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Applying the Dynamic Social Systems Model to HIV prevention in a rural African context: The Maasai and the esoto dance

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Abstract

This study applied the Dynamic Social Systems Model (DSSM) to the issue of HIV risk among the Maasai tribe of Tanzania, using data from a cross-sectional, cluster survey among 370 randomly selected participants from Ngorongoro and Siha Districts. A culturally-appropriate survey instrument was developed to explore traditions reportedly coadunate with sexual partnership, including “wife-sharing”, fertility rituals, and various traditional dances. One dance, *esoto*, accounted for over two-thirds of participants’ lifetime sexual partners ($n=10.5$). The DSSM, combining structural and systems theories, was applied to systematize complex multilevel factors regarding *esoto* practice. Participants reported multifaceted beliefs regarding *esoto*; a majority viewed the dance as exciting and essential, yet most men feared social stigma and three-quarters of women had experienced physical punishment for non-attendance. In multivariate logistic regression, *esoto* attendance was predicted by female gender (AOR 4.67, 95% CI: 1.6, 13.2), higher positive beliefs regarding *esoto* (AOR 2.84, 95% CI: 1.9, 4.2) and Maasai lifecycle events (AOR 0.06, 95% CI: 0.01, 0.47). The DSSM proved useful for characterizing *esoto* and for revealing feedback loops that maintain *esoto*, thus indicating avenues for future interventions.

Introduction

Background

Cultural and environmental contexts structure dyadic sexual partnerships. Behavioral interventions to prevent HIV should reflect these influences. On a national level, the CDC has disseminated 26 tailored behavioral HIV prevention programs with proven effectiveness for various at-risk groups, ranging from gay African-American men to inner-city girls to Latino drug users to youth recently released from prison (Centers for Disease Control and Prevention CDC/AED, 2009). Internationally, numerous efficacious HIV prevention interventions have been developed and implemented in many countries, including Tanzania, the site of the present research. Programs that have been implemented and found efficacious in Tanzania include youth education interventions (Gallant & Maticka-Tyndale, 2004; Hayes et al., 2005; Klepp et al., 1994; Ross et al., 2007), mass media programs (Vaughan, Rogers, Singhal, & Swalehe, 2000), biomedical interventions (Dickson et al., 2011; Kilewo

et al., 2008; Kilewo et al., 2009), voluntary counseling and testing as HIV prevention (Sweat et al., 2011; The Voluntary HIV-1 Counseling and Testing Efficacy Study Group, 2000), and interventions for most at-risk populations such as sex workers (Riedner et al., 2006). Some programs have been tailored for particular populations, such as truck drivers (Laukamm-Josten et al., 2000), but there are other groups within Tanzania whose risk-profiles have not been fully addressed by these successful HIV prevention programs. One reason is that there is a dearth of quantitative, culture-specific information related to concurrent sexual partnerships among many groups (Leclerc-Madlala, 2009); this is the case for the Maasai of Tanzania.

The Maasai are a semi-nomadic tribe living in Kenya and Tanzania, with approximately 1,000,000 members (Phillips & Bhavnagri, 2002). Compared to most Swahili-speaking tribes in Tanzania, the Maasai are not well integrated into contemporary Tanzanian customs, language and social institutions. No proper epidemiological studies of HIV prevalence among the Maasai have been conducted. One clinic-based HIV prevalence estimate was 8% (Sikar & Hodgson, 2006); analysis of a small sample (n=89) of Kenyan Maasai sampled in a Demographic and Health Survey indicated a prevalence of 4% (Siegler, 2006). There is no comparable information for Tanzanian Maasai; estimated regional HIV prevalence for areas where some Maasai communities reside are 1.6% for Arusha Region and 1.9% for Kilimanjaro Region (Tanzania Commission for AIDS (TACAIDS), Zanzibar AIDS Commission (ZAC), National Bureau of Statistics (NBS), Office of the Chief Government Statistician (OCGS), & and Macro International Inc, 2008).

Theoretical Model

The present investigation into Maasai tradition and HIV prevention is structured by the Dynamic Social Systems Model (DSSM) (Latkin, Weeks, Glasman, Galletly, & Albarracin, 2010). The DSSM is a structural model focused on behavioral interventions, and is unified by the concept that understanding distal structural factors is necessary to understand circumstances in which individuals can change their behavior. The DSSM builds upon Bronfenbrenner's Ecological Model, assessing the macro, meso, and micro levels.

What differentiates the DSSM from other structural models is its emphasis on dynamic linkages between broader structural components and the more proximal social factors that are tied to specified health behaviors. These dynamic linkages are emphasized through a Systems Theory component. In this framework, the ties between elements and structural factors vary in strength, and interact through positive and negative feedback loops. By exploring multiple levels and their interactions, the DSSM seeks to clarify "black boxes" where inputs and outputs are observed, but the intermediate processes are unknown.

