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SAN DIEGO STATE UNIVERSITY

Engagement in HIV Care among Male Fisherfolk in Uganda

A dissertation submitted in partial satisfaction of the requirements for the degree Doctor
of Philosophy

in

Public Health (Global Health)

by

Katelyn M. Sileo

Committee in charge:

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2017

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The Dissertation of Katelyn M. Sileo is approved, and it is acceptable in quality and form
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Chair

University of California, San Diego

San Diego State University

2017

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Chapter 2, in full, is currently being prepared for submission for publication of the material. Sileo KM; Wanyenze RK; Kizito W; Reed E; Stockman JK; Musoke W; Mukasa B; Kiene SM. The dissertation author was the primary investigator and author of this material.

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1. Sileo, K. M., Kintu, M., Kiene, S. M. (In press). The intersection of intimate partner violence and HIV risk among women engaging in transactional sex in Ugandan fishing villages. *AIDS Care*.
2. Kiene, S. M., Kalichman, S. C., Sileo, K. M., Menzies, N. A., Naigino, R., Lin, C. D., Bateganya, M. H., Lule, H., & Wanyenze, R. K. (2017). Efficacy of an enhanced linkage to HIV care intervention versus standard-of-care at improving HIV viral suppression and linkage to HIV care following home-based HIV testing in rural Uganda: Study protocol for the Ekkubo/PATH cluster randomized controlled trial. *BMC Infectious Disease*, 17(1), 460. doi: 10.1186/s12879-017-2537-z.
3. Kiene, S. M., Gbenro, O., Sileo, K. M., Lule, H., & Wanyenze, R. K. (2017). How do we get partners to test for HIV?: Predictors of uptake of partner HIV testing following individual outpatient provider initiated HIV testing in rural Uganda. *AIDS and Behavior*, 21(8), 2497-2508. doi: 10.1007/s10461-017-1817-3.
4. Kiene, S. M., Lule, H., Sileo, K. M., Silmi, P., & Wanyenze, R. K. (2017). Depression, alcohol use, and intimate partner violence among outpatients in rural Uganda: Vulnerabilities for HIV, STIs and high risk sexual behavior. *BMC Public Health*, 17(1), 88. doi: 10.1186/s12879-016-2162-2.
5. Sileo, K. M., Simbayi, L. C., Abrams, A., Cloete, A., & Kiene, S. M. (2016). The role of alcohol use in antiretroviral adherence among HIV positive men and women in South Africa: Event-level findings from a daily diary study. *Drug and Alcohol Dependence*, 167, 103-111. doi: 10.1016/j.drugalcdep.2016.07.028.
6. Sileo, K. M., Kiene, S. M., & Lule, H. (2016). "That would be good but most men are afraid of coming to the clinic": Men and women's perspectives on strategies to increase male involvement in women's reproductive health services in rural Uganda." *Journal of Health Psychology*. pii: 1359105316630297. [Epub ahead of print]. doi: 10.1177/1359105316630297.
7. Kiene, S. M., Bateganya, M. H., Sileo, K. M., & Wanyenze, R. K. (2016). Recommendations for feedback of HIV test results in population based HIV seroprevalence surveys. *Public Health*, 135, 3-13. doi: 10.1016/j.puhe.2016.01.011.

8. Sileo, K. M., Kintu, M., Chanes-Mora, P., & Kiene, S. M. (2016). "Such behaviors are not in my home village, I got them here": A qualitative study of the influence of contextual factors on alcohol and HIV risk behaviors among fishing communities along Lake Victoria, Uganda. *AIDS and Behavior*, 20(3), 537-47. doi: 10.1007/s10461-015-1077-z.
9. Sileo, K. M., Kiene, S. M., & Lule, H. (2015). Determinants of family planning service uptake and contraceptive use among postpartum women in rural Uganda. *International Journal of Public Health*, 60(8), 987-97. doi:10.1007/s00038-015-0683-x
10. Kiene, S. M., Sileo, K., Wanyenze, R. K., Lule, H., Bateganya, M. H., Jasperse, J., Nantaba H, Jayaratne, K. (2015). Barriers to and acceptability of provider-initiated HIV testing and counseling and adopting HIV prevention behaviors in rural Uganda: A qualitative study. *Journal of Health Psychology*, 20(2), 173-87. doi: 10.1177/1359105313500685.

Publications Under Review

1. Kiene, S. M., Sileo, K. M., Dove, M., Kintu, M. Hazardous and harmful alcohol use, alcohol dependence, and related risk factors associated with HIV infection and unknown HIV status in fishing communities in Uganda.
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2. Sileo, K. M., Wanyenze, R. W., Kizito, W., Reed, E., Stockman, J. K., Musoke, W., Mukasa, B., & Kiene, S. M. A mixed methods study to assess substance use and its effects on HIV treatment adherence among male fisherfolk living with HIV/AIDS in Uganda.
3. Sileo, K. S., Reed, E; Kizito, W., Wagman, J. A., Stockman, J. K., Wanyenze, R. W., Musoke, W., Mukasa, B., Kiene, S. M. "I take my medication well, so I don't even have a single doubt of fulfilling that role": A qualitative study on masculine roles and engagement in HIV care among male fisherfolk in Uganda.
4. Sileo, K. M., Fielding-Miller, R., Dworkin, S. L., & Fleming, P. J. The role of gender norms and masculinity on engagement in the HIV care continuum among men living with HIV/AIDS in sub-Saharan Africa: A systematic review.

5. Sileo, K. M., Fielding-Miller, R., Dworkin, S. L., & Fleming, P. J. The role of gender norms and masculinity on men's HIV testing uptake in sub-Saharan Africa: A systematic review.

Presentations

1. Dworkin, S., Sileo, K. M., Fielding-Miller, R., & Fleming, P. (2017, November). *A Systematic Review Examining the Relationship Between Norms of Masculinity and HIV Testing among Men Living with HIV in sub-Saharan Africa*. Poster presented at the AIDS Impact Conference, Cape Town, South Africa.
2. Sileo, K. M., Fielding-Miller, R., Dworkin, S. L., & Fleming, P. J. (2017, July). *The Role of Gender Norms and Masculinity on Men's Engagement in the HIV Care Continuum in sub-Saharan Africa: A Systematic Review*. Poster presented at the 9th IAS Conference on HIV Science, Paris, France.
3. Kiene, S. M., Kalichman, S. C., Sileo, K. M., Menzies, N. A., Naigino, R., Lin, C. D., Bateganya, M. H., Lule, H., & Wanyenze, R. K. (2017, July). *Only 36% of adults living with HIV aware of their HIV+ status but progress in ART coverage and viral suppression in a subnational survey in Uganda: Progress towards UNAIDS 90-90-90*. Poster presented at the 9th IAS Conference on HIV Science, Paris, France.
4. Sileo, K. M., Kintu, M., & Kiene, S. M. (2016, November). *The role of economic instability and empowerment in HIV prevention behaviors among women in a Ugandan fishing village: A qualitative comparison of females in high-risk occupations*. Poster presented at the Society for Scientific Study of Sexuality 2016 Annual Meeting, Phoenix, AZ.
5. Sileo, K. M., Bogart L. M., Wagner G. J., Musoke W., Naigino R., Maistrellis E., Mukasa B., & Wanyenze R. K. (2016, November). *HIV fatalism and engagement in transactional sex among Ugandan fisherfolk living with HIV*. Poster presented at the American Public Health Association Annual Meeting, Denver, CO.
6. Sileo, K. M., Kintu, M., & Kiene, S. M. (2015, November). *Motivation for Alcohol Use in the Context of Female Commercial Sex Work and its Influence on Sexual Risk: A Qualitative Study in Ugandan Fishing Communities*. Poster presentation at the APHA 2015 Annual Meeting, Chicago, IL.
7. Elsevier, H., Sileo, K. M., Dieckhaus, K., Nurnberger, B., & L'Italien, G. (2015, August). *Impact of Public Health Intervention on Rate of Soil-Transmitted Helminthis (STH) among Indigenous Village Children in Santa Maria Tepexipana Region of the State of Oaxaca, Mexico*. Poster presented at the International Conference on Parasitology, Philadelphia, PA.
8. Salazar, M., Dasgupta, A., & Sileo, K. M. (2015, April). *A Cross-Cultural Examination of Intimate Partner Violence: An Interactive Panel Discussion on Counter-Intuitive Findings from Uganda, Mexico, and India*. Panelist at the UC Global Health Day, Los Angeles, CA.

9. Sileo, K. M., Kintu, M., Kiene, S. M. (2015, March). *History of Sexual Abuse, Depression, and Alcohol Use as Risk Factors for HIV Infection in High HIV Prevalence Fishing Communities in Rural Uganda*. Poster presented at the 2015 CUGH Global Health Conference, Boston, MA.
10. Sileo, K., L'Italien, G., Schensul, & S. L., Dieckhaus, K. (2014, April). *Prevalence, distribution, and correlates of soil-transmitted helminthes (STH) among Zapotec children in the State of Oaxaca, Mexico*. Student Leader in Global Health oral presentation at Unite for Sight's 11th Annual Global Health & Innovation Conference, New Haven, CT.
11. Sileo, K., Kiene, S. M., & Lule, H. (2013, November). *Determinants of contraceptive use and related behaviors among postpartum women in rural Uganda*. Poster presented at 141st APHA Annual Meeting, Boston, MA.
12. Kiene, S. M., Sileo, K., & Kintu, M. (2013, June). *Hazardous alcohol use, alcohol dependence, and related risk factors associated with HIV infection in fishing communities in Uganda*. Plenary session presented at the 39th Annual Meeting of the Kettil Bruun Society, Kampala, Uganda.
13. Sileo, K., Cornman, D. H., & Redding, C. R. (2011, March). *Barriers to Safer Sex and ART Adherence Among HIV-Positive Soldiers and Civilians in Clinical Care in Ethiopia*. Poster presented at Yale University's Center for Interdisciplinary Research on AIDS (CIRA) AIDS Science Day 2011, New Haven, CT.
14. Cornman, D. H., Redding, C. R., Sileo, K., Dada, Z. (2010, July). *Opções Para a Saúde: The Development of a Peer-Delivered Risk Reduction Counseling Program for PLWH in the Mozambican Armed Defense Forces (FADM)*. Poster presented at the International AIDS Conference, Vienna, Austria.
15. Cornman, D. H., Redding, C. R., Sileo, K. (2010, April). *UPDF ART Adherence Support Program*. Presented at the International Military HIV/AIDS Conference, Arusha, Tanzania.
16. Sileo, K. & Magley, V. (2009, May). *The effects of coping with job stress on perpetrated workplace aggression*. Poster presented at the University of Connecticut's Frontiers in Undergraduate Research Convention, Storrs, CT.
17. Carpino, M., Johnson, A., Parent, S., & Sileo, K. (2007, May). *The relationship between monitoring and worker performance in college students: An experimental study*. Poster presented at the University of Connecticut Undergraduate Psychology Research Symposia, Storrs, CT.
18. Mills, M. A., Sileo, K., Cruce, K., Luba, D., & Goldman, E. (2008, August). *Trauma centrality and adjustment in trauma-exposed college women*. Poster presented at the American Psychological Association Annual Convention, Boston, MA.

ABSTRACT OF THE DISSERTATION

Engagement in HIV Care among Male Fisherfolk in Uganda

by

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Doctor of Philosophy in Public Health (Global Health)

University of California, San Diego, 2017

San Diego State University, 2017

Professor Susan M. Kiene, Chair

Background: Ugandan fisherfolk are a priority population for the scale up of antiretroviral treatment (ART). However, a number of multi-level factors may pose a challenge to engaging this population in HIV care.

Objectives: Our specific aims include: 1) examining the prevalence of substance use, and its effect on ART adherence; 2) exploring the role of norms of masculinity on men's engagement in HIV care; and 3) identifying individual, interpersonal, normative environment, and physical/built environment-level determinants of HIV clinic attendance and ART adherence.

Methods: A cross-sectional, mixed methods study design was employed with male fisherfolk on ART in Waksio District, Uganda. This study included a quantitative

structured questionnaire (N=300), and qualitative in-depth interviews (n=30). Aim 1 uses both the quantitative and qualitative data. Aim 2 uses only qualitative data. Aim 2 uses only quantitative data.

Results: We identified sub-optimal engagement in HIV care among men overall. Aim 1 demonstrated alcohol's negative effect on ART adherence, and alcohol's greater effect on non-adherence among men taking twice daily regimens compared to once daily. Aim 2 demonstrated HIV as a threat to men's masculinity. However, ART's positive effects on health restored men's ability to fulfill their masculine roles, which motivated men for continued engagement in HIV care. Aim 3 identified multi-level factors associated with missed HIV clinic visits, including those at the individual (age), interpersonal (marital status), normative (anticipated HIV stigma), and physical/built environment-levels (travel time to the clinic, structural-barriers to adherence, accessing care on a landing site). Factors associated with ART non-adherence included those at the individual (age, income) and normative levels (anticipated and enacted HIV stigma).

Conclusions: These findings highlight an urgent need for strategies to improve clinic attendance and ART adherence among male fisherfolk on ART, and add to our understanding of the multi-level determinants affecting HIV care engagement among male fisherfolk. We discuss public health implications, and suggest a package of interventions that may be integrated into differentiated service delivery specific to this most-at-risk population, including brief screening and intervention for alcohol reduction, gender transformative programming, and the integration of peer support and stigma reduction into community-based platforms for ART delivery.

CHAPTER 1: INTRODUCTION

HIV/AIDS in sub-Saharan Africa

Significant progress has been made in slowing the HIV/AIDS epidemic globally. AIDS related deaths have dropped 48% since they peaked in 2005, and more people are accessing life saving antiretrovirals (ARVs) (19.5 million in 2016) than ever before (1). Sub-Saharan Africa (SSA), the region in the world most affected by the HIV/AIDS epidemic, has also made great strides in the fight against HIV/AIDS. Between 2010 and 2016, the number of new HIV infections declined by 29% and the number of AIDS related deaths dropped by 42% (1). However, the region still has an unacceptably high burden of HIV/AIDS. In 2016, approximately 19.4 million people were living with HIV/AIDS in eastern and southern Africa, and an estimated 790,000 new HIV infections and 420,000 AIDS-related deaths occurred (1). Further, of the total new HIV infections globally, 43% occurred in this region (1). The primary mode of transmission in SSA is heterosexual sex, with girls and women accounting for more than half (59%) of the total number of PLHIV in the region (1). Gender inequitable norms are thought to account for women's increased vulnerability for HIV/AIDS, with women less able to control their timing and circumstances of sex, negotiate safe sex, and access HIV prevention services (2-4). Thus, engaging men in HIV risk reduction and programs to increase gender equity in relationships is an important aspect of HIV/AIDS control (5). Though the epidemic is generalized throughout the region, HIV prevalence is significantly greater in several most-at-risk populations (MARPs), such as female sex workers, people who inject drugs, men who have sex with men, and the sexual partners of MARPs (6). In 2014, more than 20% of new infections in the region were among MARPs and their sexual partners (6).

