Zambia, the United States Agency for International Development (USAID)–funded Communications Support for Health (CSH) project, in collaboration with the Government of the Republic of Zambia (GRZ) through the Ministry of Health (MOH), the Ministry of Community Development Mother and Child Health (MCDMCH), and the National HIV/AIDS/STI/TB Council (NAC), launched the *Safe Love* campaign in June 2011. The *Safe Love* campaign was a three-year comprehensive HIV prevention behavior change communication (BCC) initiative that ran through June 2014. The overall goal of the campaign was to contribute to the reduction of new HIV infections in Zambia by addressing key drivers of transmission, mainly, low and inconsistent condom use, multiple concurrent partnerships (MCP) and low uptake of prevention of mother-to-child transmission (PMTCT) services. The campaign also included messages on uptake of voluntary medical male circumcision (VMMC) to help reduce HIV transmission. The campaign focused on promoting the following key behavioral messages for condom use, MCP, HIV testing, and VMMC: Use condoms for every sexual act; reduce the number of sexual partners you have; have only one sexual partner at a time; be faithful to your partner; know your HIV status and that of your partner; get tested for HIV during antenatal care services; and go for VMMC.

The primary target audience for the campaign comprised men and women between the ages of 15 and 49, while the secondary audiences included peer networks and family members. The campaign included interventions targeted at the national, subnational, and community levels. Campaign components included television and radio advertisements or spots, a radio drama series called *Life at the Turnoff*, a television drama series called *Love Games*, interpersonal communication community activities (e.g., small-group and one-on-one discussions, radio listening clubs), social media outlets (e.g., campaign website, Facebook, Twitter), and outdoor and small mass media (e.g., billboards, posters, fliers). While certain campaign interventions, including the radio and television programs, were implemented more broadly, all interventions, including the community activities, were implemented in nine specific districts across four provinces in Zambia: Kabwe, Kafue, Kapiri Mposhi, Kawambwa, Luanshya, Lusaka, Mansa, Mkushi, and Samfya.

1.3. Outcome Evaluation of the *Safe Love* Campaign

The effects of the *Safe Love* campaign were evaluated using a one-group post-test evaluation design. A representative household survey was conducted in the nine districts where the campaign was implemented. A total of 4,114 men and women aged 15–49 completed the survey. The goal of the survey was to determine

the extent to which the target audience was exposed to the campaign (measured in terms of recall of the campaign messages and components) and to assess the effects of the campaign on the target audience's behaviors, knowledge, beliefs/attitudes, self-efficacy, perceived social norms, and intentions related to condom use, MCP, HIV testing, and VMMC.

To determine the effects on each of the four topic areas of the *Safe Love* campaign, four recall indices were constructed as follows: all spontaneous recall variables that pertained to general *Safe Love* campaign recall questions (e.g., spontaneous recall of the *Safe Love* slogan or recall of character names from specific programs, such as *Love Games*) and spontaneous recall variables that were specific to a particular topic (e.g., spontaneous recall of "partner reduction" as a topic from the campaign in general or from a specific program for the MCP index) were added together to form a recall index specific to each topic area. The value of the index reflected the number of times the respondent spontaneously recalled a general or specific component of the campaign. For each index, three recall groups were created by dividing each index into three groups: no spontaneous recall, low spontaneous recall, and high spontaneous recall. (Low and high spontaneous recalls were split at the median amongst those respondents who had any spontaneous recall.) Once the three recall groups were determined, three separate recall variables were created to be used in propensity score matching: (1) no spontaneous recall and any spontaneous recall (a combination of the low and high groups), (2) no spontaneous recall and low levels of spontaneous recall, and (3) no spontaneous recall and high levels of spontaneous recall. Propensity score matching was used to assess differences in the behavior and intermediate outcomes by recall variables.