HIV-related Maasai Customs

Qualitative studies have indicated that there are several realms of Maasai custom that can lead to concurrent partnership, including "wife-sharing" (Saitoti, 1986; Spencer, 1988; Talle, 1994), the *esoto* dance (Spencer, 1988; Talle, 2007) and *emaho* ceremonies (Coast, 2001; Llewellyn-Davies, 1978, 1990; Talle, 2007). "Wife-sharing" has been described in the qualitative literature as consisting of unhindered sexual access to age-mates' wives. We could not find a specific native Maa word, or customary phrase, to describe this custom. The *esoto* dance has been reported as a common place for warriors (aged 15-30) and girls (aged 8-15) to find sexual partners. Numerous other ceremonies (*emaho*) entailing sexual partnership have also been reported, such as *oloip* (daytime partnerships in the shade), *manyata* (warrior village), *inkipot* (gifting milk to selected lover) and *olamal* (fertility ritual).

Despite providing rich descriptions, qualitative studies on the Maasai have provided a picture that is neither fully coherent nor sufficiently clear in relative risk magnitude to prioritize targets for HIV prevention interventions. One example of disagreement within this literature can be seen in the observations of Jacobs (1979), who noted that “European mythology” has exaggerated descriptions of traditions related to sexual partnership among the Maasai. Sindiga (1987) also argued for this position, using as evidence the relatively low fertility rates of Maasai groups. Moreover, even if the qualitative literature were consistent in identifying traditions related to sexual risk, it could not describe the magnitudes of such risks.

Only two quantitative studies of sexual partners among the Maasai have been conducted; both were small-scale and addressed only Maasai males. They reported markedly different findings, echoing the dissension in the qualitative literature; respectively the studies reported averages of two and twelve partners per year (Coast, 2006; Morley, 1991).

This study seeks to fill a gap in the present literature by assessing the intersection of sexual partnership and Maasai ritual by (1) quantitatively identifying overall number of sexual partners and the number attributable to each custom, (2) exploring descriptive statistics and correlates of ritual participation and (3) incorporating study findings into the rubric of the Dynamic Social Systems Model.

Methods

Overview

This mixed qualitative-quantitative methods study was conducted in areas randomly selected from Siha and Ngorongoro Districts in northern Tanzania. A series of semi-structured interviews was conducted with community members in two pilot sub-villages, Karansi and Mondorosi. The aim of this data collection was to inform development of a quantitative survey instrument intended to measure culturally-situated risks for HIV transmission. The 32 semi-structured interviews were conducted with purposive sampling, leading to four in-depth interviews in each of eight categories created by sampling across age (18-30 and 31-50), gender, and education levels (no education versus some education). Domains addressed in the interviews included relationship with main sexual partner, relationships with non-spousal/non-main partners, HIV/AIDS knowledge and stigma, condom-related beliefs, traditional community celebrations, and cultural influences on sexual identity and partnership norms.

The survey instrument was translated directly from English into Maa by a team of two native Maa speakers, and then back-translated by a second tandem. The face validity of the instrument was improved through comments obtained in 15 cognitive interviews, a survey item analysis methodology suggested by Beatty and Willis (2007) to improve question design, clarity and cultural compatibility.

Data were obtained from face-to-face interviews conducted by native Maa-speaking, gender-matched interviewers. The sample frame consisted of a set of local leaders (*balazi wa nyumba kumi*), who represented the smallest administrative unit of government in Tanzania. These units were theoretically sized at ten households, but in our sample they were generally larger, with a mean of 12.1 households. From 955 units, representing an estimated population of 29,000 adults, 37 were randomly selected. From each of these, eleven households were randomly selected (for areas with <11 households, we sampled nearest neighboring unit), and one adult member was randomly selected from each household.

Measures

Demographic—Demographic variables not specific to the Maasai were adapted from the Tanzanian DHS Survey (National Bureau of Statistics: Tanzania and ORC Macro, 2005). These included *gender, age, marital status, number of wives, religion, cell phone ownership, radio ownership, education and literacy of any household member*. Items were also developed to assess *livestock wealth, age set* (Maasai male life stages, each approximately 15 years) and *tribal section*.

HIV-related—A scale assessing *knowledge of HIV transmission* was adapted from the Tanzanian DHS Survey, consisting of true/false identification of fourteen potential pathways for HIV transmission, such as “sharing needles” and “kissing”. A seven-item dichotomously coded *stigma scale*, adapted from the Tanzania Stigma Indicators survey (UNAIDS, 2005), included items such as, “HIV is punishment for bad behavior” and, “I would feel ashamed if I were infected with HIV.”