Since the introduction of ARVs in 1996, antiretroviral treatment (ART) has become increasingly available in SSA and worldwide. It is estimated that 60% of PLHIV in southern and eastern Africa, or 11.7 million people, were accessing ART in 2016 (1). This represents a 36% increase in ART coverage since 2010, when only 24% of PLHIV were accessing ART in the region (7). ART's primary goal is to reduce mortality and morbidity among PLHIV (8). Moreover, evidence that correct adherence to ART reduces the chance that PLHIV will transmit the virus by 96% (9, 10) has resulted in efforts to use "treatment as prevention" as a secondary goal of ART (8). To this end, global guidelines and initiatives have been put forth with the aim of increasing the number of PLHIV accessing HIV testing and treatment, which could reduce HIV incidence through population-level viral load suppression. For example, the United Nations Joint Programme on HIV/AIDS (UNAIDS) released ambitious goals in 2014 to garner global action towards universal access to ART, known as the "90-90-90" targets (11). These goals aim to get 90% of PLHIV aware of their status, 90% of those diagnosed linked to care and receiving HIV treatment, and 90% of those receiving treatment virally suppressed by 2020 (11). In line with these goals, the World Health Organization (WHO) released its 2016 consolidated guidelines, which recommend all PLHIV be started on ART immediately upon diagnosis, regardless of CD4 cell count or disease stage (12). To meet these targets, national government policies are adopting the WHO guidelines to expand HIV treatment to all in national HIV programming and policy, while scaling up test-and-treat initiatives that provide immediate treatment initiation upon HIV diagnosis (6).

The HIV care continuum

Achieving optimal health outcomes on ART and the success of treatment-as-prevention efforts is dependent on optimal engagement in the HIV care continuum, which remains a significant public health challenge. The HIV care continuum is a framework that models the stages of HIV care, consisting of five main stages: HIV testing and diagnosis, linkage to care, engagement/retention in care, ART initiation and adherence, and viral suppression (13-15). Though typically depicted as linear and unidirectional (see Figure 1.1), progression through each stage is often nonlinear in reality, as PLHIV may iteratively fall in and out of care over time (15). Engagement in all stages of HIV care is vital to the health of PLHIV; research from the United States and Africa demonstrate delayed HIV testing and linkage to care (16, 17), delayed ART initiation and sub-optimal adherence (8, 18-21), and poor retention in care (22-25) are associated with reduced CD4 cell count, suboptimal viral suppression, disease progression, viral resistance, and mortality. Thus, the significant gaps apparent in each stage of the care continuum in SSA are alarming. UNAIDS estimated that only 62% of people were aware of their status, only 54% of PLHIV were receiving ART, and only 45% of PLHIV were virally suppressed in eastern and southern Africa as of 2015 (6). See Figure 1.2 for a graphic representation of the number of PLHIV engaged in HIV care in SSA in 2015 against the 90-90-90 targets for 2020.

Gender disparities in the HIV care continuum

In the context of SSA, the engagement of men in the HIV care continuum is especially important; the primary mode of transmission is heterosexual vaginal sex (6) and engaging men in HIV care may increase women's engagement, as men often hold decision-making power over women's access to HIV services (26, 27). However,

referred to as “the HIV blind spot,” evidence has emerged to suggest significant disparities in men’s engagement in HIV prevention, testing, and treatment (28, 29). In general, men have been shown to be less likely to utilize health care than women across settings (30). Specific to HIV/AIDS, men are less likely to know their status than women (31, 32). The literature similarly demonstrates men living with HIV are less likely to utilize ART than women (1, 33, 34). UNAIDS estimates in 2016 only 51% of adult men infected with HIV were accessing ART in eastern and southern Africa, compared to 67% of adult women (1). Men who do access ART are more likely to delay in linking to HIV care (35, 36), are more likely to drop out of care (37), and have poorer ART adherence (38) compared to women on ART. The consequences of men’s poor engagement in the HIV care continuum are apparent in health outcomes for men living with HIV. Men present to care with more advanced disease progression and more complications (35, 36), and ultimately men on ART are more likely to die compared women on ART (29, 39-42). A recent meta-analysis reported a 41% increased risk of death among men on ART compared to women on ART in SSA (39).

HIV/AIDS in Uganda

Uganda is one of the countries in SSA most affected by the HIV/AIDS epidemic and is still considered a high burden country. The country is well known for its early interventions and success in reducing the HIV prevalence and incidence early in the epidemic; at the epidemic’s peak in the 1990s, approximately 19% of the adult population was HIV infected in Uganda, dropping to 6.4% in 2005 (43). More recently, AIDS Indicator Survey data demonstrated an increase in adult HIV prevalence between 2004/5 and 2011, rising from 6.4% to 7.3% (44), with prevalence stabilizing at 7.4% in 2012/13 according to Ministry of Health (MOH) estimates (45). The most recent estimate

from 2015 was 7.1% (confidence interval: 6.6%-7.7%) according to UNAIDS (46).

Improvements have been witnessed in the reduction of new infections between 2010 and 2015, dropping from 160,000 to 83,500, respectively (47). In addition, the annual number of AIDS-related deaths has dropped by nearly half from 67,000 in 2010 to 28,163 in 2015 (47).

Uganda is also making great efforts to expand the number of PLHIV aware of their HIV status and receiving ART; the number of PLHIV enrolled in treatment nearly tripled between 2011 and 2016 (47). However, much work needs to be done to reach the UNAIDS “90-90-90” targets; it is estimated that 69% of the 1.5 million PLHIV in Uganda were aware of their status in 2016, of which only 60% were receiving ART (47). In 2016, the Ugandan MOH national treatment guidelines were revised to promote the expansion of ART to all PLHIV (48), in accordance with WHO’s 2016 consolidated guidelines (12). Prior to this policy change, since 2014, the general population was eligible for ART initiation at the threshold of CD4<500, and lifelong ART was offered to all children, pregnant and breastfeeding women, PLHIV with both TB or Hepatitis B coinfection and the PLHIV in serodiscordant relationships, and several key populations (48). The roll out of this treatment-for-all policy into clinical practice began in 2017, which will result in an increased number of people eligible for ART in Uganda.

Fisherfolk: A most-at-risk population for HIV/AIDS

While the epidemic has stabilized in much of the country, elevated HIV incidence and prevalence is evident among Uganda’s most-at-risk populations (MARPs). MARPs in Uganda, as defined by Uganda’s National Strategic Plan for HIV/AIDS, 2015/2016 – 2019/2020, include: sex workers, fisherfolk, truckers, uniformed forces, prisoners, men who have sex with men, and injection drug users (43). Based on their elevated risk,

these groups are prioritized for HIV testing, treatment, and prevention efforts by the Ugandan MOH. Fisherfolk is a term used to describe individuals working to support the fishing industry in the communities surrounding Lake Victoria, including fishermen, fish traders and sellers, and boat operators. HIV prevalence is estimated to be between 22-40% in fishing communities (49-52). Since 2014, fisherfolk have been eligible for lifelong ART immediately upon diagnosis, and are named in the 2016 MOH guidelines as a priority population for the scale up of test-and-treat initiatives (48, 53).

Engagement in the care continuum among fisherfolk

As the number of fisherfolk aware of their HIV status and linked to care increases in Uganda, there is a need for more research to understand the level of engagement fisherfolk are able to maintain after linking to care, and factors impeding and bolstering care engagement; this data would allow for the adaption of HIV/AIDS service delivery to meet the specific needs of this population. Research with fisherfolk to-date has mainly examined uptake of prevention services and HIV testing (49-51). Only one study to our knowledge has examined initial linkage to care among Ugandan fisherfolk after testing positive (54). This study reported only half of those screened HIV positive linked to care, and identified significant barriers to accessing HIV care in qualitative interviews, including distance and structural barriers to accessing care, HIV stigma, and substance use (54). Once linked to care, little is known about the level of engagement fisherfolk are able to maintain; no studies to our knowledge have examined continued HIV clinic attendance or ART adherence in HIV-infected fisherfolk.

Based on what is known about fishing populations, fisherfolk living with HIV may be at an increased risk for missed clinic visits and poor ART adherence. This may be especially true for men in these communities. As previously discussed, men in general in

Uganda and SSA are already disadvantaged in accessing ART (28, 29), and for men in fishing villages, clinic appointment and treatment adherence may be complicated by the frequent mobility inherent in fishing occupations. Fishermen typically move to different landing sites along Lake Victoria based on fish yield and season (55). Other fisherfolk, such as fish traders and sellers, similarly migrate across fishing communities for work, making them at similarly high risk for non-engagement. Moreover, mobile fisherfolk may be at risk for a number of other risk factors for non-engagement; high rates of substance use, poor social support, and structural barriers to care are documented in Ugandan fishing villages (56-58), though they have not been studied as they relate to HIV clinic attendance or ART adherence with this population. *Thus, the overarching goal of this dissertation is to examine determinants of HIV clinic attendance and ART adherence among men on ART in Ugandan fishing communities.*

Theoretical framework: A social ecological approach

We frame the overarching aims of the three chapters of this dissertation within a social ecological perspective (59-61). The social ecological model (SEM) is a framework that is commonly used to understand the complex interactions between an individual and factors in the broader environment on health behavior and health outcomes. It recognizes the interplay of factors external to the individual and outside of his/her control on health behavior and outcomes (59-61). This model has been used to understand HIV behaviors generally (62), including HIV medication adherence and retention in HIV care in various settings (62-65). Within this framework, the individual is conceptualized as embedded within and influenced by their intrapersonal, interpersonal, community, health system/institutional, and structural-level environments. Figure 1.3 includes a depiction of factors influencing HIV health behaviors and behavior change at each level of the SEM,

developed by Kauffman and colleagues (62) and adapted to include factors most relevant to HIV treatment engagement outcomes.

The use of a social ecological perspective can help paint a picture of multi-level factors that may contribute to HIV outcomes. In the context of Ugandan fishing villages, the application of this framework to understand HIV care engagement is justified by prior research demonstrating multi-level influences on sexual risk behavior and elevated HIV prevalence among fisherfolk (57). Based on support from the literature for the potential occurrence of substance use (49, 50, 58, 66, 67), norms of masculinity that may deter HIV care engagement (67, 68), HIV stigma (54, 69), and structural barriers to care (e.g., mobility, distance from clinic, lack of transportation) (54, 57, 67, 69) in this setting, the chapters of this dissertation separately examine these different factors as they relate to HIV care engagement. The first two aims of this dissertation provided a more in-depth look at factors hypothesized to influence engagement in HIV care at specific levels of the SEM. Chapter 2 focuses on the individual-level, specifically assessing the influence of substance use on ART adherence. Chapter 3 explores the effect of normative-level norms of masculinity on individual HIV care engagement behavior. Finally, chapter 4 compares the effects of factors at the individual, interpersonal, normative, and physical/built environment-levels on clinic attendance and ART adherence, with the aim of identifying which levels of the SEM have the greatest potential for intervention. Taken together, this dissertation aims to provide insight into the influence of SEM factors that impede and bolster HIV care engagement for male fisherfolk on ART.

Prevalence and determinants of substance use and its influence on ART adherence (Aim 1)

In the fishing communities surrounding Lake Victoria, Uganda, hazardous levels

of alcohol consumption have been documented among fisherfolk and drug use is also reported (49, 50, 58, 66, 67). However, less research has examined the level and patterns of alcohol and other substance use among fisherfolk living with HIV. Alcohol and drug use among PLHIV is a major public health concern, as it can advance HIV/AIDS disease progression (70, 71) and interfere with condom use (72-74). Moreover, substance use among PLHIV has been associated with poor HIV treatment adherence (75-78). A meta-analysis of 40 studies reported alcohol drinkers were approximately 50-60% less likely to be classified as adherent, compared to those who abstained or drank at lower risk levels (not meeting criterion for high risk drinking) (78). Studies with fishermen identify substance use as a risk factor for HIV acquisition (49, 50, 79) and major barrier to prevention services and linkage to HIV care (56, 80). However, little is known about the prevalence or determinants of substance use among male fisherfolk in Uganda, or about the effects of substance use on ART adherence.

Aim 1 is to determine the prevalence of alcohol and drug use among male fisherfolk on ART, and its effect on ART adherence. We also qualitatively explore men's motivation for substance use, the contexts in which substance use occurs, changes in substance use since HIV diagnosis, and the mechanisms by which substance use may lead to missed ARVs (Paper 1).

We hypothesize that those who drink and/or use drugs will have worse ART adherence compared to those who do not drink and/or use drugs, or use them at a lesser rate. In our qualitative exploration, we hypothesize that substance use is used as a coping mechanism to deal with the stressors of the fishing occupation, poverty, and to cope with their HIV diagnosis. We used quantitative data collected from structured interviews with 300 male fisherfolk on ART and qualitative data from in-depth interviews with a sub-sample of 30 men to achieve aim 1.

The role of norms of masculinity and gender roles on HIV care engagement (Aim 2)

In SSA, disproportionate HIV infection among women has called global attention to the role of gender inequity in perpetuating the HIV epidemic (81). While gender inequitable norms have been shown to increase women's vulnerability to HIV, once infected, women have better outcomes than men across the HIV care continuum (28, 29, 33). Despite men's higher status and subsequent greater access to resources in eastern and southern African countries, men are less likely to know their status, are more likely to access care at a more advanced disease stage, and have worse treatment outcomes among those in care, including higher mortality compared to women (28, 29, 33). Norms of masculinity that reduce men's care seeking and increase risky behaviors have been identified in qualitative studies in Uganda and similar settings as a major driver of men's poor engagement in the HIV care continuum (82-84).