The full analysis of the survey results is described in the *Safe Love* Outcome Evaluation Report (7). Of note, there were a number of behaviors found to be affected by exposure to the *Safe Love* campaign in the outcome evaluation related to condom use. Survey respondents who recalled the campaign were more likely to have acquired condoms in the past six months, to have used a condom at last sex, and to report consistent condom use in the past four weeks and in the past six months. Other behaviors changed in certain sub-groups. For example, rural respondents with higher levels of campaign recall reported higher rates of HIV testing. The campaign also had effects on various intermediate outcomes, including communication about MCP and HIV risk, intention to be tested for HIV or undergo VMMC, and knowledge surrounding all topic areas.

1.4. Cost-Effectiveness Analysis of the *Safe Love* Campaign

The goal of this analysis was to evaluate the cost-effectiveness of the *Safe Love* campaign in preventing the spread of HIV in Zambia. Using a previously developed mathematical model of HIV spread (8), calibrated to Zambia's population and HIV epidemic, the expected number of new HIV infections, life-years, and costs over a 10-year time horizon with the campaign (based on behaviors reported by those who recalled the campaign) and without the campaign (based on behaviors reported by the control population of those with no recall) were estimated. Calculating the cost per HIV infection averted and cost per life-year gained, we compare the cost-effectiveness of the *Safe Love* campaign to the efficiency of other HIV prevention programs (e.g., a cost per HIV infection averted of $112 for community-based voluntary counseling and testing, $321–$1,665 for the treatment of ulcerative STIs, or $1,806 for male circumcision (9)) and against standard cost-effectiveness thresholds (e.g., cost per life-year saved less than 3 x GDP (10,11)).

II. Methodology

2.1. Mathematical Model of HIV Spread in Zambia

For this analysis, we adapted a stochastic microsimulation model of HIV transmission and progression previously developed by Enns, et al., to evaluate the cost-effectiveness of reducing concurrency in four

southern African countries, including Zambia (8). The model simulates the spread of HIV through heterosexual contact in a population of 15-49 year-olds in one-month intervals. The model tracks sexual partnerships, entry into the population, HIV transmission and disease progression, deaths from HIV and other causes, life years experienced in the population, and HIV incidence and prevalence over time. Full details of the model are described in the published article and appendix (8). We provide a brief description here, with a focus on features that were modified or added for this analysis. Relevant input parameters and sources are summarized in Table 1.

Population Dynamics

Individuals in the model are characterized by a set of attributes (which may or may not change over time), such as gender, age, circumcision status (for men), HIV infection status, awareness of HIV status, and CD4 count. New individuals enter the model each month at age 15 and older; individuals are removed from the model at age 50. Individuals face age-specific mortality risks (non-HIV-related), as well as additional mortality for those infected with HIV, depending on their CD4 count. As in the analysis by Enns, et al., population demographics and rates of aging were estimated from demographic data (12,13). Age-specific mortality rates were taken from country-specific life tables (14).

HIV Disease Progression

The model of HIV disease progression was unchanged from that used in the analysis by Enns, et al. The model reflects stages of infection (acute, chronic), changes in CD4 counts (sharp drop during acute infection, slow declines during chronic), CD4 count-specific mortality and occurrence of AIDS-defining illnesses, the impact of antiretroviral therapy (recovery in CD4 count), and risks of treatment failure. Parameters governing these processes were estimated from the published literature (15–18). The level of HIV treatment coverage used in the model was updated to reflect recent expansion of treatment access in Zambia, with 90% of eligible individuals now receiving antiretroviral therapy (2).

Sexual Partnership Dynamics

The model by Enns, et al., simulates HIV transmission through heterosexual contact. Heterosexual partnerships are explicitly tracked in the model and evolve over time, with old partnerships ending and new partnerships forming. Individuals can have up to four concurrent sexual partnerships. Partnership dissolution probabilities were estimated from average partnership durations, while partnership formations were calculated so as to balance the process of partnership dissolution as well as new individuals entering the population at age 15 years without partnerships, to maintain a stable partnership distribution in the population over time. The model has the capacity to include multiple types of partnerships with different durations and/or risk behaviors. In the original model, the authors made the distinction between “spousal” and “non-spousal” partnerships. In this analysis, we include spousal and non-spousal partners (which we consider to be types of regular partners) and add the additional possibility of casual sexual encounters. We assume that casual partners are one-time encounters that do not persist over time and occur randomly between individuals.