Sexual partnership—*Number of lifetime sexual partners by type*, a key variable for descriptive analyses, was ascertained using emic partnership categories (Jewkes, Nduna, Jama, Dunkle, & Levin, 2002), a method designed to make partner reporting more accurate. This resulted in seven categories: “premarital boyfriend/girlfriend”, “extramarital lover”, “esoto partner”, “emaho partner”, “partner met at bar”, “shared spouse” and “sex worker.” These seven categories populated the question, “Did you have vaginal sex with ___ in your lifetime? [IF YES] How many different ___?” Emaho, or traditional ceremony, was used to assess partnership stemming from oloip, manyata, inkipot and olamal; field-testing indicated that these practices vary by locale, and emaho provided a universally understood concept in their stead. Formative research for our project found that the esoto dance is particularly important for development of Maasai sexuality, so we developed questions to assess *weekly frequency of esoto, esoto as location of first coitus, punishment for esoto non-attendance, and fear of esoto punishment*.

Dependent and independent variables—For the logistic regression model, *esoto attendance* was assessed with the binomial question, “Did you ever attend an esoto that ended with sexual partnership between warriors and girls?” Independent variables for the regression included general and Maasai-specific demographic variables described above. The regression also included a three-item *positive esoto beliefs* scale we developed. Dichotomous scale items were: “Girls should attend esoto because they need the sperm to develop breasts”, “Attending esoto is an essential part of being a Maasai youth”, and “I was enthusiastic to attend esoto because it meant I was becoming a man [woman]”. The average scale inter-item correlation was 0.49. The Kuder-Richardson coefficient, a dichotomous version of Cronbach’s alpha, was 0.67, an expected low value because shorter scales have lower coefficient alpha values (DeVellis, 2003).

Data Analysis

Data analyses corrected for the hierarchical nature of the data by weighting and statistically adjusting error terms for correlations within housing clusters and natural variation in household sizes. Exploratory analyses were conducted assessing proportions, means, medians, and their error terms. Univariate analyses were conducted to build a regression model assessing determinants of esoto participation. Model building techniques for the logistic regression that predicted esoto participation were implemented based on methodology suggested by Hosmer and Lemeshow (2000). All analyses were conducted in Stata 11.2 for Mac OS X (StataCorp, 2011). Each participant was consented by a trained interviewer, a process approved by Emory University’s Institutional Review Board and Tanzania’s National Institute for Medical Research.

Application of theoretical model

We applied the DSSM framework to the esoto dance to reveal factors that could be leveraged in future HIV prevention interventions. The DSSM seeks to elucidate “black boxes” between model inputs and outputs; in our case this involved inputs of Maasai culture/governance, Tanzanian governance, and environmental settings. The primary model output was esoto attendance, as it entailed unprotected sex with multiple partners. The DSSM was selected because it is a structural model (requisite for the multi-level nature of esoto practice) specified for behavioral interventions. The full model includes six dimensions that represent possible arenas for theory building, but not all dimensions are considered pertinent for each environment (Latkin et al., 2010). In applying the model to Maasai traditions, we assessed three dimensions: Informal Social Influences, Formal Social Control, and Settings. To explicitly incorporate the impact of traditional Maasai culture, we divided the Formal Social Control category into Maasai Formal Social Control and Governmental Formal Social Control.

Quantitative survey findings were the primary source of information for applying the DSSM, and were supplemented by qualitative observations. During nine months of fieldwork, numerous conversations were held between the Principle Investigator and traditional leaders, female heads of households hosting esoto, traditional medical/ritual practitioners, and representatives of various NGO’s and hospitals working with the Maasai on HIV prevention. Participant observation of the esoto dance (researchers left prior to the sexual portion of the ritual) also informed DSSM development. Field notes from interviews and observations were entered into maxQDA (2012), coded, and analyzed for emergent themes; this information was triangulated, along with quantitative survey data, to explore esoto in the DSSM framework. When possible, field observations were verified through literature, such as information regarding the local Tanzanian governmental system (United Republic of Tanzania President’s Office, 2003) and traditional Maasai leadership structure (Spencer, 1993). Field observations of esoto customs were corroborated through correspondence with Maasai leadership (Kin’gori, 2009).

Results

Demographics

A sample of 370 individuals, mean reported age 29 and 53% female, agreed to participate in the survey, a 91% response rate; the sample represented seven Maasai tribal sections (Table 1). The majority (78%) was married, with roughly half in a non-polygynous marriage, another quarter in a polygynous marriage with one husband and two wives, and the remaining quarter in a polygynous marriage with one husband and three to six wives. Most (59%) of the population held traditional Maasai religious beliefs; a sizable minority subscribed to Lutheran or Catholic beliefs. Educational attainment of this sample was low, with only 3% having attained education beyond the 7th year, and only 39% having ever attended school. Females were more likely than males to have received no education (69% versus 52%). Around 40% of participants were very poor, owning fewer than 20 cattle and goats.

HIV knowledge and condom use

Nearly all respondents (99%) were aware of HIV, yet many had a limited understanding of HIV transmission. Transmission pathways of blood, vaginal sex, and injections were each identified correctly by over 90% of the population. Yet false pathways were also posited, with kissing, mosquitos and saliva each incorrectly identified by over 40% as sources of HIV transmission. This resulted in low scores on the HIV knowledge scale. Stigma towards people living with HIV was common (mean 5.2 out of 7 point scale), although only 25% of

respondents reported ever meeting someone they believed to have HIV. Regarding prophylactics, less than 3% ever used a condom, yet nearly one-third said they would be willing to use condoms if available.