Though gender norms and masculinity have not been explored as they relate to engagement in HIV care in this population, fishing villages have been characterized as "hyper-masculine" environments, and norms related to masculinity have been named a driver of sexual risk taking and risky alcohol consumption among fisherfolk (67, 68). Qualitative studies in Uganda and throughout SSA with non-fishing populations suggest norms of masculinity can dually serve as both barriers and facilitators to men's engagement in HIV care. For example, the masculine notion that men should be strong and self-reliant may make men less likely to seek help from others, including medical treatment (84-86). In contrast, the role of caretaker and provider has emerged as a facilitator to engagement in HIV care, with men motivated to seek and remain on treatment in order to continue to fulfill their family roles as husband, father, and provider (84-87).

Aim 2 is to explore the role of norms of masculinity and gender roles on men's engagement in HIV care for male fisherfolk on ART in Uganda. We qualitatively explore the construction of masculinity among men, how HIV and ART affect men's roles, and how notions of masculinity influence men's engagement in HIV care (Paper 2).

We hypothesized that men who view HIV and ART as a threat to their masculine identities and ability to fulfill their masculine roles would have poorer engagement in HIV care. However, we anticipated these roles would also serve as facilitators to care for men aware of the benefits of ART on their ability to fulfill their masculine roles. We used qualitative in-depth interviews with 30 fishermen and other fisherfolk on ART to achieve aim 2.

Multi-level determinants of clinic attendance and antiretroviral treatment adherence (Aim 3)

Ugandan fishing villages are considered a hot spot for HIV/AIDS, with HIV prevalence estimated to be as high as 40% in some communities (1-4). Thus, fisherfolk are being prioritized for the scale up of HIV prevention, testing, and treatment efforts. While a large body of literature has focused on HIV risk behaviors and HIV transmission in this population (54, 55, 57, 67-69, 88, 89), once infected and linked to care, less is known about fisherfolk's engagement in HIV care. The ability to engage and retain this population in HIV care has important public health implications, both for the health of individuals, and as a strategy to reduce the spread of HIV on a population-level by using HIV treatment as prevention (9, 90). Thus, there is a need for research that identifies determinants of engagement in HIV care for men on ART in order to develop effective and targeted programs to help fisherfolk maintain optimal care engagement and sustained viral suppression.

An array of multi-level factors have been identified in research with fisherfolk on linkage to HIV care, uptake of HIV testing, and sexual risk behavior (54, 55, 57, 67-69, 88, 89) that may also affect adherence to clinic appointments and ART, but have not been previously studied as they relate to HIV care engagement. For example, individual-level alcohol use (57, 91) and a lack of social support at the interpersonal-level (67, 68, 92) have been documented among fishermen, which may negatively impact adherence to ART and clinic appointments. At the health system-level, long wait times, patient-provider relationships, and low service quality are barriers to HIV care in SSA more broadly (93, 94). In the broader cultural environment, norms promoting risky behaviors and HIV stigma are documented in this setting (54, 57), and the broader contextual influences of poverty, mobility, distance from the clinic, and difficulty accessing transportation (50, 57, 66) may created challenges for fishermen on ART.

Given the unique setting of fishing communities, determinants of HIV care engagement likely occur at multiple levels of the social ecological model (SEM) (59-61). This study assesses multi-level barriers to HIV clinic attendance and ART adherence among male fisherfolk on ART, comparing factors at different levels of the SEM, in order to inform the developed of targeted multi-level interventions to engage fisherfolk in HIV care.

Aim 3 is to examine individual, interpersonal, normative environment, and physical/built environment-level determinants to HIV clinic attendance and ART adherence. We compare select determinants of care in order to determine which levels of the SEM have the greatest potential for intervention.

We hypothesized that individual (younger age, lower education, lower income, less time on ART, alcohol use, internalized HIV stigma, greater individual-level barriers to adherence), interpersonal (being single, lack of social support, non-disclosure of HIV

status), normative (enacted and anticipated HIV stigma), and physical/built environment-level factors (greater distance to the clinic, mobility, accessing care on an island, greater structural barriers to ART adherence) would be associated with worse engagement in HIV care. We used quantitative data collected from structured interviews with 300 male fisherfolk on ART to achieve aim 3.

Rationale and Implications

There is a gap in the literature on the level of HIV care engagement men are able to maintain in Ugandan fishing communities, as well as the primary barriers and facilitators to HIV care engagement. Understanding determinants of HIV care engagement would have important implications for the tailoring of HIV services and development of programs aimed to improve ART adherence and retention with this MARP. Efforts to improve HIV care engagement are essential to reaching the UNAIDS 90-90-90 goals, and to ultimately slowing the HIV/AIDS epidemic in Uganda, which can be optimized by focusing on MARPs. Aim 1 of this dissertation may have implications for the development of substance use interventions aimed to reduce substance use and HIV outcomes. By exploring the role of masculinity on HIV care engagement, aim 2 may have implications for gender-specific HIV programming and service delivery, and may contribute more broadly to our understanding of underlying factors driving the gender gap in HIV/AIDS care. Finally, a comparison of multi-level determinants of care in aim 3 can inform the targeted development of interventions to improve HIV care engagement, specifically identifying which levels of the SEM have the greatest potential for intervention.



Figure 1.1: The HIV/AIDS care continuum

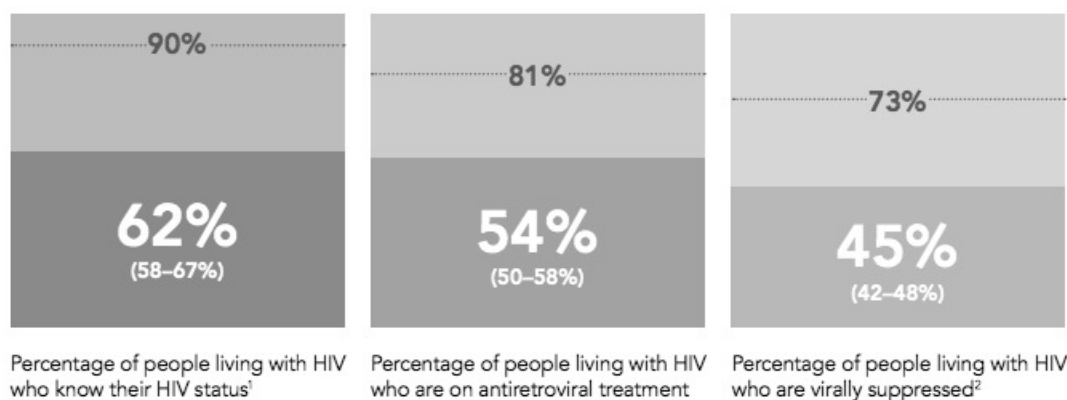


Figure 1.2: Progress towards the 90-90-90 target, eastern and southern Africa, 2015 from UNAIDS, 2016

¹ 2015 measure derived from data reported by 12 countries, which accounted for 77% of people living with HIV in the region.

² 2015 measure derived from data reported by 8 countries. Regionally, 14% of all people on antiretroviral therapy were reported to have received a viral load test during the reporting period.

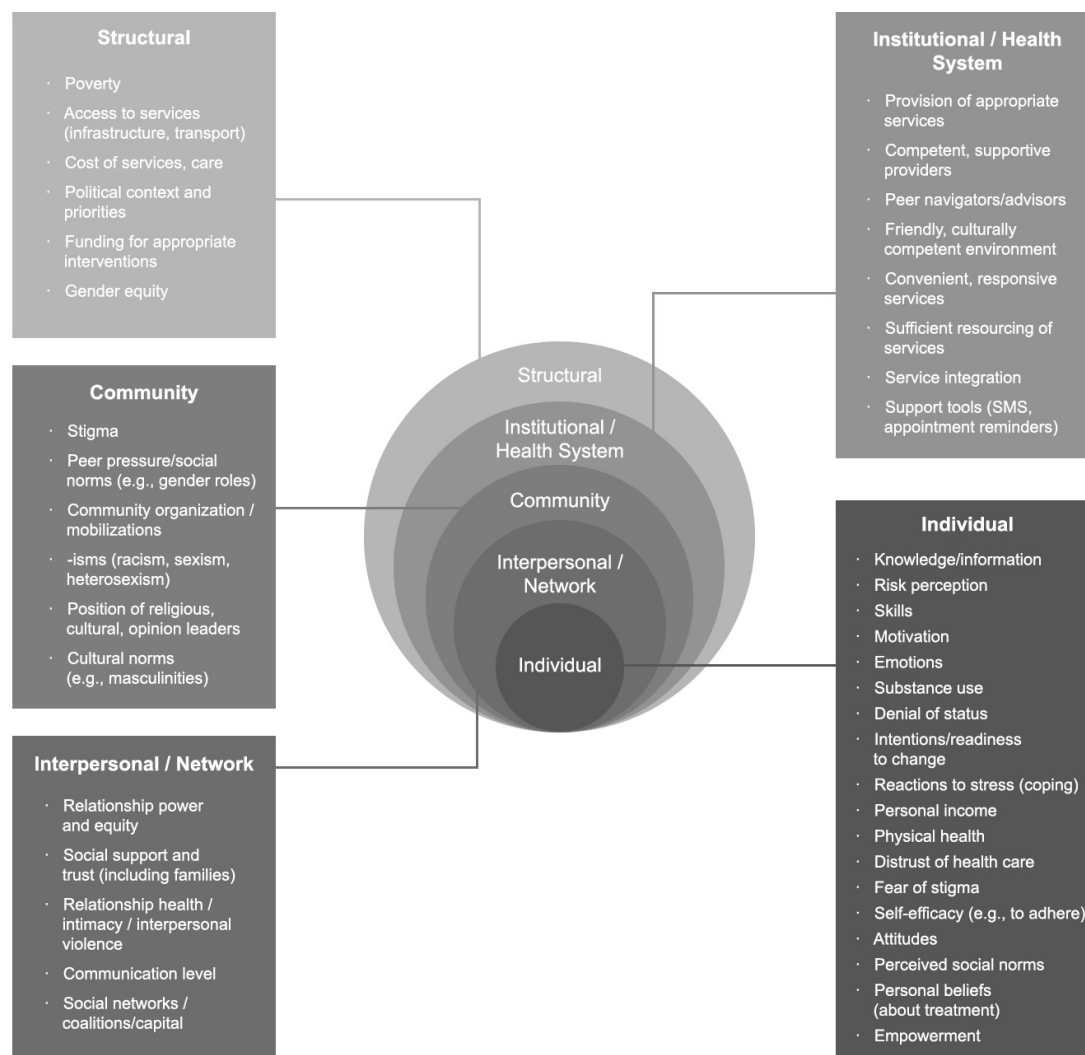


Figure 1.3: Factors influencing HIV-related behavior and/or behavior change at each level of the social ecological model adapted from Kaufman et al., 2014

References

1. UNAIDS. Fact Sheet July 2017 - Latest Statistics on the HIV/AIDS Epidemic. Retrieved from: <http://www.unaids.org/en/resources/fact-sheet>. 2017.
2. Dunkle KL, Decker MR. Gender-based violence and HIV: reviewing the evidence for links and causal pathways in the general population and high-risk groups. *Am J Reprod Immunol*. 2013;69:20-6.
3. Shannon K, Leiter K, Phaladze N, Hlanze Z, Tsai AC, Heisler M, et al. Gender inequity norms are associated with increased male-perpetrated rape and sexual risks for HIV infection in Botswana and Swaziland. *PLoS ONE*. 2012;7(1):e28739.
4. Shattuck D, Burke H, Ramirez C, Succop S, Costenbader B, Attafuah JD, et al. Using the inequitable gender norms scale and associated HIV risk behaviors among men at high risk for HIV in Ghana and Tanzania. *Men Masculinities*. 2013;16(5):540-59.
5. Barker G, Ricardo C, Nascimento M. Engaging Men and Boys in Changing Gender Based Inequity in Health: Evidence from Programme Interventions. Geneva: WHO; 2007.
6. UNAIDS. Prevention Gap Report. Geneva: UNAIDS; 2016.
7. UNAIDS Announces 2 Million More People Living with HIV on Treatment in 2015, Bringing New Total to 17 Million [press release]. Geneva/Nairobi: UNAIDS; 2016.
8. Panel on Antiretroviral Guidelines for Adults and Adolescents. Guidelines for the use of antiretroviral agents in HIV-1-infected adults and adolescents. Department of Health and Human Services. Available at <http://www.aidsinfo.nih.gov/ContentFiles/AdultandAdolescentGL.pdf>. Accessed 1 Sept 2017. 2016.
9. World Health Organization. Consolidated guidelines on the use of antiretroviral drugs for treating and preventing HIV infection. Geneva, Switzerland: WHO; 2013.
10. Cohen MS, Chen YQ, McCauley M, Gamble T, Hosseinipour MC, Kumarasamy N, et al. Prevention of HIV-1 infection with early antiretroviral therapy. *N Engl J Med*. 2011;365(6):493-505.
11. UNAIDS. 90-90-90: An ambitious treatment target to help end the AIDS epidemic. Geneva: UNAIDS; 2014.
12. World Health Organization. Consolidated Guidelines on the Use of Antiretroviral Drugs for Treating and Preventing HIV Infection: Recommendation for a Public Health Approach. Second Edition. Geneva: WHO; 2016.
13. Centers for Disease Control and Prevention. Understanding the HIV care continuum. http://www.cdc.gov/hiv/pdf/dhap_continuum.pdf. Accessed 18 Jul 2017. 2014.