Like in the original analysis by Enns et al., we estimated the partnership distribution (proportion of individuals reporting zero, one, two, or three concurrent partners) in the population by partnership type from Zambia’s most recent demographic health survey (13). We estimated rates of engaging in casual sexual partnerships through model calibration.

HIV Transmission

The model by Enns, et al., simulated heterosexual HIV transmission with varying transmission risk by stage of HIV infection (acute, chronic, and on treatment). It did not explicitly model condom use. To capture the effects of the increased condom use reported by those exposed to the *Safe Love* campaign, we extended the

model to include condom use and its protective effects against HIV transmission. We also explicitly included the protective effects of male circumcision against acquiring HIV.

Healthcare Costs

Healthcare costs were estimated using overall per-capita estimates and HIV-specific sources. The overall per-capita annual healthcare expenditure in Zambia was most recently estimated to be $96 in 2014 USD (19). For individuals living with HIV and receiving antiretroviral therapy (ART), the average healthcare expenditure was estimated to be $266 in 2010 USD, which we inflated to $289.65 in 2014 USD (20). In 2011, 385,498 individuals were receiving ART in Zambia, representing 3% of its total population of 1,309,2666 (2). Assuming that individuals without HIV and individuals with HIV but not taking ARTs have the same healthcare costs, the average healthcare cost in Zambia, $96, should be equal to (0.03)*($266) + (1-0.03)*($ baseline costs). Solving this equation, we estimate baseline healthcare costs to be $90.13 2014 USD per person per year.

End of Horizon Effects

HIV infection is a chronic condition with life-long consequences on survival and healthcare costs. To capture the lifetime impacts of HIV on the population remaining in the model at the end of the time horizon, we calculate the remaining life-expectancy and lifetime healthcare costs (discounted as appropriate) for each individual still alive in the model at the end of the 10-year time horizon, accounting for their current age and infection status. These outcomes are added to the total number of life-years and costs for the population.

2.2. Model Calibration

We calibrated the model to match recent demographic and HIV prevalence trends in Zambia. We adjusted the birth rate to match Zambia's recent growth rate of 3% (21). We also adjusted parameters relating to sexual behavior and HIV transmission to match the approximately stable HIV prevalence in Zambia of 12-14% (2). These parameters included per-act probability of HIV transmission, the number of coital acts per month, the average duration of regular (spousal and non-spousal) sexual partnerships, and the monthly probability of having a casual sexual encounter until the HIV prevalence projected by the model matched Zambia's HIV epidemic, on average.

2.3. Modelling *Safe Love* Campaign Effects

Behavioral changes observed among those who recalled the *Safe Love* campaign primarily related to condom use, which is therefore the focus of the cost-effectiveness analysis. While increases in HIV testing were also observed among those who recalled the campaign, these were only significant among rural respondents, a differentiation not included in the mathematical model. Intermediate features, such as attitudes or intentions, are also not captured by the model. Thus, we do not include the effects of the campaign on intermediate outcomes and their potential impact on *future* behavior.

Overall, 51% of survey respondents recalled any condom use component of the *Safe Love* campaign. Among respondents who recalled the condom use component, 8.15% reported consistent condom use with regular partners in the past 4 weeks, compared to 2.66% in the matched, no recall control groups (7). In the model, the effect of the *Safe Love* campaign is modeled as a change in the average level of condom use with regular partners from 2.66% to 5.46% (representing the weighted average of 51% of the population reporting 8.15% consistent condom use and 49% reporting 2.66% consistent condom use). Consistent condom use in the past four weeks was used because it aggregated behavior over more than one sex act (vs. condom use at last sex), but still had a relatively limited recall timeframe (compared with consistent condom use in the past six months).