Premarital sexual partnership and Maasai traditions

Table 2 displays mean lifetime non-marital sexual partners by partnership category. With a mean of 10.2 lifetime partners in all categories, 6.7 came from traditional sources, with 6.3 from esoto, 0.4 from emaho and <0.1 from wife sharing. Partners not encountered at Maasai traditional venues accounted for a mean of 3.5 total partners, with 2.4 from premarital boyfriends/girlfriends, 0.9 from long-term extramarital partnerships and 0.2 from all other sources. The esoto dance accounted for over twice the partnerships of all other modes of non-marital lifetime partners. Among those who attended esoto, a range of 0 to 280 partners was reported, with a mean of 10.5 and a median of four esoto-specific partners. Outliers were included in our calculations, as reports of large partner numbers were consistent with field reports of popular males termed “dance heroes”. Males reported significantly more sexual partners than females did for the categories of esoto, emaho and pre-marital boy/girlfriends. In survey studies across Africa, males nearly always reported significantly more sexual partners than females (Clark, Kabiru, & Zulu, 2011; Glynn et al., 2011; Nnko, Boerma, Urassa, Mwaluko, & Zaba, 2004). Despite different absolute levels of sexual partners reported, patterns within gender were similar; esoto accounted for the majority of lifetime partners for both males and females.

Esoto experience

Interviews indicated that esoto was closely linked to sex, with 80% of those surveyed reporting that the dance always ended in sexual partnership (Table 3). The esoto dance was attended by 61% of the sample; this number increased to 82% when the Ilarussa tribal section was excluded. All 93 members of the Ilarussa section reported never attending esoto, and were thus excluded from all subsequent analyses regarding esoto. In follow-up interviews with Ilarussa elders, they could not recall a time when esoto was practiced in their section.

Esoto was a common locale for first coitus (92% females, 66% males). Support for the esoto tradition in the abstract was strong, yet participants had mixed feelings about their own experiences. Agreement ranged from 85-89% for statements in the positive esoto beliefs scale, including, “I was enthusiastic to attend esoto”, “esoto is essential to being Maasai”, and “semen is necessary for girls to develop breasts”. Despite agreement with these abstract statements, 80% of males and females feared the social consequences of non-attendance. In addition to potential social ramifications, females faced physical ramifications; three-quarters of females reported experiencing physical punishment, by beating with a stick, for non-attendance. Moreover, 80% of females reported that they would have attended esoto less if there were no threat of physical punishment.

Correlates of esoto participation

A multivariate logistic analysis predicting ever attending esoto showed that positive beliefs regarding esoto, female gender, and adult lifecycle rituals were significant positive predictors (Table 4). The overall model was highly significant, with the global F-test ($F=8.7e32$, $prob>F=0.000$) indicating good model fit. For each point higher score on the positive esoto beliefs scale, the likelihood of a community member ever attending esoto was 2.84 times higher (AOR 2.84, 95% CI: 1.9, 4.2). Average female likelihood of attending esoto was over four times higher than males (AOR 4.67, 95% CI: 1.6, 13.2). Maasai who had not undergone adult lifecycle rituals, either male circumcision or female excision, had a

94% lower chance of attending esoto (AOR 0.06, 95% CI: 0.01, 0.47). The final regression model had no significant interactions among independent variables.

Although male circumcision and female excision was a significant predictor of esoto attendance, different causes seemed to underlie why males had not been circumcised and females not excised. For males, most (15/18) were ineligible for circumcision by Maasai ritual rules due to their age-group (boy). All females were of sufficient age to be eligible for excision (experience of menarche). Predictors of women's avoidance of excision included higher levels of any education (65% vs. 24%) and Christianity (65% vs. 34%) than their peers.

Education's impact on esoto attendance was fully mediated by the positive esoto beliefs scale, based on Barron and Kenny's (1986) criteria. We hypothesized that the relation between education (IV) and esoto attendance (DV) was mediated by the positive esoto beliefs scale (MED), and tested this with a single mediation model. The Sobel value was -2.51 ($p=.01$), indicating a significant mediator effect. The indirect, mediated, effect accounted for 40% of the total effect, suggesting that positive esoto beliefs accounted for 40% of education's effect on esoto attendance.

Dynamic Social Systems Model of the Esoto Dance

The DSSM application to the esoto dance can be seen in Table 5, exploring the esoto system by detailing macro, meso and micro levels of factors that eventuate a positive, stabilized feedback loop in which esoto and attendant unprotected sex is practiced by most (82%) of the eligible population. This section details the esoto feedback loop, and potential areas for disruptive negative feedback, by addressing informal social influences, Maasai formal social control mechanisms, governmental formal control mechanisms and settings.