14. Gardner EM, McLees MP, Steiner JF, Del Rio C, Burman WJ. The spectrum of engagement in HIV care and its relevance to test-and-treat strategies for prevention of HIV infection. *Clin Infect Dis*. 2011;52(6):793-800.
15. Mugavero MJ AK, Horn T, Thompson MA,. The state of engagement in HIV care in the United States: from cascade to continuum to control *Clin Infect Dis*. 2013;57(8):1164-71.
16. Samet JH, Freedberg KA, Stein MD, Lewis R, Savetsky J, Sullivan L, et al. Trillion virion delay: time from testing positive for HIV to presentation for primary care. *Archives of Internal Medicine*. 1998;158(7):734-40.
17. Samet JH, Freedberg KA, Savetsky JB, Sullivan LM, Stein MD. Understanding delay to medical care for HIV infection: the long-term non-presenter. *AIDS*. 2001;15:77-85.
18. Seal PS, Jackson DA, Chamot E, Willig JH, Nevin CR, Allison JJ, et al. Temporal trends in presentation for outpatient HIV medical care 2000-2010: implications for short-term mortality. *J Gen Intern Med*. 2011;26(7):745-50.
19. Torian LV, Wiewel EW. Continuity of HIV-related medical care, New York City, 2005-2009: do patients who initiate care stay in care? *AIDS Patient Care STDS*. 2011;25(2):79-88.
20. Hall HI TT, Westfall AO, Mugavero MJ,. HIV care visits and time to viral suppression, 19 US jurisdictions, and implications for treatment, prevention and the national HIV/AIDS strategy. *Plos ONE*. 2013;8(12):e84318.
21. Nachega JB UO, del Rio C, Mugavero MJ, Rees H, Mills EJ. Addressing the Achilles' heel in the HIV care continuum for the success of a test-and-treat strategy to achieve an AIDS-free generation. *Clin Infect Dis*. 2014;59(Suppl 1):S21-S7.
22. Mugavero MJ, Lin HY, Willig JH, Westfall AO, Ulett KB, Routman JS, et al. Missed visits and mortality among patients establishing initial outpatient HIV treatment. *Clin Infect Dis*. 2009;48(2):248-56.
23. Mugavero MJ WA, Cole SR, Geng EH, Crane HM, Kitahata MM, Mathews WC, Napravnik S, Eron JJ, Moore RD, Keruly JC, Mayer KH, Giordano TP, Raper JL, Centers for AIDS Research Network of Integrated Clinical Systems (CNICS). Beyond core indicators of retention in HIV care: missed clinic visits are independently associated with all-cause mortality. *Clin Infect Dis*. 2014;59(10):1471-9.
24. Reveles KR JT, Labreche MJ, Mortensen EM, Koeller JM, Seekins D, Oramasionwu CU, Bollinger M, Copeland LA, Jones X, Frei CR. Comparative value of four measures of retention in expert care in predicting clinical outcomes and health care utilization in HIV patients. *PLOS ONE*. 2015;10(3):e0120953.

25. Mugavero MJ, Amico KR, Westfall AO, Crane HM, Zinski A, Willig JH, et al. Early retention in HIV care and viral load suppression: implications for a test and treat approach to HIV prevention. *J Acquir Immune Defic Syndr*. 2012;59(1):86-93.
26. Kalembo FW, Zgambo M, Mulaga AN, Yukai D, Ahmed NI. Association between male partner involvement and the uptake of prevention of mother-to-child transmission of HIV (PMTCT) interventions in Mwanza District, Malawi: a retrospective cohort study. *PLoS ONE*. 2013;8(6):e66517.
27. Hoffman RM, Phiri K, Parent J, Grotts J, Elashoff D, Kawale P, et al. Factors associated with retention in Option B+ in Malawi: a case control study. *J Int AIDS Soc*. 2017;20(1):21464.
28. Cornell M, McIntyre J, Myer L. Men and antiretroviral therapy in Africa: our blind spot. *Trop Med Int Health*. 2011;16(7):828-9.
29. Shand T, Thomson-de Boor H, van den Berg W, Peacock D, Pascoe L. The HIV blind spot: men and HIV testing, treatment and care in sub-Saharan Africa. *IDS Bulletin*. 2014;45(1):53-60.
30. Baker P, Dworkin SL, Tong S, Banks I, Shand T, Yamey G. The men's health gap: men must be included in the global health equity agenda. *Bull World Health Org*. 2014;92(8):618-20.
31. Camlin CS, Ssemmondo E, Chamie G, El Ayadi AM, Kwarisiima D, Sang N, et al. Men "missing" from population-based HIV testing: insights from qualitative research. *AIDS Care*. 2016;28(sup3):67-73.
32. Kirakoya-Samadoulougou F, Jean K, Maheu-Giroux M. Uptake of HIV testing in Burkina Faso: an assessment of individual and community-level determinants. *BMC Public Health*. 2017;17(1):486.
33. Tromp N, Michels C, Mikkelsen E, Hontelez J, Baltussen R. Equity in utilization of antiretroviral therapy for HIV-infected people in South Africa: a systematic review. *Int J Equity Health*. 2014;13(1):1-17.
34. Muula AS, Ngulube TJ, Siziya S, Makupe CM, Umar E, Prozesky HW, et al. Gender distribution of adult patients on highly active antiretroviral therapy (HAART) in Southern Africa: a systematic review. *BMC Public Health*. 2007;7(63).
35. Stringer JS, Zulu I, Levy J, Stringer EM, Mwango A, Chi BH, et al. Rapid scale-up of antiretroviral therapy at primary care sites in Zambia: feasibility and early outcomes. *JAMA*. 2006;296(7):782-93.
36. Cornell M, Technau K, Fairall L, Wood R, Moultrie H, van Cutsem G, et al. Monitoring the South African national antiretroviral treatment programme, 2003-2007: the IeDEA Southern Africa collaboration. *S Afr Med J*. 2009;99(9):653-60.

37. Ochieng-Ooko V, Ochieng D, Sidle JE, Holdsworth M, Wools-Kaloustian K, Siika AM, et al. Influence of gender on loss to follow-up in a large HIV treatment programme in western Kenya. *Bull World Health Organ.* 2010;88(681–688).
38. Kranzer K, Lewis JJ, Ford N, Zeinecker J, Orrel C, Lawn SD, et al. Treatment interruption in a primary care antiretroviral therapy program in South Africa: Cohort analysis of trends and risk factors. *J Acquir Immune Defic Syndr.* 2010;55(3):e17-23.
39. Beckham SW, Beyrer C, Luckow P, Doherty M, Negussie EK, Baral SD. Marked sex differences in all-cause mortality on antiretroviral therapy in low- and middle-income countries: a systematic review and meta-analysis. *J Int AIDS Soc.* 2016;19(1):21106.
40. Mills E, Bakanda C, Birungi J, Chan K, Ford N, Cooper CL, et al. Life expectancy of persons receiving combination antiretroviral therapy in low-income countries: a cohort analysis from Uganda. *Ann Intern Med.* 2011;155(4):209-19.
41. Taylor-Smith K, Tweya H, Harries AD, Schoutene E, Jahn A. Gender differences in retention and survival on antiretroviral therapy of HIV-infected adults in Malawi. *Malawi Med J.* 2010;22:49-56.
42. Cornell M, Grimsrud A, Fairall L, Fox MP, van Cutsem G, Giddy J, et al. Temporal changes in programme outcomes among adult patients initiating antiretroviral therapy across South Africa, 2002-2007. *AIDS.* 2010;24(14):2263-70.
43. Uganda AIDS Commission (UAC). National HIV and AIDS Strategic Plan 2015/2016- 2019/2020. An AIDS free Uganda, My responsibility. Kampala, Uganda: Uganda AIDS Commission; 2015.
44. Uganda MOH, ICF International. Uganda AIDS Indicator Survey (AIS) 2011. Kampala, Uganda; Calverton, Maryland, USA: MOH and ICF International; 2012.
45. Uganda AIDS Commission. The HIV and AIDS Uganda Country Progress Report 2014. Kampala, Uganda: UAC. Retrieved from: http://www.unaids.org/sites/default/files/country/documents/UGA_narrative_report_2015.pdf. 2015.
46. Joint United Nations Programme on HIV/AIDS (UNAIDS). Uganda. HIV and AIDS estimates (2015) Retrieved from <http://www.unaids.org/en/regionscountries/countries/uganda>. Accessed on 16 Sept 20172015.
47. Uganda AIDS Commission (UAC). The Uganda HIV and AIDS Country Progress Report: July 2015-June 2016. Kampala, Uganda: UAC; 2016.
48. Uganda Ministry of Health. Consolidated Guidelines for Prevention and Treatment of HIV in Uganda. Kampala, Uganda: MOH; 2016.

49. Asiki G, Mpendo J, Abaasa A, Agaba C, Nanvubya A, Nielsen L, et al. HIV and syphilis prevalence and associated risk factors among fishing communities of Lake Victoria, Uganda. *Sex Transm Dis*. 2011;87(6):511-5.
50. Seeley J, Nakiyingi-Miir J, Kamali A, Mpendo J, Asiki G, Abaasa A, et al. High HIV incidence and socio-behavioral risk patterns in fishing communities on the shores of Lake Victoria, Uganda. *Sex Transm Dis*. 2012;39(6):433-9.
51. Opio A, Muyonga M, Mulumba N. HIV sero behavioral survey in fishing communities of the Lake Victoria basin of Uganda. SIDA, MOH, AMREF; 2011.
52. Chang LW, Grabowski MK, Ssekubugu R, Nalugoda F, Kigozi G, Nantume B, et al. Heterogeneity of the HIV epidemic in agrarian, trading, and fishing communities in Rakai, Uganda: an observational epidemiological study. *Lancet*. 2016;3(3):8.
53. Uganda MOH. Addendum to the National Antiretroviral Treatment Guidelines. Kampala, Uganda: Uganda Ministry of Health; 2013.
54. Bogart LM, Naigino R, Maistrellis E, Wagner GJ, Musoke W, Mukasa B, et al. Barriers to linkage to HIV care in Ugandan fisherfolk communities: a qualitative analysis. *AIDS Behav*. 2016;20(10):2464-76.
55. Kwenza ZA, Camlin CS, Shisanya CA, Mwanzo I, Bukusi EA. Short-term mobility and the risk of HIV infection among married couples in the fishing communities along Lake Victoria, Kenya. *PLoS ONE*. 2013;8(1):e54523.
56. Wanyenze RK. Barriers to linkage to HIV Care in Ugandan fisherfolk communities: a qualitative analysis. under review.
57. Sileo K, Kintu M, Chanes-Mora P, Kiene S. "Such behaviors are not in my home village, I got them here": a qualitative study of the influence of contextual factors on alcohol and HIV risk behaviors in a fishing community on Lake Victoria, Uganda. *AIDS Behav*. 2016;20(3):537-47.
58. Tumwesigye NM, Atuyambe L, Wanyenze RK, Kibira SP, Li Q, Wabwire-Mangen F, et al. Alcohol consumption and risky sexual behaviour in the fishing communities: evidence from two fish landing sites on Lake Victoria in Uganda. *BMC Public Health*. 2012;12:12.
59. Brofenbrenner U. Toward an experimental ecology of human development. *Am Psychol*. 1977;32(513-531).
60. McLeroy KR BD, Steckler A, Glanz K. A.,. An ecological perspective on health promotion programs. *Health Educ Q*. 1988;15(4):351-77.
61. Stokols D. Establishing and maintaining healthy environments: toward a social ecology of health promotion. *Am Psychol*. 1992;47(1):6-22.
62. Kaufman M, Cornish F, Zimmerman R, Johnson B. Health behavior change models for HIV prevention and AIDS care: practical recommendations for a multi-level

approach. *J Acquir Immune Defic Syndr*. 2014. 15;66 Suppl 3:S250-8. doi: 10.1097/QAI.0000000000000236.

63. Castro EM, Santiago LE, Jiménez JC, Dávila-Vargas D, Rosal MC. A social-ecological view of barriers and facilitators for HIV treatment adherence: interviews with Puerto Rican HIV patients. *PLOS ONE*. 2015;10(9):e0125582.
64. Berger MB, Sullivan KA, Parnell HE, Keller J, Pollard A, Cox ME, et al. Barriers and facilitators to retaining and reengaging HIV clients in care. *J Int Assoc Provid AIDS Care*. 2015;15(6):486-93.
65. Hoffmann CJ, Mabuto T, McCarthy K, Maulsby C, Holtgrave DR. A framework to inform strategies to improve the HIV care continuum in low- and middle-income countries. *AIDS Edu Prev*. 2016;28(4):351-64.
66. Smolak A. A meta-analysis and systematic review of HIV risk behavior among fishermen. *AIDS Care*. 2013;26(3):282-91.
67. Seeley JA, Allison EH. HIV/AIDS in fishing communities: challenges to delivering antiretroviral therapy to vulnerable groups. *AIDS Care*. 2005;17(6):688-97.
68. Allison EH, Seeley JA. HIV and AIDS among fisherfolk: a threat to 'responsible fisheries'? *Fish Fisheries*. 2004;5(3):215-34.
69. Bogart LM, Wagner GJ, Musoke W, Naigino R, Linnemayr S, Maistrellis E, et al. A comparison of home-based versus outreach event-based community HIV testing in Ugandan fisherfolk communities. *AIDS Behav*. 2017;21(2):547-60.
70. Samet JH, Cheng DM, Libman H, Nunes DP, Alperen JK, Saitz R. Alcohol consumption and HIV disease progression. *J Acquir Immune Defic Syndr*. 2007;46(2):194-9.
71. Kahler CW, Liu T, Cioe PA, Bryant V, Pinkston MM, Kojic EM, et al. Direct and indirect effects of heavy alcohol use on clinical outcomes in a longitudinal study of HIV patients on ART. *AIDS Behav*. 2016.
72. Kiene SM, Simbayi LC, Abrams A, Cloete A, Tennen H, Fisher JD. High rates of unprotected sex occurring among HIV-positive individuals in a daily diary study in South Africa: the role of alcohol use. *J Acquir Immune Defic Syndr*. 2008;49(2):219-26.
73. Kiene SM, Subramanian S. Event-level association between alcohol use and unprotected sex during last sex: evidence from population-based surveys in sub-Saharan Africa. *BMC Public Health*. 2013;13(1):1-8.
74. Woolf-King SE, Maisto SA. Alcohol use and high-risk sexual behavior in sub-Saharan Africa: a narrative review. *Archives of Sexual Behavior*. 2011;40(1):17-42.
75. Gonzalez A, Barinas J, O'Cleirigh C. Substance Use: Impact on Adherence and HIV Medical Treatment. *Curr HIV/AIDS Rep*. 2011;8(4):223-34.