Differences in consistent condom use with non-regular partners were not statistically significant between those with no recall and those with any recall, thus we did not include any campaign effects on condom use during casual sexual encounters.

We did not consider varying levels of recall in the model (e.g., low vs. high).

2.4. *Safe Love* Campaign Cost Estimates

The total estimated cost of the *Safe Love* campaign was $9,063,722, which included initial start-up costs and ongoing operating costs from July 2010 through November 2013 (C. Wakefield, personal communication, October 30, 2014).

Start-up costs were estimated at $4,657,630, which included strategy development and stakeholder meetings and the development of materials. We assume these costs were incurred once at the beginning of the campaign. Additional, ongoing operational costs were included in the model as a month per-person expenditure. These costs reflect ongoing campaign activities, such as media air time, community implementation, and staff time to support the campaign. Between July 2010 and November 2014, the operating costs of the *Safe Love* campaign were $4,406,092, which averages to $83,134 per month.

In our base case analysis, we include all campaign expenditures necessary for the observed increase in condom use among those who were exposed to the campaign. However, condom use promotion was only one component of the *Safe Love* campaign and, in reality, should account for only a fraction of the total campaign expenditures. It is estimated the condom use promotion activities and messaging accounted for 30-40% of the overall *Safe Love* campaign budget (C. Wakefield, personal communication, October 16, 2014). However, due to the integrated messaging of the *Safe Love* campaign, it is difficult to definitively determine the proportion of the campaign budget that was allocated to condom use promotion. Therefore, we conducted an additional sensitivity analysis to determine how the assumed proportion of campaign funds allocated to condom use promotion influences the cost-effectiveness of the campaign.

In the model simulations, we assume that the campaign is ongoing over the full 10-year time horizon, with operating costs incurred every month. We assume that these costs remain constant over time.

2.5. Model Outputs

We used the model to simulate the spread of HIV in Zambia and estimate the number of new infections that would occur over a 10-year time horizon, as well as the number of life-years experienced by the population and the total healthcare costs incurred. We evaluated two scenarios: (1) the status quo, where condom use among regular partners remains at 2.66% (as reported by individuals unexposed to the *Safe Love* campaign) and (2) the campaign scenario, where 51% of the population increases their condom use among regular partners, for an overall average condom use of 5.46%, and campaign costs are incurred in addition to healthcare costs. We simulated each scenario 100 times and reported the average outcomes, both undiscounted and discounted at 3% per year.

Table 1: Select model parameter values and sources.

Parameters	Value	Source
Demographic Characteristics		
Male-to-female ratio	1:1	(12)
% of men who are circumcised	13%	(13)
% of total population who are married	58%	(13)
Sexual Behaviors		
Condom use with regular (spousal or non-spousal) partners	2.7%†	(7)
Condom use with non-regular (casual) partners	35%‡	(7)
Distribution of number of regular partners (M, F)		(13)
0 partners	33.8%, 14.0%	
1 partner	49.8%, 83.8%	
2 partners	12.6%, 2.1%	
3 partners	2.1%, 0.1%	
4 partners	1.8%, 0.0%	
Average partnership duration		(22,23), calibration
Spousal	10 years	
Non-spousal regular	6 months	
Monthly probability of casual sexual encounter (M, F)	8%, 2%	Calibration
HIV Transmission		
Per-act transmission probability (unprotected)		(18), calibration
Acute infection	3.75%	
Chronic infection	0.25%	
Chronic infection with effective treatment	0.01%	
Relative risk if circumcised (female-to-male transmission)	0.52	(24)
Relative risk with condom (both female-to-male and male-to-female transmission)	0.20	
Number of coital acts per regular partner per month	10	(18), calibration
HIV Treatment		
CD4 count at HIV treatment initiation	350 cells/μL	(25)
HIV treatment coverage (of eligible individuals)	90%	(2)
Annual healthcare costs (in 2014 USD)		(2,19,20), calculated
Baseline (HIV-)	$90.13	
HIV+, not receiving antiretroviral therapy	$90.13	
HIV+, receiving antiretroviral therapy	$289.65	
***Safe Love* Campaign costs (in 2014 USD)**		
Fixed start-up costs	$4,657,630	
Ongoing monthly operational costs	$83,134	
***Safe Love* Campaign effectiveness**		(7)
Proportion of target population who recalled the condom use component of the campaign	51%	
Condom use with regular partners among those who recalled the condom use component of the campaign	8.15%	

†Based on level of consistent condom use in the past four weeks with regular partners reported by survey respondents who had no recall of the campaign.