Informal social influences serve as key reinforcing mechanisms for esoto practice. Entrenched as the normative source of first coitus, esoto is further bulwarked by norms of attendance, with most Maasai fearing stigma for lapses in attendance. HIV risk is standard when attending esoto, with multiple sexual partners and unprotected sex being the current practice. Those who equate the importance of esoto to Maasai identity, or who subscribe to the traditional belief that women need sperm to develop breasts, are most likely to participate.

Maasai formal social control mechanisms reinforce esoto practice, yet simultaneously provide potential inroads for destabilizing negative feedback to be added. Physical coercion of females by warriors is normative. Without explicitly endorsing this, Maasai tradition and current leadership implicitly sanction the beatings, as warriors face no repercussions. Females, unable to opt out of esoto, are more likely to participate than males.

Esoto is conducted at local host compounds, generally in groups of 15-30 participants. The "hosting" family controls the environment in numerous ways; for instance, we observed one host sending girls home whom they deemed too young to participate. Maasai formal social control mechanisms could provide inroads for leveraging change; at the meso-level hosting households are influential, whereas at the macro-level, traditional leaders such as age-group heads and traditional healers can instigate change.

Governmental formal control mechanisms have the potential to disrupt the esoto feedback loop. Educated participants were less likely to participate in esoto; basic investment in early education could yield a multitude of benefits. Expanding the government's legal presence could also provide utility. Both sex with minors (girls attending are pre-pubescent) and

physical coercion are illegal in Tanzania (Interpol, 2003), yet no enforcement mechanisms exist to address known Maasai practices.

Settings frame the esoto dance, proscribing both limitations on its practice as well as on any programs seeking to alter it. Esoto is practiced only during the rainy seasons, as warriors periodically leave during the dry season in search of water. Cattle herding also impacts population density, with Maasai populations and local leadership being relatively dispersed based on herding needs. Due to low population density, transportation is limited. Few roads, and low road quality, are the norm. Any programs working with the Maasai must overcome transport, geographical and seasonal challenges in order to gain sufficient intervention penetration away from population centers.

One method of applying the DSSM involves identifying systems-based feedback loops across structural levels, with interventions designed to alter ties or build new disruptive loop elements. For instance, one positive reinforcing feedback loop involves esoto norms and physical beatings that coerce female attendance. The loop starts with individual esoto participation (micro), which strengthens esoto as normative Maasai rite of life passage (macro), contributing to stigma surrounding non-attendance (macro) which manifests in values and customs that sanction physical beatings (macro), normatively enacted at host households (meso), leading to greater likelihood of individual esoto attendance (micro). This loop may be susceptible to macro level interventions that develop structural barriers to prevent beatings, such as enforcement of governmental or Maasai regulations. Alternately, meso-focused interventions could involve parents, host households and local community leaders in reaching out to warriors to change behaviors surrounding non-attendance.

A different application of the DSSM could seek to increase connections between informal norms at the macro level, such as norms of sex without condoms, and formal Maasai social control mechanisms that currently don't engage these norms, such as Maasai age-group leaders. This would be similar to a Popular Opinion Leader approach (Kelly et al., 1991), adapted to a Maasai context. Future structural interventions addressing esoto will likely be most effective if they involve direct collaboration with Maasai leadership.

Discussion

At a proximal level, this study has important implications for the design of future HIV prevention programs for the Maasai. In meeting the first study objective, to quantify the number of sexual partners attributable to each emic category, we found that the esoto ritual was responsible for the vast majority of premarital partners for attendees. Given the high numbers of partners and the concurrent, overlapping nature of partnership that the dance entails, esoto is likely a principle source of HIV risk among the Maasai.

The second study objective, to describe characteristics and correlates of ritual participation, revealed a complex picture. Esoto was ubiquitous in its practice, and sex was strongly tied to the ritual. Participants held positive beliefs about it, but most feared stigma for non-attendance, and most females would have attended less in the absence of physical coercion. Although esoto was highly attended, the 18% of non-attenders (among practicing Maasai sections) were more likely to be male, have higher education, hold more negative beliefs towards esoto, and not have experienced male circumcision or female excision.

The third study objective, to incorporate the findings into the rubric of the DSSM, yielded several implications for future interventions seeking to address HIV-risk entailed by esoto. The DSSM does not indicate any single intervention, but instead provides a flexible framework for potential interventions. In designing an intervention to address esoto, program designers must determine whether to take an approach that aims to (1) eliminate

esoto or (2) reduce potential hazards and maximize the right of self-determination of participants.

The current practice of esoto constitutes two areas of human rights violations: female participants are too young to provide consent and are frequently physically coerced to participate. A programmatic approach seeking to eliminate esoto is attractive, in that it provides a clear ethical stance on these issues. This strategy could be paralleled to the current WHO strategy regarding female genital excision, which solely emphasizes eradication and explicitly discourages harm-reduction approaches (WHO et al., 2010). Yet female excision is different from esoto in that, no matter how it is adapted, it fundamentally violates human rights. Esoto is more nuanced; if age of participating girls was increased, and coercion was ended, esoto would be no more a human rights violation than some nightclubs in the west.