76. Wandera B, Tumwesigye NM, Nankabirwa JI, Kambugu AD, Parkes-Ratanshi R, Mafigiri DK, et al. Alcohol consumption among HIV-infected persons in a large urban HIV clinic in Kampala Uganda: a constellation of harmful behaviors. *PLoS ONE*. 2015;10(5):e0126236.
77. Sileo KM, Simbayi LC, Abrams A, Cloete A, Kiene SM. The role of alcohol use in antiretroviral adherence among individuals living with HIV in South Africa: event-level findings from a daily diary study. *Drug Alcohol Depend*. 2016;167:103-11.
78. Hendershot CS, Stoner SA, Pantalone DW, Simoni JM. Alcohol use and antiretroviral adherence: review and meta-analysis. *J Acquir Immune Defic Syndr*. 2009;52(2).
79. Kiwanuka N, Ssetaala A, Nalutaaya A, Mpendo J, Wambuzi M, Nanvubya A, et al. High Incidence of HIV-1 infection in a general population of fishing communities around Lake Victoria, Uganda. *PLoS ONE*. 2014;9(5):e94932.
80. Tumwesigye NM, Wanyenze RK, Greenfield TK. Intoxication before last sexual encounter and HIV risk behavior among men and women in Uganda: evidence from a nationwide survey. *Int J Alcohol Drug Res*. 2012;1(1):17.
81. UNAIDS. Global Report: UNAIDS Report on the Global AIDS Epidemic 2012. UNAIDS; 2012.
82. Mburu G, Ram M, Siu G, Bitira D, Skovdal M, Holland P. Intersectionality of HIV stigma and masculinity in eastern Uganda: implications for involving men in HIV programmes. *BMC Public Health*. 2014;14:1061.
83. Siu GE, Seeley J, Wight D. Dividuality, masculine respectability and reputation: How masculinity affects men's uptake of HIV treatment in rural eastern Uganda. *Soc Sci Med*. 2013;89:45-52.
84. Siu GE, Wight D, Seeley J. 'Dented' and 'resuscitated' masculinities: the impact of HIV diagnosis and/or enrolment on antiretroviral treatment on masculine identities in rural eastern Uganda. *SAHARA J*. 2014;11(1):211-21.
85. Sikweyiya YM, Jewkes R, Dunkle K. Impact of HIV on and the constructions of masculinities among HIV-positive men in South Africa: implications for secondary prevention programs. *Global Health Action*. 2014;7:10.3402/gha.v7.24631.
86. Siu GE, Wight D, Seeley JA. Masculinity, social context and HIV testing: an ethnographic study of men in Busia district, rural eastern Uganda. *BMC Public Health*. 2014;14(1):1-11.
87. Siu GE, Seeley J, Wight D. Dividuality, masculine respectability and reputation: how masculinity affects men's uptake of HIV treatment in rural eastern Uganda. *Soc Sci Med*. 2013;89:45-52.

88. Nunan F. Mobility and fisherfolk livelihoods on Lake Victoria: implications for vulnerability and risk. *Geoforum*. 2010;41(5):776-85.
89. Mack N, Odhiambo J, Wong CM, Agot K. Barriers and facilitators to pre-exposure prophylaxis (PrEP) eligibility screening and ongoing HIV testing among target populations in Bondo and Rarieda, Kenya: results of a consultation with community stakeholders. *BMC Health Serv Res*. 2014;14:231.
90. The World Health Organization (WHO). Guidelines on when to start antiretroviral therapy and on pre-exposure prophylaxis for HIV. Geneva: WHO; 2015.
91. Bogart LM, Naigino R, Maistrellis E, Wagner GJ, Musoke W, Mukasa B, et al. Barriers to linkage to HIV care in Ugandan fisherfolk communities: a qualitative analysis. *AIDS Behav*. 2016;20(10):2464-76.
92. Seeley J, Tumwekwase G, Grosskurth H. Fishing for a living but catching HIV: AIDS and changing patterns of the organization of work in fisheries in Uganda. *Anthropol Work Rev*. 2009;30(2):66-76.
93. Geng EH, Bangsberg DR, Musinguzi N, Emenyonu N, Bwana MB, Yiannoutsos CT, et al. Understanding reasons for and outcomes of patients lost to follow-up in antiretroviral therapy programs in Africa through a sampling-based approach. *J Acquir Immune Defic Syndr*. 2010;53(3):405-11.
94. Govindasamy D, Ford N, Kranzer K. Risk factors, barriers and facilitators for linkage to antiretroviral therapy care: a systematic review. *AIDS*. 2012;26(16):2059-67.

CHAPTER 2: The prevalence of alcohol and drug use among male fisherfolk on ART, and its effect on ART adherence

Abstract

Background: Substance use among people living with HIV (PLHIV) can advance disease progression, and interfere with condom use and antiretroviral treatment (ART) adherence. In Lake Victoria fishing communities, hazardous alcohol consumption and drug use are documented, and HIV prevalence is high, but substance use among men living with HIV has not been investigated in this setting. This mixed methods study examines the prevalence and determinants of substance use, and its influence on antiretroviral treatment (ART) adherence, among male fisherfolk on ART in Wakiso District, Uganda.

Methods: This study employed cross-sectional, mixed methods design. We conducted interviews using a structured questionnaire (N=300) and in-depth semi-structured interviews (n=30) with men attending HIV clinics near Lake Victoria.

Results: Thirty-one percent of men reported sub-optimal adherence. Half (46.7%) reported drinking, of which 64.8% were considered hazardous drinkers. Illicit drug use was low (6%). In the multivariate model, men who drank four or more drinks on average were more likely to report missed pills compared to those reporting no drinking (AOR: 1.71, 95% CI: 1.01-2.92). Drinking four or more drinks on average (AOR: 5.65, 95% CI: 1.25-25.63) and hazardous drinking (AOR: 4.91, 95% CI: 1.68-14.37) both had a greater effect on missed pills among men taking twice daily regimens compared to once daily. Our qualitative data sheds light on the context in which alcohol use occurs,

the pathways in which alcohol leads to non-adherence, and men's motivation for alcohol reduction.

Conclusions: This study highlights the need for alcohol reduction interventions in with men on ART in Ugandan fishing villages in order to improve ART adherence and to prevent the known negative health effects of alcohol for PLHIV. The integration of SBI for alcohol reduction into HIV clinical care may be an effective approach to reduce alcohol consumption and improve adherence among men on treatment who drink.

Introduction

In Uganda and throughout sub-Saharan Africa, national strategies for HIV/AIDS prevention and control are increasingly centered on the scale up of antiretroviral treatment (ART). When taken as prescribed, antiretrovirals (ARVs) have the ability to reduce one's viral load to non-infectious levels, which extends the life years of people living with HIV (PLHIV) substantially, and has the potential to curb the population-level incidence of HIV (1, 2). In an effort to achieve universal access to treatment globally, the World Health Organization (WHO) has issued recommendations for the expansion of ART eligibility to all, regardless of CD4 cell count or disease stage (3). The Ugandan Ministry of Health (MOH) is currently rolling out this policy, which has been in place for most-at-risk populations (MARPs) since 2014 (4). In Ugandan fishing villages, HIV prevalence is estimated between 22-40% (5-7) compared to the national prevalence of 7.3% (8). Thus, fisherfolk, or individuals living and working in the fishing communities on Lake Victoria, are a MARP being prioritized for test-and-treat initiatives (4, 9). However, little is known about HIV care engagement with this population.

In order to achieve and sustain viral suppression and realize the full benefits of

ART, it is necessary that PLHIV take 95% of their ARVs as prescribed (10). In Uganda and across the region, men on ART have worse treatment adherence and greater mortality compared to women (11-13). Men in fishing communities are likely to encounter even greater barriers to ART adherence than men generally; in addition to frequent travel, conflicting work responsibilities, distance and other structural barriers to HIV care (14, 15), high risk alcohol use and drug use observed in this setting (5, 9, 15-18) may pose a significant threat to men's ART adherence. Substance use among PLHIV is a major public health concern, as it can advance HIV/AIDS disease progression by directly decreasing CD4, and can indirectly increase viral load, through its effect on poor treatment adherence (19-22). A meta-analysis of 40 studies reported alcohol drinkers were approximately 50-60% less likely to be classified as adherent, compared to those who abstained or drank at non-hazardous levels (23).

Tumwesigye et al. (16) found 69.8% of fishermen drank at hazardous levels in two Ugandan fishing communities. Moreover, hazardous alcohol use, defined as a pattern of alcohol consumption that increases the risk of harmful consequences for the user and others (24), has been described in qualitative studies as part of the broader culture of fishermen (14). Other drug use, including marijuana and khat (a plant-based stimulant) may also be high among fisherfolk (9, 18); however, more data is needed on the prevalence of drug use in this setting. While alcohol use is reportedly high among the general population in fishing communities (5, 9, 15-18), to our knowledge no research has examined the level and patterns of alcohol and drug use among fisherfolk living with HIV and on ART. Substance use may differ among PLHIV compared to the general population; some studies in Uganda report high rates of alcohol use and misuse among PLHIV (25), and others report temporary reductions in unhealthy drinking upon ART initiation, but a return to baseline drinking over time (26). Studies with fishermen identify

alcohol use as a risk factor for HIV acquisition (5, 9, 18, 27) and a major barrier to prevention services and linkage to HIV care (28, 29). However, research is needed on the prevalence and determinants of substance use among HIV-infected fishermen and its effects on ART adherence, in order to inform effective programming to improve adherence among this population.

In this mixed methods study, we use both quantitative and qualitative methods to examine the prevalence of and motivation for substance use, as well as the influence of substance use on HIV medication adherence. Using quantitative survey data, we test the associations between substance use and ART adherence, hypothesizing that those who drink and/or use drugs will have worse adherence. We also quantitatively explore which risk levels of drinking may drive associations between alcohol use and adherence, and based on findings from prior studies (23, 30), explore the potential modifying effect of number of ARV pills prescribed on this relationship. In-depth interviews explore how men's substance use has changed since being diagnosed with HIV, the mechanisms in which alcohol and drug use may lead to poor adherence, and motivations for substance use reduction.

Methods

This cross sectional study employed a simultaneous mixed methods research design with a single quantitative assessment (N=300), paired with qualitative interviews among a sub-sample of participants (N=30). The simultaneous research design falls within Morse & Niehaus' "QUAN + *qual*" design, comprised of a quantitatively-driven core component and a qualitative supplementary component (31). In this design, the core and supplemental components are conducted simultaneously, and the qualitative data is used to provide explanation and further probe into the quantitative findings.

The study was conducted between October 2016 and March 2017 at seven health centers/outreach sites in Wakiso District, Uganda, including three sites on land (Kasenyi outreach, Entebbe Hospital, Kigungu Health Centre III) and four sites on islands (Rapha Health Centre [Bussi Island], Zzinga outreach [Zzinga Island], Bussi Health Centre [Bussi Island], Kachanga outreach [Kachanga Island]). Rapha, Bussi HCIII, Kigungu, and Entebbe Hospital are governmental public health facilities that serve large populations of fisherfolk. Kasenyi, Kachanga, and Zzinga are Mildmay Uganda outreach sites, which serve the surrounding landing sites and islands. We worked in collaboration with Mildmay Uganda in the implementation of the study, a non-governmental organization that partners with the Ugandan Ministry of Health to provide free HIV services to patients, including HIV testing, care, and treatment. Eligibility for ARVs at the time of the study was $CD4 < 500$ in the broader population in Uganda, but among fisherfolk and other MARPs, the MOH and Mildmay Uganda were implementing immediate initiation of ART upon diagnosis regardless of CD4 cell count or WHO clinical stage; in practice, this included same day initiation, with the exception of men testing in community settings who initiate after linking to an HIV clinic.

The research population included male fisherfolk living with HIV/AIDS, including fishermen and other occupations supporting the fishing industry (fish sellers, boat loaders/operators). We focused specifically on fisherfolk because we hypothesized they would have unique barriers to HIV care engagement, including heavy drinking, and we included only men based on evidence of a gender gap in the HIV care continuum (11-13). Our additional eligibility criteria were: aged 18 years or older and prescribed ART for at least 6 months (in order to measure adherence). Using purposive sampling, clinic staff and a trained research assistant recruited men for participation as they presented to the HIV clinic/outreach clinics during routine HIV appointments. Study staff non-

systematically approached men to inform them about the study and assess their eligibility. We also invited men to participate during routine reminder calls for HIV clinic appointments. During calls, the research assistant informed men of the opportunity to participate in the study at their next appointment or to schedule an appointment at a time more convenient to them. A total of 64 men were recruited via telephone, and participated at a future clinic appointment. Of the 322 eligible men approached for the quantitative portion of the study, 22 declined participation for the following reasons: did not have time/other responsibilities (n=14), did not want to disclose sensitive information (n=4), intoxicated at the time of interview (n=1), hearing impairment (n=1), wanted more compensation (n=1), wanted to be interviewed with wife present (n=1). Participants meeting eligibility criteria and providing written informed consent completed an interviewer-administered questionnaire immediately after enrolling in the study. The research assistant conducted the individual structured computer-based interviews (<45 minutes duration) in a private space in the HIV clinic or another agreed upon location. Participants received 10,000 Ugandan Shillings (~2.75 USD) for participation in the structured interview.

We recruited a subsample (n=30) of men completing the quantitative portion of the study to additionally participate in a qualitative in-depth interview (IDI). These men were purposively sampled based on their responses on the questionnaire to ensure at least half of men interviewed experienced difficulty with ART adherence (missed any pills in prior 4 days) and self-reported any alcohol use, to allow us to adequately explore these issues. Of the 35 men asked to participate in an IDI, 5 declined participation due to time constraints. Those meeting eligibility criteria and providing additional written informed consent participated in the semi-structured IDI either immediately after the quantitative questionnaire in the same private space, or at a later agreed upon

time/location. The IDIs were conducted and audio-recorded by the same research assistant conducting the quantitative interview. The research assistant was experienced in qualitative data collection and received further training by the first author. Interviews lasted approximately 40 minutes, and participants received 15,000 Ugandan Shillings (~4 USD) for completion of the IDI. Approximately half of the audio-recorded interviews were transcribed and translated verbatim from Luganda to English by the research assistant. The other half were transcribed and translated by an experienced translator.

Quantitative measures

Covariates

Among the socio-demographics and HIV-related variables measured, we include the following variables as potential covariates: age, education, monthly income, occupation, marital/partner status, research site, mobility, time spent traveling to the HIV clinic, time since HIV diagnosis, time since ART initiation, and number of pills prescribed per day. Based on the distribution of the data, several variables were dichotomized for analysis, including education (no schooling vs. any schooling), employment status (fishermen vs. other fishing occupations), marital status (married vs. not married/separated), research site (landing site vs. island), mobility (traveled/slept outside of the community in the prior year, yes or no), and number of pills prescribed per day (once daily vs. twice daily). Continuous variables included monthly income (1 unit equates to 50,000 shillings), time spent traveling to the HIV clinic (1 units equates to 30 minutes), and time on ART and since diagnosis (1 unit equates to 6 months).