‡Based on level of consistent condom use with non-regular partners in the past four weeks among all respondents (with and without recall).

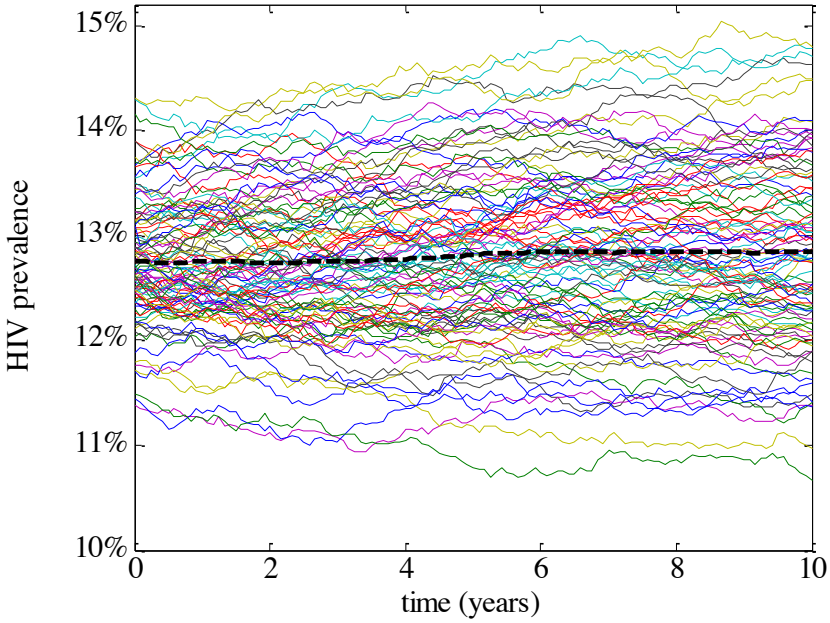

Figure 1: Projected HIV prevalence in 15-49 year-olds in Zambia over 10 years with no campaign (status quo). Prevalence curves shown for each of 100 simulation runs. The dashed line plots mean prevalence.

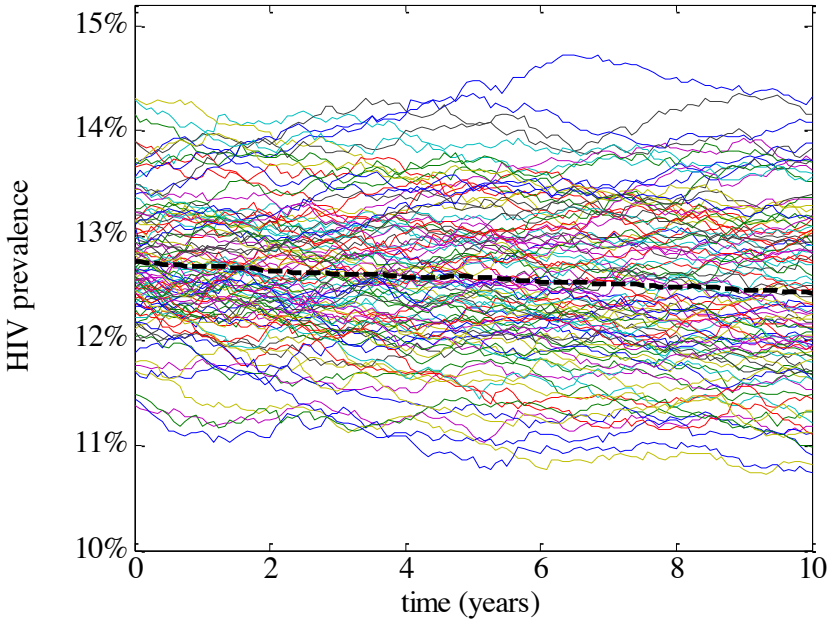

Figure 2: Projected HIV prevalence in 15-49 year-olds in Zambia over 10 years with the *Safe Love* campaign. Prevalence curves shown for each of 100 simulation runs. The dashed line plots mean prevalence.