The DSSM framework indicates that esoto practice is deeply embedded in Maasai culture, having strong support from both elders and performing youth. Thus, a harm-reduction approach may be more likely to succeed than an elimination approach. Harm-reduction approaches have been applied to various groups, including injection drug users (Sterk, Theall, Elifson, & Kidder, 2003), commercial sex workers (Rekart, 2005) and “rave dance” (all-night parties frequently entailing Ecstasy drug use) attendees (Weir, 2000).

DSSM findings suggest several underlying factors that should be addressed in any harm-reduction approach to interventions regarding esoto. First, Maasai institutions at multiple levels should be engaged in developing and implementing interventions. This translates to collaborating with the Maasai Council of Tanzania and age-group leaders (*ilaiguenak*) in the project area (macro level), working directly with hosting households (meso level) and developing projects that communicate directly to warriors and girls practicing esoto (micro level).

Second, DSSM analysis indicates the centrality of physical coercion of females in perpetuating esoto and esoto values, and also shows pathways to end or limit this custom. Preventing physical coercion should start with interventions targeting changes in the rules established by Maasai leadership. Following a rule change, campaigns to prevent coercion should establish behavioral change programs targeting host households, parents of young girls, and younger age-group leaders who hold influence over their peers. Allowing girls to opt out of esoto will not only impact those girls, but also the entire cultural framework supporting esoto.

A complementary harm-reduction strategy suggested by the DSSM would involve increasing the age at which girls are eligible to participate. In this scenario, rather than pregnancy being prevented by the young age of girls, condoms would be the factor that prevents pregnancy, and moreover would provide protection against HIV and other sexual transmitted infections. This strategy would likely be welcomed by warriors, as warriors prefer more physically developed sexual partners (Talle, 2007). Hosting households already assist in the selection of girls deemed too young for esoto, so they could be key stakeholders in implementing this change.

Navigating age eligibility changes might be difficult due to potential opposition from older age-sets, who traditionally have held marital rights to girls post-menarche. Yet, age-group roles have begun to change, so this scenario is a possibility. For instance, warriors are traditionally strictly forbidden to have sex with women (Talle, 2007), yet the Principle Investigator attended a marriage ceremony between a warrior and a woman in rural Loliondo village. Maasai traditions are evolving, and the DSSM provides a flexible

framework within which to approach Maasai leadership and negotiate a harm-reducing HIV prevention strategy for esoto that in turn protects human rights.

At a more distal level, this study demonstrates the utility of combining and tailoring qualitative and quantitative approaches to understand HIV-related practices in underserved rural areas. Given solely quantitative information, such as from a general knowledge, attitudes and practices (KAP) survey, the source of high levels of partnership and surrounding norms would have been obscured. Given solely qualitative information, the magnitude of different potential sources of risk would be unknown, making it nearly impossible to design targeted programs. By establishing a qualitative foundation that informs quantitative assessment of magnitude, future behavioral HIV prevention studies can avoid these pitfalls.

The DSSM provides a flexible framework that can serve as a tool for community-based, structural interventions. By overtly characterizing structural factors, multifaceted interventions can be designed to alter connection patterns based on a systems approach. It may be possible to leverage DSSM flexibility by using it as a tool to engage communities in developing locally appropriate structural interventions. This study is the first we know of that applies the DSSM framework to developing country settings. Further exploration of model implications for program planning and community participation is needed.

The present study has several limitations. One is that face-to-face interviews tend to increase levels of socially desirable reporting, compounding potentially unbiased recall error. Another is measurement error in translating a survey across languages and cultures, a process that is fraught with difficulty despite efforts to ameliorate this problem through reverse-translation and cognitive interviewing. Another limitation is that the study was exploratory, and did not fully address the impact of seasonality and migration patterns on sexual networks during migratory periods; future studies should be conducted to more fully explore this area.

This study also has several strengths. It is the first study to quantitatively measure the intersection of ritual and HIV-related behaviors among the Maasai. It also provides a novel example of the utility of developing locally-appropriate quantitative survey items based on qualitative work. Lastly, the present study provides a foundation for future research and interventions aimed at preventing HIV transmission among the Maasai, while simultaneously highlighting areas for future research into application of the DSSM.