Alcohol variables

We used the WHO's Alcohol Use Disorders Identification Test (AUDIT) to assess

drinking risk levels (32) (present sample, $\alpha = 0.63$). The AUDIT includes cut-off scores to categorize individuals at different levels of risky drinking, which we use for data analysis, including: hazardous alcohol use (score of 8 or more), high risk or harmful use (16-19), and dependence (20 or more) (24). In addition, we assessed the type of alcohol typically consumed. Response options included alcoholic beverages common in the study setting: bottled beer (4.5-7% alcohol by volume [ABV]), tonto (locally brewed fermented banana juice, 3% ABV), malwa (locally brewed from millet, communally shared in single container with straws, 3% ABV), Waragi (traditional gin, 48.4% ABV), “other kind of local brew,” and “other kind of alcohol.”

We assessed the average number of drinks typically consumed in one day, which we categorized for analysis into three levels to demonstrate incremental change in non-adherence by drinking level compared to no drinking: no drinking, 1-3 drinks, and 4 or more drinks. We chose these categories based on prior work assessing the influence of quantity of drinks on non-adherence for PLHIV found 4 or more drinks was an important threshold in increased risk for missed ARVs (33). We calculated participants' average number of “standard” drinks per day by taking into account the alcohol content and serving size of the type of alcohol they reported most typically consuming (34), with the exception of malwa which does not come in a standardized container and is difficult to measure consumption volume because it is consumed communally. A standard drink contains approximately 14 grams of pure alcohol (35).

Other drug use variables

Drug use was assessed by the National Institute of Drug Abuse (NIDA) Modified ASSIST scale (36), adapted for the Ugandan context. Participants were asked about their lifetime use of substances, use within the prior 3 months, and the extent of use for

each type of drug reported in the prior 3 months. We included all drugs in the original NIDA ASSIST, adapted to include the Lugandan and local names for each. Drugs included: cannabis, cocaine, prescription stimulants, methamphetamine, inhalants, sedatives or sleeping pills, hallucinogens, street opioids, prescription opioids, and tobacco. We added substances specific to Uganda, derived from consultation with Ugandan experts in drug use, and the piloting of items locally. Additions include the following: kuber (a plant-based stimulant, chewed or consumed as a tea), shisha (a plant-based stimulant, commonly smoked with marijuana), and khat (a plant-based stimulant, chewed).

Adherence outcome

The Adult AIDS Clinical Trial Group (AACTG) scale was used to measure self-reported ARV adherence (37). The AACTG includes recall questions about ARVs missed for the previous four days prior to the interview and items measuring reasons for non-adherence. It has demonstrated construct validity in Uganda and similar settings (38). For analysis, we assess the proportion of missed ARVs in the prior four days, out of total ARVs prescribed. In addition to self-reported adherence, we documented initiation date, and ART regimen from participants' medical records.

Qualitative measures

In-depth interviews (IDIs) followed a semi-structured protocol including open-ended questions on barriers to ART adherence, as well as alcohol consumption (e.g., type of alcohol, frequency, binge drinking) and other drug use (types, frequencies). For participants reporting any alcohol or drug use, we asked about reasons for substance use and the specific circumstances in which substances are more likely to be used

(settings, social networks, community norms). Finally, a series of questions and probes were included to assess if/how being diagnosed with HIV has changed men's substance use, and how alcohol and drug use affects men's ability to take their medications.

Data analysis plan

Quantitative analysis. In SPSS version 24, we characterize the prevalence of alcohol and other substance use using descriptive statistics. We identified outliers (values greater than 3 standard deviations [SD] outside of the mean) (39) and truncated them to the highest value within 3 SDs of the mean for the following variables: monthly income, months since diagnosis, months on ART, and minutes traveled to the clinic. We used generalized logistic modeling analyses with a binomial distribution and logit link with our outcome in the form of events within trials, with events being the number of missed ARVs and trials being the number of ARVs prescribed over a four day recall period (possible range given regimens prescribed was 4-8). We tested bivariate associations between potential independent variables, including socio-demographic and HIV variables (age, education, monthly income, occupation, marital/partner status, research site, mobility, time spent traveling to the HIV clinic, time since HIV diagnosis, time since ART initiation, number of pills prescribed) and missed pills, in order to determine which variables to include in the final models. We also planned to test the bivariate associations between average drinks consumed and drinking by AUDIT risk categories (risky drinking, hazardous, dependent) and missed pills, contingent on prevalence. Finally, we tested separate multivariate models for each alcohol variable (AUDIT risk categories, average number of pills) associated with missed pills ($p < 0.10$ in bivariate models), adjusting for statistically significant covariates ($p < 0.10$), and testing for interactions between number of pills prescribed and alcohol variables. Odds Ratios

(OR) and Adjusted Odds Ratios (AOR) from bivariate and multivariate analysis with 95% confidence intervals are presented. In multivariate models, we drop covariates that lost statistical significance ($p < 0.05$), presenting only the trimmed models. We planned to mirror the analyses described for alcohol, with the drug use variables, dependent on sufficient prevalence among the sample.

Qualitative analysis. IDIs were analyzed using a content analysis approach (40). The first author reviewed the transcripts and developed a coding scheme based on the interview guide, with domains related to barriers to medication adherence, motivation for substance use, the context of substance use, and mechanisms in which substance use influences ART adherence. The coding scheme was then modified after review of the data. The first author, experienced in qualitative analysis, iteratively reviewed coded data. Finally, the first author identified major themes through iterative review of the coded data.

Mixing quantitative and qualitative data. We use the qualitative data to better understand the quantitative association between substance use and ART adherence. We therefore follow Morse and Niehaus' recommendations for mixed methods analysis, analyzing the data simultaneously, and combining the findings in the presentation of results (31). The qualitative findings provide context and further explanation in the results and discussion section for the quantitative association between substance use and ART adherence.

Results

Participant characteristics

The average age of our full sample (N=300) was 37 (SD=8.6), and the majority of men reported being employed as a fisherman (82%) and never attending school

(67.3%). On average, men had been aware of their status for about two years (mean=24.6 months, SD=17.8) and were initiated on ART soon after diagnosis (mean=22.9 months, SD=13.5). Men reported taking 87.8% (SD=21.5%) of their ARV pills over the 4-day recall period, making 69% of the sample adherent (using a criterion for optimal adherence of 95% of pills taken as prescribed), and about a third of the sample was sub-optimally adherent (31%). See Table 2.1 for more details on sample characteristics for the full sample (N=300). Men participating in the qualitative portion of the study (n=30) were purposively sampled for poor adherence levels and therefore had worse adherence (60% classified as sub-optimally adherent). On average they were slightly younger (mean 33.8, SD=6.9), were more mobile (76.7%), and had less variation in occupation (90% fishermen).

Quantitative findings

Prevalence of alcohol use

Among men completing the quantitative questionnaire (N=300), approximately half reported drinking in the prior 30 days (47.3%). Tonto (30.3%) and Waragi (24.6%) were the most commonly consumed drinks. Men reported an average of almost 3 drinks per drinking day for beverages other than malwa. Among those reporting any alcohol use, 40% of those who drink reported ever binge drinking, but binge drinking was infrequent (2.1% at least once/week, 9.2% at least once/month, 23.9% less than once/month). Among the full sample, the average AUDIT score was 4.5 (SD = 5.13), and nearly a third (30.7%) of the full sample met criterion for hazardous drinking (AUDIT score ≥ 8) in the prior year; among those reporting any drinking, two-thirds drank at hazardous levels (64.8%). Only eight men met AUDIT criterion of high-risk drinking (AUDIT ≥ 16), and one for alcohol dependence (AUDIT ≥ 20). Descriptive statistics for

alcohol use are displayed in Table 2.1. Since men in the qualitative portion of the study (n=30) were sampled based on alcohol consumption, alcohol use was higher: 90% had drunk in the prior 30 days, 80% classified as hazardous drinkers, and the mean AUDIT score was 10.4 (SD=4.7).

Prevalence of drug use, excluding alcohol

Only 6% of the sample reported ever using drugs, and only 3% reported using prescription drugs for non-medical reasons. Among the 18 men who reported any drug use other than alcohol, illicit substances included kuber (n=7), sisha (n=5), khat (n=3), and Cannabis (n=2); tobacco use was also reported (n=15). Table 2.1 includes descriptive statistics for drug use. Due to the low use of other drugs, we focus the remainder of the quantitative findings on alcohol use.

Effect of alcohol use on ART adherence

In bivariate and multivariate analyses, we operationalized alcohol use in two ways: average number of drinks in one day (no drinking, 1-3 drinks, 4 or more) and any hazardous alcohol use (AUDIT ≥ 8) (yes or no). For hazardous alcohol use, we pooled no drinking and low risk drinking together as the reference group, as the mean adherence percentage demonstrated no difference in adherence levels between no drinking and low risk drinking (AUDIT = 1-7) (mean adherence for non-drinkers = 88.49%, for low risk drinkers = 88.70%). In addition, we did not separate the AUDIT categories of high-risk/harmful drinking (AUDIT ≥ 16) or alcohol dependence (AUDIT ≥ 20) for analysis due to their low prevalence in the prior year according to the AUDIT.

In unadjusted models, compared to men who reported no drinking, men reporting four or more drinks per drinking day had over twice the odds of reporting missed ARVs

(OR: 2.13, 95% CI: 1.30-3.48, $p = 0.003$), but adherence among men reporting an average of 1-3 drinks per day was only marginally different from those reporting no drinking (OR: 1.37, 95% CI: 0.95-1.97, $p = 0.09$). Any hazardous alcohol use (AUDIT ≥ 8) was associated with greater non-adherence compared to no drinking or low risk drinking (AUDIT=1-7) pooled together (OR: 1.39, 95% CI=0.98-1.98); however, the effect was marginally significant ($p = 0.06$). Covariates found statistically associated with missed pills ($p < 0.10$) in bivariate models included: younger age, greater education, lower monthly income, mobility in the prior 12 months, greater travel time to HIV clinic, and being prescribed a once daily (ART) regimen (compared to twice daily). See Table 2.2 for detailed statistics.

In the final trimmed model testing average number of drinks and missed pills adjusted for covariates (see Table 2.3), a positive main effect remained for the highest level of drinking; men reporting an average of four or more drinks were 1.71 times as likely to miss ARVs compared to those reporting no drinking (AOR: 1.71, 95% CI: 1.01-2.92, $p = 0.04$). Negative main effects for younger age and number of pills prescribed also remained in the final model, with the odds of missed ARVs greater among younger men (AOR: 0.96, 95% CI: 0.94-0.99, $p = 0.001$) and men taking once daily regimens (compared to twice daily) (AOR: 0.25, 95% CI: 0.10-0.63, $p = 0.004$). Men with any school were also more likely to report missed doses than men with no schooling (AOR: 1.46, 95% CI: 1.03-2.07, $p=0.03$). A statistically significant interaction was identified between average number of drinks and number of pills prescribed; men taking twice daily dosing and consuming an average of four or more drinks were nearly six times as likely to report missed ARVs than men taking twice daily dosing but reporting no drinking (AOR: 5.65, 95% CI: 1.25-25.63, $p = 0.03$). See Figure 2.1 for a graphic depiction of the observed interaction.

Table 2.4 displays the final trimmed multivariate model testing the association between any hazardous drinking and ART adherence, adjusted for covariates. The main effect between any hazardous drinking and missed pills was not statistically significant in the full model (AOR: 1.10, 95% CI: 0.75-1.61, $p = 0.63$). Younger age (AOR: 0.96, 95% CI: 0.94-0.99, $p = 0.002$), greater education (AOR: 1.54, 95% CI: 1.08-2.18, $p = 0.02$), and taking a twice-daily regimen compared to once daily (AOR: 0.26, 0.12-0.55, $p < 0.001$) remained significantly associated with missed pills in the full model. There was a statistically significant interaction between hazardous alcohol consumption and number of pills prescribed; men taking twice daily dosing and reporting hazardous alcohol use were nearly five times as likely to report missed ARVs than men taking twice daily dosing but reporting no hazardous alcohol use (AOR: 4.91, 95% CI: 1.68-14.37, $p = 0.004$); see Table 2.4 for statistics and Figure 2.2 for a graphic depiction of the observed interaction.

Qualitative findings

Context of substance use: Setting, company, and motivation for substance use

IDIs revealed alcohol and other substance use occur in both social and occupational settings, and drinking was perceived as a social activity among men. When drinking socially, men stated it was usually in the company of other men (peers, coworkers, male family members) in bars, both in the daytime and in the evening, depending on men's work schedules. When asked what prompted men to drink, nearly a third of men interviewed implied some social or peer influence from other men. The majority of men said they drink casually with friends, but not to get drunk and that peers often influenced them to drink. However, a smaller proportion of men described drinking

with friends as “partying,” which involved heavier drinking, going to dance clubs, and meeting women (see Table 2.5 for select quotations).

Alcohol use was also considered a normalized part of the lifestyle of fishermen, and the occupation itself; drinking while working on the lake was reportedly common. Men described using alcohol to cope with long working hours, being on the lake overnight, to help sleep in off-hours, and to deal with the cold and wind. Several men reported being more likely to drink when they acquire cash from fishing, citing a common perception that fishermen have difficulty saving money. However, many men stated they spend their money on alcohol only when they’ve met their main responsibilities to their families. Among the small number of men using other drugs (cannabis, kuber, sisha), they also described using them in social settings, and during work hours to “stay warm,” and to “energize” them.

A third of men interviewed cited stress relief, or using alcohol to “relax,” “calm the mind,” and “feel happy,” as the main reason they drink; these reasons also emerged for cannabis use. Specific stressors named included: marital and other interpersonal conflict, coping with HIV-related stress, and financial worries. Financial concerns centered on earning enough money for food security, and the ability to provide for one’s children. Specific HIV-related stressors identified by men included being diagnosed with HIV, grief from lost loved ones who died from HIV, and HIV-related stigma.

Despite most men participating in the IDIs being classified as “hazardous” drinkers based on their AUDIT score, men did not express concern about their level of drinking as long as it did not interfere with their ART adherence or interpersonal relationships. Only a few men said they drank because they had a need for alcohol. An outline of all major themes with select representative quotations is presented in Table 2.5.