III. Results

3.1. Projected HIV Prevalence in Zambia

The HIV prevalence projected by the model over the 10-year time horizon is shown for the status quo in Figure 1 and with the *Safe Love* campaign in Figure 2. Each of the 100 runs is plotted separately, with the mean prevalence indicated by a heavy dashed line. Consistent with the calibration target, prevalence in the status quo remains relatively stable over the 10 years, whereas the average prevalence decreases slightly over time with the campaign (from 12.75% to 12.45%).

3.2. New HIV Infections, Life-Years, and Costs

The number of new HIV infections, life-years experienced by the population, and costs incurred over the 10-year time horizon, averaged over the 100 simulation runs, are shown in Table 2 for the status quo and campaign scenarios. Discounted results were calculated using a 3% annual discount rate. These outcome values were scaled up to the population size of the nine target districts (total 15-49 year-old population = 1,682,128).

On average, in our simulations, the *Safe Love* campaign averted over 12,000 HIV infections (undiscounted) over 10 years, representing a 4.4% reduction in new HIV infections. Our simulations projected that this averted infections would result in a gain of 59,900 life-years (undiscounted), an increase of 0.09%. In terms of costs, at a similar intensity of implementation over the 10 years, this would result in a savings of $13.8 million (undiscounted) or $8.2 million (discounted) in healthcare costs.

Cost-effectiveness outcomes are presented in Table 3. The cost per HIV infection averted was calculated by dividing the total campaign costs by the number of HIV infections averted with the *Safe Love* campaign (compared to no campaign) and was estimated to be $1,217 (undiscounted) or $1,303 (discounting both costs and benefits at 3% per year). The cost per life-year gained was calculated by dividing the total costs (campaign + healthcare) by the number of life-years gained with the campaign (compared to no campaign) and was estimated to be $14.80 (undiscounted) or $189 (discounted at 3% per year).

Table 2: Projected outcomes over a 10-year time horizon (averaged over 100 simulations).

Outcomes over 10-year time horizon*	Status Quo		*Safe Love* Campaign		Difference	
	Undiscounted	Discounted†	Undiscounted	Discounted†	Undiscounted	Discounted†
Number of new infections	276,081	238,199	263,990	227,944	-12,091	-10,255
Life-Years‡	69,746,540	44,533,897	69,806,435	44,561,168	59,896	27,271
Total Costs – 2014 US$ (millions)	$7,123	$4,552	$7,124	$4,557	$0.89	$5.17
Healthcare costs‡	$7,123	$4,552	$7,109	$4,543	-$13.83	-$8.20
Campaign costs	$-	$-	$14.7	$13.4	$14.7	$13.4

*Scaled from 10,000 simulated individuals to the population of the nine district target region (total population = 1,682,128).
†Discounted at 3% per year.
‡Total life-years and healthcare costs presented here comprise outcomes accrued over the 10-year time horizon as well as the remaining life-expectancy and lifetime healthcare costs of the population still alive at the end of the time horizon.

Table 3: Cost-effectiveness of the *Safe Love* campaign.

Cost-Effectiveness	*Save Love* Campaign	
	Undiscounted	Discounted†
US$ per infection averted	$1,217	$1,303
US$ per life-year gained	$14.80	$189

†Discounted at 3% per year.