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Table 1

Demographic variables

	Total		Female		Male	
	n	%, 95% CI	n	%, 95% CI	n	%, 95% CI
General Demographic						
Gender	370		194		176	
Age: Mean, 95% CI	na	29 (28, 30)	na	27.6 (26.4, 28.8)	na	30.5 (28.5, 32.4)
Age set ^a			na	na		
<i>Ilayiok</i> (Boys)	15	9% (5, 17)			15	9% (5, 17)
<i>Ilmurran</i> (Warriors)	79	44% (35, 52)			79	44% (35, 52)
<i>Iipayani</i> (Junior Elders)	59	35% (26, 45)			59	35% (26, 45)
<i>Ilmoruak</i> (Elders)	22	13% (8, 20)			22	13% (8, 20)
Married	291	78% (72, 83)	161	83% (77, 89)	130	72% (62, 81)
Number of wives						
One	179	56% (48, 64)	82	44% (36, 53)	97	72% (60, 81)
Two	60	24% (18, 31)	43	30% (22, 39)	17	15% (9, 26)
Three-Six	56	20% (15, 27)	40	26% (19, 35)	16	13% (7, 22)
Religion						
Traditional	218	59% (50, 68)	114	60% (50, 70)	104	58% (46, 69)
Lutheran	94	26% (18, 36)	56	28% (19, 40)	38	24% (16, 34)
Catholic	39	10% (7, 15)	16	8% (4, 13)	23	13% (8, 21)
Other	17	5% (3, 7)	8	4% (2, 8)	9	5% (3, 10)
Education						
None	223	61% (54, 68)	131	69% (61, 77)	92	52% (43, 61)
Standard 1-7 ^b	125	36% (29, 43)	50	28% (21, 37)	75	44% (36, 53)
> Standard 7 ^b	12	3% (2, 5)	5	3% (1, 6)	7	3% (1, 8)
Literate household member	249	69% (63, 75)	101	54% (44, 64)	148	86% (79, 91)
Wealth						
Cattle < 20	204	51% (40, 61)	105	51% (40, 62)	99	51% (38, 63)
Goats < 20	197	52% (41, 63)	109	54% (43, 65)	88	50% (37, 63)
Cell phone	124	36% (29, 43)	63	35% (27, 44)	61	37% (27, 49)
Radio	153	41% (33, 50)	67	33% (23, 46)	86	50% (41, 60)
HIV-related						
Heard of HIV	354	99% (97, 100)	186	98% (94, 100)	168	100% (99, 100)
Met someone with HIV	82	25% (18, 34)	50	28% (19, 39)	32	22% (14, 33)
HIV Knowledge Scale ^c : Mean, 95% CI	na	9.0 (8.7, 9.3)		8.9 (8.5, 9.2)		9.1 (8.5, 9.7)
Stigma PLHIV Scale ^c : Mean, 95% CI	na	5.2 (5.0, 5.4)		4.9 (4.5, 5.4)		5.5 (5.3, 5.8)
Ever condom use	7	3% (1, 6)	3	2% (1, 7)	4	4% (1, 10)
Willing to try condoms	107	31% (22, 42)	39	24% (15, 36)	68	40% (28, 53)

Note: CI=Confidence interval ;

^a Age sets are Maasai male life stages, each $\approx$ 15 years

^b Standards in Tanzanian education approximate US grades

^c Scales total 14- and 7-points for knowledge and stigma respectively, with higher values indicating greater levels

Table 2

Means of lifetime sexual partners in emic Maasai categories

	All	Males	Females	Esoto attenders	Non-attenders
	Mean (S.E.)	Mean (S.E.)	Mean (S.E.)	Mean (S.E.)	Mean (S.E.)
Maasai-specific					
Esoto	6.27 (1.9)	9.68 (3.9)	3.26 (.92)	10.54 (3.2)	0 (NA)
Emaho	0.39 (.13)	0.77 (.26)	0.06 (.02)	0.61 (.21)	0.07 (.02)
Spouse sharing	0.06 (.02)	0.11 (.05)	0.01 (.01)	0.08 (.04)	0.03 (.02)
Non-Maasai specific					
Premarital boyfriend/girlfriend	2.35 (.41)	4.86 (.83)	0.15 (.06)	3.17 (.60)	1.16 (.23)
Postmarital boyfriend/girlfriend	0.91 (.14)	1.20 (0.31)	0.70 (.14)	1.16 (.19)	0.31 (.06)
Sex worker	0.03 (.02)	0.04 (.03)	0.01 (.01)	0 (NA)	0.06 (.04)
Partner met at bar	0.09 (.03)	0.12 (.05)	0.06 (.03)	0.10 (.04)	0.07 (.03)
Other partner	0.14 (.04)	0.02 (.01)	0.24 (.07)	0.14 (.04)	0.14 (.06)
Total	10.2 (2.2)	16.45 (4.5)	4.38 (.92)	15.8 (3.6)	1.8 (0.2)