HIV and alcohol use

Change in alcohol use since HIV diagnosis. When asked if their alcohol use has increased, decreased, or stayed the same since their HIV diagnosis, the majority of participants said they had reduced their drinking since being diagnosed with HIV. Several participants stated a temporary increase in drinking right after diagnosis; however, after coming to terms with their status, they reduced their overall alcohol consumption.

Effect of alcohol use on ART adherence. All 30 men participating in an IDI demonstrated awareness that PLHIV should avoid or reduce alcohol use. Men were aware that alcohol can effect the efficacy of their HIV medication, can interfere with their ARV adherence, and some men stated mixing alcohol with their ARVs causes negative physical side effects or toxic interactions. This knowledge was obtained primarily from healthcare providers; in all IDIs men stated that the healthcare providers have encouraged them to reduce or quit drinking. Nevertheless, in line with above-reported quantitative findings, alcohol use emerged unsolicited as one of the main reasons men reported missing their ARVs in IDIs. When probed further on how alcohol impacts their ART adherence, two pathways emerged. First, men reported forgetting to take their ARVs when drinking because of alcohol's effect on their cognitive functioning, or because they stay out too late drinking and leave their pills at home. The second pathway described was the intentional skipping of doses when drinking, which some men reported doing in order to avoid side effects from mixing alcohol with their ARVs. The men in the sample who said alcohol does not affect their medication adherence reported either reducing their alcohol use significantly already, or make intentional efforts to plan their drinking around their ART regimen to avoid missed doses or interactions between alcohol/ARVs. See Table 2.5 for quotations.

Reasons for not drinking or alcohol reduction. When asked the main reasons men had stopped or reduced their amount of drinking, the majority of responses were related directly to men's HIV status and health; namely, learning about alcohol's negative effect on health, medication adherence, and treatment efficacy motivated men to reduce their alcohol consumption. Most men stated that the counseling they received from health care providers influenced this decision.

Other reasons men reported alcohol reduction included the desire to save money, to better fulfill their role of father and provider, and for their general health. In general, men stated that they were motivated to take their ARVs so that they could remain healthy, and thus continue to provide for their families and children. Their diagnosis had motivated them to plan more for the future, sharing specific goals to earn and save enough to leave their families with money or property. Alcohol reduction was one aspect of their shift towards adopting a healthy lifestyle and saving money for the future since learning their HIV status; see supportive quotations in Table 2.5.

Discussion

Despite PLHIV in fishing communities being prioritized for the scale up of test-and-treat initiatives in Uganda, little is known about substance use in this population or fisherfolk's ability to maintain optimal ART adherence. This is the first study to our knowledge to begin to fill this gap in the literature. Among our sample of men enrolled in HIV care, approximately a third reported sub-optimal ART adherence, and our quantitative findings demonstrated alcohol use was associated with an increased likelihood of missed ARVs among men. In line with prior studies, two pathways emerged from our qualitative data to explain the alcohol-adherence relationship, including alcohol's negative effect on cognitive functioning leading to missed pills (23, 41), as well

as the intentional skipping of ARV doses when drinking to avoid perceived side effects or toxic interactions between ARVs and alcohol (42-44).

Our quantitative findings add to the broader literature demonstrating an association between alcohol consumption and missed ARVs (23, 45). We found men who typically consume four or more drinks were almost twice as likely to miss ARVs compared to no drinking, but this association was not found for those drinking an average of one to three drinks on drinking days. We also found men reporting no drinking and men reporting low risk drinking had similar rates of adherence, suggesting the consumption of higher quantities of alcohol may be driving the alcohol-adherence association. However, no direct association was found for hazardous drinking (which encompasses other negative outcomes of drinking in addition to quantity) and missed ARVs. In the literature, there have been mixed findings on the role of alcohol quantity and risk levels on adherence; some studies suggest any drinking regardless of amount or low risk drinking (45) may drive the alcohol-adherence association (30, 42, 45-48), while others suggest higher quantities of drinking drive this association (23, 41, 45). Though our findings support the latter, more research is needed to better understand the relationship between alcohol use and non-adherence.

Counter to evidence on the advantage of once-daily single tablet regimens for treatment adherence (49), we found a negative direct effect between number of pills prescribed and adherence; that is, men taking once daily regimens reported overall worse adherence than men taking twice daily regimens. However, as demonstrated by the observed interactions between the alcohol variables and number of pills prescribed (see Figures 2.1 and 2.2), for men drinking four or more drinks on average and for those classified as hazardous drinkers, those on twice daily dosing had worse adherence compared to those on once daily regimens. One possible explanation that men on twice

daily regimens had better adherence overall may be that they were receiving more intensive ART adherence counseling and monitoring since treatment failure on the once daily regimen. Further, men taking twice daily regimens who drink at higher quantities (4 or more drinks) and hazardous levels may have failed on the preferred first line regimen because of alcohol use. For these men, increased adherence counseling and monitoring, which was shown to be working for all other men, may not be addressing their main barrier to adherence, alcohol use. Being switched to twice daily dosing despite increased monitoring may especially increase risk of non-adherence among high quantity and hazardous drinkers, who may have more difficulty remembering or planning their alcohol consumption around two pills compared to one. Prior studies similarly report regimen complexity is an important factor in alcohol's influence on adherence (23, 30), reinforcing the benefits of a once daily regimen for men who drink.

Alcohol consumption levels were lower in our sample of men living with HIV compared to prior studies with non-HIV positive fisherfolk (9, 16), with almost half of our sample reporting abstaining from alcohol use in the prior year. In addition, while several studies have suggested marijuana and khat may be prevalent in these communities (9, 18), very few men reported drug use. However, hazardous drinking was prevalent among those who do drink; one-third of the overall sample, and two-third of those who drink, were classified as hazardous drinkers on the AUDIT. In addition to the demonstrated negative effects of alcohol on adherence, alcohol's direct effect on CD4 cell count and disease progression is dangerous for PLHIV (19, 20, 50), making the level of drinking observed in our sample concerning. The main motivations for drinking were in line with previous research with non-HIV positive fisherfolk, including social influences among male peers, and coping with occupational, financial, and interpersonal stressors (14). Unique to our sample, participants noted that they used alcohol to cope with HIV-

specific stressors, which may be useful in informing alcohol reduction counseling with men in this setting.

These findings have important implications for clinical practice. First, the integration of screening and brief intervention (SBI) (51) into HIV clinical care with this population may be beneficial, given the observed rates of alcohol consumption and associations between drinking alcohol use and non-adherence. SBI includes universal screening for alcohol misuse, followed by targeted, low-resource, and time-limited (1-2 meetings) efforts to provide information, increase motivation, and teach behavioral change skills to reduce alcohol use (51). Our findings suggest screening questions should assess both the quantity of alcohol consumed and risk levels, and intervention efforts focused on those screening for higher levels of alcohol use, as opposed to those drinking at lower risk levels, may be most effective. While SBI has gained considerable support in developed settings (52, 53), among the more limited number of studies assessing SBI in sub-Saharan Africa, there is mixed support (54-59). The successful implementation of SBI and other integrated alcohol-adherence interventions would need to be tailored to the unique context of fishing villages, especially considering significant occupational and structural barriers to HIV care in fishing villages. Given that considerable structural barriers, as well as time and resource constraints may challenge the integration of SBI in this context, the brief AUDIT-C for SBI may be appropriate for this setting, which uses only the first 3 questions of the AUDIT to screen for hazardous drinkers and alcohol use disorders (60). However, the sensitivity and specificity should be rigorously tested for optimal cut-offs with fisherfolk, as the AUDIT-C classified considerably fewer men for “risky” alcohol use (8.7%) than the full AUDIT.

While further implementation research is needed to understand how to best structure and deliver an intervention to support men who drink to adhere to their

medication in this setting, our study has implications for the content of such an intervention. Counseling that provides men with healthy coping skills to employ in the face of stressful occupational and economic conditions, in lieu of alcohol use, are needed based on our qualitative findings related to influences of alcohol use. In addition, emphasizing how alcohol reduction and adherence can enhance men's goals towards better health, savings, and providing for their family may increase men's motivation for alcohol reduction. Men in our sample reported intentionally skipping ARV doses when drinking to avoid toxic interactions, which has been reported in other studies (42-44). As there is no empirical support that the toxicity of alcohol is increased when mixed with ART (61-63), this finding highlights an important knowledge gap in our population, suggesting the need for an intervention also aimed to correct misinformation regarding alcohol-related toxicity beliefs.

Our study adds support for a link between alcohol use and missed ARVs; using a mixed methods design allowed us to triangulate the quantitative associations with qualitative narratives, and gain insight into the mechanisms in which alcohol may influence adherence. However, inference of a causal relationship is limited by the cross-sectional design; daily process or event sampling studies are needed to temporally link alcohol-adherence, and quantitatively assess potential mechanisms between the two. Other limitations include the use of self-reported, over biological, measures in our study. Furthermore, a one year recall period for the AUDIT may have weakened the observed associations between alcohol and adherence, measured with a 4-day recall period. Our alcohol measures also required men to estimate the number of drinks they typically consume. While the interviewer explained to participants the typical size of each type of alcohol assessed during the structured interview, men's accuracy in this assessment may have varied. Social desirability may have led to under-reporting of both alcohol use

and missed ARVs, which is highlighted by the high AUDIT scores among men participating in the IDIs but overall consensus that men had significantly reduced their drinking. In addition, we did not use random sampling to recruit participants; therefore, we cannot generalize our findings to the broader population. Though we did capture men struggling with adherence and retention in care, by recruiting men presenting to the clinic, our sample may over-represent men engaged in HIV care. In an attempt to capture men lost-to-follow up, we also recruited men overdue for their clinic appointments via telephone (21% of the sample, n=64), and offered to meet men outside of the clinic for their interviews if they were not willing to come to the clinic. Nevertheless, more research is needed on barriers to care for men lost-to-follow up completely.

Conclusions

As global strategies to end the HIV/AIDS epidemic move towards universal testing and treatment for all (3, 64), efforts to optimize ART adherence, especially with high prevalence populations facing significant barriers to HIV care, are needed. Our findings highlight the need for alcohol-reduction interventions for male fisherfolk on ART in order to improve ART adherence and to prevent the known negative health effects of alcohol for PLHIV (50). The integration of SBI for alcohol reduction into HIV clinical care may be an effective approach to reduce alcohol consumption and improve adherence among men on treatment who drink. Focusing alcohol reduction and adherence intervention efforts on men reporting higher quantities of alcohol consumption may optimize SBI with this population, and alcohol SBI is especially needed for men on twice daily regimens. Future research is needed to understand how to best tailor and implement an alcohol-reduction intervention given the structural challenges for men in the fishing occupation. This study also provides data on men's main motivations for

alcohol use and reduction, which can inform the tailoring of intervention content for fishermen aimed to increase their motivation for behavior change.

Acknowledgements

Chapter 2, in full, is currently being prepared for submission for publication of the material. Sileo KM; Wanyenze RK; Kizito W; Reed E; Stockman JK; Musoke W; Mukasa B; Kiene SM. The dissertation author was the primary investigator and author of this material.

Table 2.1: Participant characteristics, and alcohol and other substance use

	n (%)	Mean	SD	Range
Demographics				
Age		36.9	8.6	20-70
Education				
No schooling	202 (67.3%)			
Primary level	84 (28.0%)			
Secondary level	14 (4.7%)			
Marital status				
Never married	30 (10.0%)			
Divorced	78 (26.0%)			
Widowed	16 (5.3%)			
Married & separated most of the time	29 (9.7%)			
Married & living together most of the time	147 (49.0%)			
Monthly income (converted to USD)		62.2	29.7	4.1- 160.4
Occupation				
Fishermen	246 (82.0%)			
Fish seller, cleaner, dryer	35 (11.7%)			
Boat operator, repairer, loader, other	19 (9.7%)			
Mobility (frequency of travel in prior 12 months)				
No travel	106 (35.3%)			
Once	73 (24.3%)			
2-5 times	91 (30.3%)			
6 or more times	30 (10.0%)			
Travel time to clinic (minutes)		41.4	39.56	2-180
HIV/AIDS variables				
Months since HIV diagnosis		24.6	17.8	4-102
Months since ART initiation		22.9	13.5	2-55
Treatment regimen*				
First line regimen	298 (99.3%)			
TDF+3TC+EFV (Preferred)	260 (87.2%)			
AZT+3TC+EFV	11 (3.7%)			
AZT+3TC+NVP	24 (8.0%)			
TDF+3TC+NVP	3 (1.0%)			
Second line regimen	2 (0.7%)			
TDF/3TC	1 (50.0%)			
AZT+3TC	1 (50.0%)			

Table 2.1: Continued

	n (%)	Mean	SD	Range
Number of pills prescribed per day				
Once daily dosing	260 (86.7%)			
Twice daily dosing	40 (13.3%)			
ART Adherence (% of prescribed pills taken)		87.8%	21.5%	0-100%
Sub-optimal adherence (< 95% of pills taken as prescribed)				
Yes	93 (31.0%)			
No	207 (69.0%)			
Alcohol use				
Type of alcohol typically consumed*				
Ttonto	43 (30.3%)			
Waragi	35 (24.6%)			
Malwa	28 (19.7%)			
Bottled beer	26 (18.3%)			
Any other kind of local brew	8 (5.6%)			
Any other kind of alcohol	1 (1.4%)			
Average number of drinks per day (prior 30 days)*				
4 or more drinks	33 (11.0%)			
1-3 drinks	109 (36.3%)			
No drinking	158 (52.7%)			
AUDIT score		4.5	5.1	0-20
AUDIT score (drinkers only)*		9.0	3.9	2-20
Hazardous alcohol use (AUDIT $\geq$ 8)	92 (30.7%)			
Hazardous alcohol use (AUDIT $\geq$ 8) (drinkers only)*	92 (64.8%)			
High risk alcohol use (AUDIT $\geq$ 16)	8 (2.7%)			
Alcohol dependence (AUDIT $\geq$ 20)	1 (0.30%)			

Note: Adherence calculated based on the proportion of pill taken over a four-day recall period of total pills prescribed, based on the Adult AIDS Clinical Trial Group (AACTG) scale (Chesney et al., 2000). * indicates items assessed only among participants reporting alcohol consumption in the prior 12 months (n=142); AUDIT = Alcohol Use Disorder Identification Test (World Health Organization, 2001); variables calculated from AUDIT score assess alcohol use in the prior year; Ttonto is a locally brewed fermented banana juice, 3% volume/volume percent (v/v), malwa is locally brewed from finger millet, communally shared in single container with straws, 3% v/v; Waragi is traditional gin, 48.4% v/v.