3.3. Sensitivity Analysis: Campaign Costs

We varied the assumed proportion of campaign costs allocated to condom use promotion from 0 to 1.0 (base case) to determine how this assumption influences the cost-effectiveness of the condom use component of the *Safe Love* campaign. The expected cost per life-year gained (discounted) as a function of the budget allocation to condom use promotion is presented in Figure 3. If the condom use component consisted of less than 60% of the full campaign budget, the condom use component was found to be cost-saving, on average, meaning that the savings in healthcare expenditures due to HIV infections averted by the condom use component exceeded the cost of that campaign component.

Though it is difficult to disentangle the costs associated with specific messaging in the *Safe Love* campaign, best guess estimates are that the condom use component comprised 30-40% of the total campaign costs. At this level, the total cost of the condom use component would be $4.0 to $4.5 million (discounted) over the 10 years, which is far less than the $8.2 million savings in lifetime healthcare costs due to averted HIV infections, resulting in a net savings of $3.7 to $4.2 million.

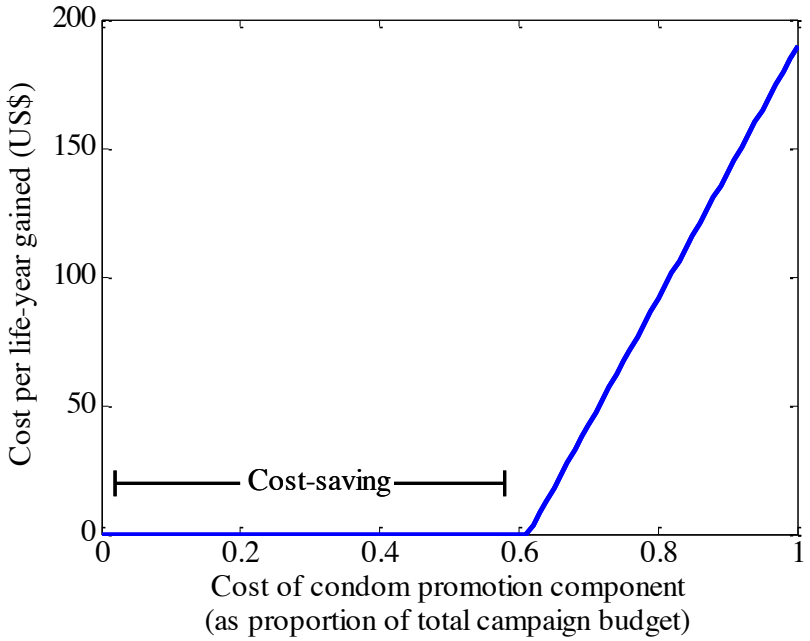

Figure 3: The cost per life-year gained as a function of the cost of the condom use promotion component (as a proportion of the total *Safe Love* campaign budget).

IV. Discussion

The *Safe Love* campaign resulted in increases in consistent condom use with regular partners, which we projected would result in 4.4% fewer HIV infections and a 0.09% gain in life-years over 10 years in the nine district target population. The cost per HIV infection averted by the *Safe Love* campaign was estimated to be

$1,303 (discounted), which is within the range of other HIV prevention interventions (9). The cost-per life-year gained by the *Safe Love* campaign was $189 (discounted). In developing countries, an intervention is often considered cost-effective if the cost per life-year gained is less than 3x the per-capita CDP or very cost-effective if it is less than 1xGDP. In Zambia, the current per-capita GDP is $1,540 (26), making the *Safe Love* campaign a very cost-effective intervention.

In this analysis, we evaluated the *Safe Love* campaign as a whole, rather than considering the costs and benefits of each component (condom use, MCP, HIV testing, and VMMC) separately. Given that condom use was the primary behavior impacted by the campaign, and the only source of health benefit included in the model, it would be reasonable to evaluate the condom use component on its own, including only the campaign costs associated with condom use messaging and promotion. However, the comprehensive, multi-message approach of the *Safe Love* campaign makes it difficult to precisely estimate total expenditures related only to condom use. Because of this uncertainty, we conducted a sensitivity analysis by varying the cost of achieving the observed increase in condom use, from 100% of the total campaign budget down to 0%. As the cost of the condom use component decreases, the cost per life-year gained decreases. If the condom use component comprised less than 60% of the total campaign budget, we find that the component is cost-saving overall due to the averted lifetime healthcare costs associated with prevented HIV infections.