Table 3

Esoto dance attendees' beliefs and sexual experiences regarding esoto by gender

	Total		Male		Female	
	n	% (95% CI)	n	% (95% CI)	n	% (95% CI)
Sex occurs at every <i>esoto</i>	145	80% (76, 84)	36	59% (49, 68) ^a	109	91% (81, 96)
First coitus occurred at <i>esoto</i>	154	83% (76, 89)	42	66% (49, 79) ^a	112	92% (80, 97)
Number of days per week <i>b esoto</i> is held: Mean, 95% CI	na	6.0 (5.5, 6.4)	na	6.6 (6.3, 6.9) ^a	na	5.7 (5.1, 6.2)
Number of days per week <i>b esoto</i> is attended: Mean, 95% CI	na	4.5 (4.2, 4.8)	na	4.8 (4.2, 5.5)	na	4.3 (3.9, 4.7)
Felt enthusiasm in attending <i>esoto</i> for the first time	193	88% (81, 93)	83	88% (80, 93)	110	88% (77, 94)
Attending <i>esoto</i> is essential to being Maasai	199	89% (82, 93)	87	87% (77, 93)	112	90% (80, 95)
Semen provided at <i>esoto</i> is necessary for female breast development	185	85% (78, 90)	76	77% (67, 85)	109	90% (81, 95)
Fear social stigma if not attending <i>esoto</i>	178	82% (74, 88)	75	79% (69, 86)	103	84% (74, 90)
Ever beaten for not attending <i>esoto</i>	95	75% (61, 86)	na ^c	na ^c	95	75% (61, 86)
Would attend <i>esoto</i> less if there was no punishment for non-attendance	99	80% (64, 90)	na ^c	na ^c	99	80% (64, 90)

Note: CI=Confidence interval

^aSignificant difference between males and females at the p=.05 level^b*Esoto* frequencies are for times of the year when the dance is held, during the rainy seasons lasting 4-6 months^cMale warriors may beat girls for not attending *esoto*, but are not themselves subject to such punishment.

Table 4

Logistic regressions predicting attendance of esoto dance with Maasai socio-demographic and esoto factors

	Unadjusted Odds Ratios (95% CI)	Adjusted Odds Ratios (95% CI)
<i>Esoto</i> Positive Beliefs Scale	2.73 (1.9, 4.0)	2.84 (1.9, 4.2)
Female gender	2.92 (1.1, 8.0)	4.67 (1.6, 13.2)
Has not received adult genital cutting ritual	0.07 (0.01, 0.32)	0.06 (0.01, 0.47)
Any education	0.25 (0.11, 0.56)	na ^a

Note: CI=Confidence interval.

^aEducation is fully mediated by the *Esoto* Positive Beliefs Scale

Table 5

Dynamic Social Systems Model of the Esoto Dance

	Macro	Meso	Micro
Informal social influences	<i>Esoto</i> is normative location of first coitus (92% females, 66% males), normative source of multiple sexual partners (mean=10.5, median=4). Customary social stigma for non-attendance (82% fear stigma) and nearly universal sex without condoms (3% ever condom use)	Population is aware of HIV (99%), yet only 1/4 believe they have met someone with HIV. HIV knowledge is low: over 40% believe mosquitos and kissing transmit HIV. Stigma towards people living with HIV is high (mean=5.2 on a 7-point scale).	Those with higher scores on the positive <i>esoto</i> beliefs scale are more likely to participate (AOR=2.84). (ie. believing <i>esoto</i> is essential to being Maasai, being enthusiastic to attend or believing girls need sperm to develop)
Maasai formal social control mechanisms	Normative beatings for non-attendance (75% women beaten). The Ilarussa section does not practice <i>esoto</i> . Influential cultural leaders include age-group heads (Warrior, Jr. Elder, Elder), traditional healers and circumcisers, and the Maasai Council.	Frequent <i>esoto</i> dance availability (mean=6 days per week). Customs of hosting household, local leaders and parents influence participants. Implicit local sanctioning of beatings allows practice to continue.	Females are more likely to participate than males (AOR=4.67). Individuals enact norms: <i>esoto</i> "heroes" have many sexual partners. Visiting warriors access non-local <i>esoto</i> .
Governmental formal social control mechanisms	Low reach of education programs (61% no education, 97% less than 8th grade education), government leaders and medical officers influence local life at District, Village and Sub-Village levels. Low reach of national prevention programs (i.e. condom social marketing and VCT).	Tanzanian legal framework establishes sex with minors as illegal (female <i>esoto</i> participants are all pre-pubescent). Moreover, all physical coercion is illegal under Tanzanian statutes.	Those with any education are less likely to participate (OR=.25); education is mediated by positive <i>esoto</i> beliefs scale in multivariate model. Local formal mechanisms, and political will, for law enforcement are limited.
Settings	Nearly half the population is very poor (51% own less than 20 cattle). Seminomadic population is influenced by droughts, seasonality and political allocations for cattle herding.	Availability of <i>esoto</i> sites in walking distance influences attendance, seasonality (dry versus rainy) influences migration of cattle, and thus the presence of men who herd.	Those who have not undergone adult rituals (female excision or male circumcision) are less likely (AOR=0.06) to have participated in <i>esoto</i> .

Sources: All quantitative findings are from survey data detailed in the present study. Sources on the Tanzanian governmental system (United Republic of Tanzania President's Office, 2003) and traditional Maasai leadership structure (Spencer, 1993) informed the model. Description of customs surrounding *esoto* practice are based on field observations by the Principle Investigator, which were subsequently verified through correspondence with Maasai leadership (Kin'gori, 2009).