The *Safe Love* campaign director and financial manager estimated that approximately 30-40% of the campaign budget was spent on condom use promotion activities, well below the level at which the condom use component would be cost-saving. These figures should be interpreted cautiously, as it may be erroneous to assume that changes in condom use behavior were exclusively the result of condom use messaging. Campaign messages about general HIV risks, the importance of knowing a sexual partner's HIV status, and the risk of multiple concurrent sexual partners may also indirectly promote condom use, making it difficult to attribute behavioral outcomes to specific campaign components. However, even if the entire campaign budget were needed to achieve the observed increase in condom use, the *Safe Love* campaign still has very favorable cost-effectiveness results.

The *Safe Love* campaign had little impact on HIV prevalence over the 10-year time horizon. This is not surprising. In general, HIV prevalence changes more slowly compared to incidence, given the chronic nature of the infection (27). Furthermore, with Zambia's recent achievements in improving access to HIV treatment, the vast majority of eligible Zambians infected with HIV will receive antiretroviral therapy, greatly improving their survival. As people infected with HIV live longer, HIV prevalence will be maintained, even if incidence is decreasing.

Analysis results were somewhat sensitive to discounting costs and benefits. Though the *Safe Love* campaign would be considered cost-effective in either case, the cost per life-year gained increased quite substantially when costs and benefits were discounted at 3% per year ($189 per life-year gained compared to an undiscounted $15 per life-year gained). The increase in the cost per life-year gained under discounting is driven by the gains in life-years being further in the future, whereas campaign costs are accrued throughout the time horizon. This speaks to the long-term nature of HIV infection and the importance of time horizon considerations when evaluating HIV prevention. Though our analysis only evaluates the campaign over a 10-year time horizon, we capture the lifetime survival benefits and lifetime healthcare savings of the HIV infections that are averted over that time frame by adding the remaining life-expectancy and lifetime healthcare costs of those remaining in the population at the end of the time horizon to the final outcomes. Without this adjustment, we would see far fewer healthcare savings and little increase in life-years, as these benefits would have yet to be realized.

In this analysis, we use a mathematical model to translate changes in behaviors (namely, name condom use) into changes in health outcomes. However, the outcome evaluation found many other positive impacts of the *Safe Love* campaign that are not captured by this particular framework. For example, the campaign had an effect on changing attitudes towards multiple concurrent partners, such as increasing agreement with the statement "I believe having one partner at a time is important," which may lead to future changes in social norms and ultimately changes in behavior. Better quantitative and predictive models of how intentions, attitudes, and communication skills relate to future behavior change are needed before these features can be systematically incorporated into mathematical models of HIV spread.

4.1. Limitations

Our analysis has several limitations. Many input parameters for model were unavailable or uncertain, which required estimation through model calibration. The mathematical model also does not capture differences in sexual behaviors by age or assortative mixing patterns. Mixing patterns induced by cross-generational partnerships, in particular, could prove to be important for HIV spread in Zambia.

As with all mathematical models, the model used in this analysis is an approximation and simplification of reality. The goal of this analysis was to estimate the potential magnitude of impact that the *Safe Love* campaign might have on HIV spread. The mathematical model used in this analysis was not developed for predicting future trends, but rather for the comparative analysis of interventions. Specific outcome estimates presented in this report should be interpreted with care.

Campaign costs were estimated from program accounting records. Expenditures for specific budget categories were available (e.g., materials development, media time, staff time); however, designating these spending categories as either one-time start-up costs or on-going operational costs was done using the expert opinion of program accounting staff. Cost estimates were further complicated by the changing activities of the campaign, with different components being launched at different times.

The effectiveness of the *Safe Love* campaign was based on the outcomes evaluation survey. Thus, the limitations of the sampling and/or data analysis methodologies used to evaluate the campaign impacts also apply here.

V. References

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