Table 2.1: Continued

	n (%)	Mean	SD	Range
Drug use (excluding alcohol)				
Prescription drug use for non-medical reasons (ever)				
Yes	9 (3.0%)			
No	291 (97.0%)			
Illicit drug use (ever)				
Yes	18 (6.0%)			
No	282 (94.0%)			
Drugs used (ever)				
Cannabis	2 (0.70%)			
Tobacco	15 (5.0%)			
Kuber (stimulant)	7 (2.3%)			
Sisha (stimulant)	5 (1.7%)			
Khat (stimulant)	3 (1.0%)			

Table 2.2: Bivariate associations between independent variables and missed antiretroviral medication

	OR (95% CI)	x²	p
Demographics and HIV variables			
Age	0.96 (0.94-0.98)	12.99	<0.001
Education			
Any schooling	1.58 (1.12-2.22)	6.75	0.01
No schooling (ref)			
Marital status			
Not married or separated	1.05 (0.75-1.46)	0.07	0.79
Married (ref)			
Research site			
Landing site	0.92 (0.66-1.30)	0.21	0.65
Island (ref)			
Monthly income	0.92 (0.84-1.00)	3.86	0.05 [†]
Occupation			
Fishermen	1.03 (0.67-1.56)	0.01	0.91
Other fishing occupation (ref)			
Mobility			
Yes	1.65 (1.14-2.40)	6.92	0.01
No (ref)			
Travel time to clinic	1.13 (1.01-1.26)	4.33	0.04
Months since HIV diagnosis	0.99 (0.94-1.04)	0.86	0.77
Months since ART initiation	0.93 (0.87-1.00)	3.69	0.06 [†]
Number of pills prescribed per day			
Twice daily dosing	0.37 (0.22-0.62)	14.28	<0.001
Once daily dosing (ref)			
Alcohol variables			
Average number of drinks, categorized			
4 or more drinks	2.13 (1.30-3.48)	9.00	0.003
1-3 drinks	1.37 (0.95-1.97)	2.78	0.09 [†]
No drinking (ref)			
Hazardous alcohol use			
Yes (AUDIT $\geq$ 8)	1.39 (0.98-1.98)	3.43	0.06 [†]
No (no drinking and AUDIT <8) (ref)			

Note: Bold text indicates associations $p < .05$; [†] $p < .10$; OR: Odds Ratio; x^2 = Wald chi square; AUDIT = Alcohol Use Disorder Identification Test; ART = antiretroviral treatment; ref = reference group; Monthly income: 1 unit = 50,000 UGX; Travel time to clinic: 1 unit = 30 minutes; Months since HIV diagnosis: 1 unit = 6 months; Months since ART initiation: 1 unit = 6 months.

Table 2.3: Multivariate models testing associations between average number of drinks per day and missed antiretroviral medication

	AOR (95% CI)	x²	p
Age	0.96 (0.94-0.99)	10.41	0.001
Education			
Any schooling	1.46 (1.03-2.07)	4.55	0.03
No schooling (ref)			
Number of pills			
Twice daily dosing	0.25 (0.09-0.63)	8.52	0.004
Once daily dosing (ref)			
Average drinks/day			
4 or more drinks	1.71 (1.01-2.91)	3.86	0.04
1-3 drinks	1.27 (0.85-1.89)	1.42	0.23
No drinking (ref)			
Number of pills x Average drinks/day			
Twice daily dosing x 4 or more drinks	5.65 (1.25-25.63)	5.04	0.02
Twice daily dosing x 1-3 drinks	2.32 (0.69-7.80)	1.86	0.17
No drinking (ref)			

Note: Bold text indicates associations $p < .05$; AOR: Adjusted Odds Ratio; x^2 = Wald chi square; ref = reference group.

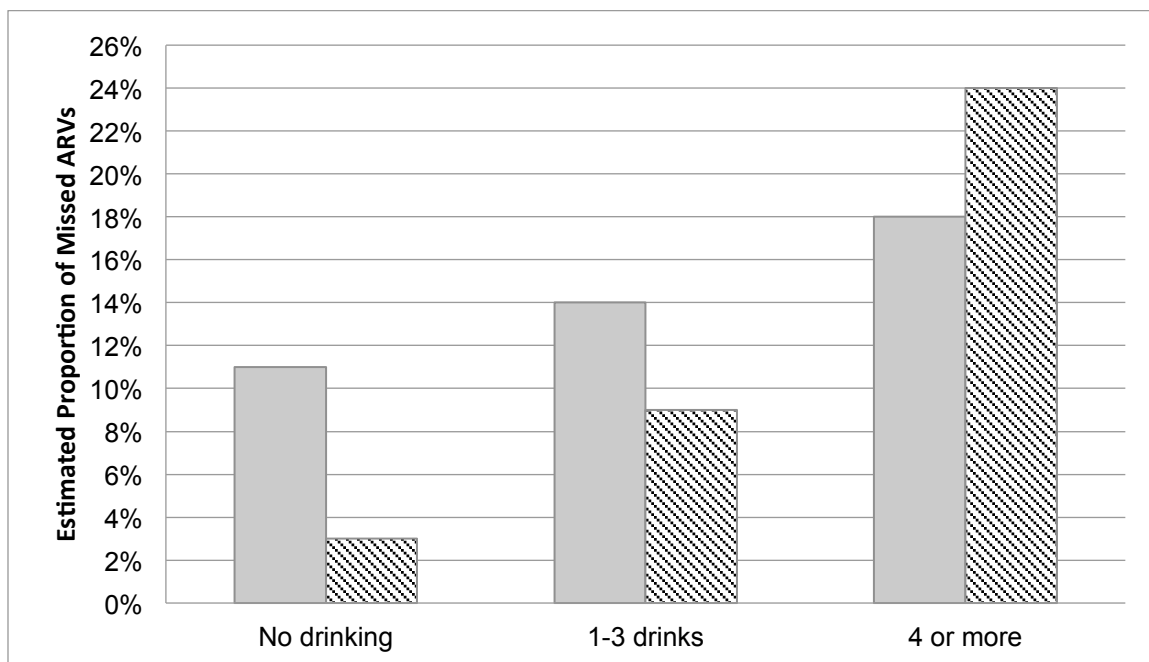


Figure 2.1: Interaction between average number of drinks and pills prescribed per day on the proportion of missed pills over a 4-day recall period, controlling for covariates.

The odds of missed ARVs increases with increased number of drinks consumed regardless of number of pills taken, but alcohol affects men taking twice daily dosing greater than those taking once daily dosing. Men taking twice daily dosing and consuming an average of 4 or more drinks were nearly six times as likely to report missed antiretrovirals (ARVs) than men taking twice daily dosing but reporting no drinking (AOR: 5.65, 95% CI: 1.25-25.63, $p = 0.03$). No interaction with number of pills was identified for men drinking 1-3 drinks compared to no drinking. Covariates were fixed at their mean value. Full statistics reported in Table 2.3.

Table 2.4: Multivariate models testing associations between hazardous drinking and missed antiretroviral medication, Uganda 2016-17, N=300

	AOR (95% CI)	x²	p
Age	0.96 (0.94-0.99)	9.68	0.002
Education			
Any schooling	1.54 (1.08-2.18)	5.75	0.02
No schooling (ref)			
Number of pills			
Twice daily dosing	0.26 (0.12-0.55)	12.66	<0.001
Once daily dosing (ref)			
Any hazardous drinking			
Yes	1.10 (0.75-1.61)	0.23	0.63
No (ref)			
Hazardous drinking x Number of pills	4.91 (1.68-14.37)	1.68	0.004

Note: Bold text indicates associations $p < .05$; AOR: Adjusted Odds Ratio; x^2 = Wald chi square; hazardous alcohol use is defined as AUDIT score equal or greater to 8 and no hazardous alcohol use defined as AUDIT score less than 8; ref = reference group.

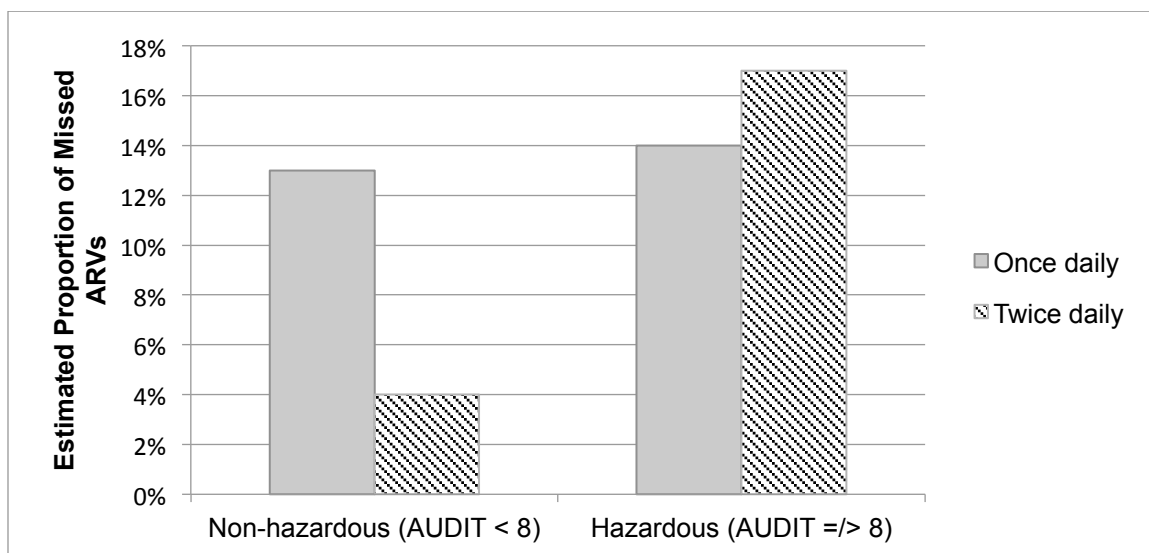


Figure 2.2: Interaction between any hazardous alcohol use and pills prescribed per day on the proportion of missed pills over a 4-day recall period, controlling for covariates. Men taking twice daily dosing and reporting hazardous alcohol use were nearly five times as likely to report missed antiretrovirals (ARVs) than men taking twice daily dosing but reporting no hazardous alcohol use (AOR: 4.91, 95% CI: 1.68-14.37, $p = 0.004$). Covariates were fixed at their mean value. Full statistics reported in Table 2.4.

Table 2.5: Major themes from qualitative exploration of motivation for alcohol use and the intersection of alcohol and HIV/AIDS with select representative quotations

Context of substance use: Setting, company, and motivation
Social • Social activity and peer influence from other males ○ <i>"I don't have any serious reason why I take alcohol other than hanging out with friends chatting and then maybe one says, 'You should get a bottle on my bill'"</i> (Fisherman, age 37). • "Partying" (binge drinking, dance bars) and to meet women ○ <i>"In order to start a conversation with her, you need to buy alcohol for her. This continues for all the drinking days, where women come in, and we order [alcohol] to continue talking with them. We do it under the influence of alcohol"</i> (Fisherman, age 27). Occupational • The culture of fishermen ○ <i>"With us the fishermen, alcohol is part of our daily lives"</i> (Fisherman, age 25). • To cope with working conditions (long working hours, being on the lake overnight, to help sleep in off-hours, to deal with the cold and winds) ○ <i>"If you don't take any alcohol you would feel so cold while on the lake; you wouldn't feel comfortable unless you take some alcohol for your body to feel okay"</i> (Fisherman, age 29). • Influx of cash from fishing, and perception that fisherfolk have difficulty saving Stress relief • To cope with the following stressors: ○ Marital and other interpersonal conflict ○ Financial worries ○ Coping with HIV-related stress (being diagnosed with HIV, grief from lost loved ones who died from HIV, and HIV-related stigma) ▪ <i>"Some of my friends mock me that I am on ARVs, and any time you are going to die. This mockery prompts me to take alcohol such that I can do away with the stigmatizing statements from my friends, which later relaxes my mind"</i> (Fisherman, age 23).

Table 2.5: Continued
HIV and Alcohol

Change since diagnosis in alcohol consumption

- Reduction in drinking since being diagnosed with HIV reported by the majority, with the exception of a smaller proportion of men reporting no change, or a temporary increase after diagnosis.

Effect of ART on adherence

- Awareness that PLHIV should avoid or reduce alcohol use; mainly from health providers
- Cited as a major barrier to ART adherence, affecting adherence through two pathways:
 1. Forgetting doses when drinking
 - *"When I go to take alcohol out there, in most cases, I do forget taking my medication...by the time I go back home to take my medication, I find that the time for taking it had elapsed...which worries me"* (Fisherman, age 23).
 2. Intentional skipping of doses when drinking, to avoid side effects/negative interactions
 - *It is not that I just forget to take my medication, but just fear that since I have taken some alcohol or since am drunk, if I swallow my medication I would go through a very bad experience. That is only when I would choose not to swallow medication, because I have taken some alcohol or because am drunk"* (Fisherman, age 37).
- Men reporting no effect on their adherence reported either reducing their alcohol use, or make intentional efforts to plan their drinking around their ART doses
 - *"It [alcohol] doesn't affect me, because I swallow my drugs at 8:00 PM and 8:00 AM, so if I plan to drink some alcohol at 8:00 PM, I would wait three hours after swallowing those drugs to allow them flow in the body and then go and take some alcohol"* (Fisherman, age 38).

Reasons for alcohol reduction/quitting

- Men's HIV status and health
 - Influenced by counselors
 - *Well the period in which I missed taking my medication was when I hadn't yet received a sufficient counseling session from the care providers and yet in that period I was using alcohol. Sometimes I drank and forgot taking my medication! It was until the care providers gave me the right counseling session and told me to quit alcohol* (Fisherman, age 30).

Table 2.5: Continued

Reasons for alcohol reduction/quitting
• To save money, to better fulfill their role of father and provider, and for their general health ○ <i>Having HIV has on the other hand helped me, because I was wasting a lot of money and yet not benefiting at all. Now that I started taking my pills, let me protect myself to see that I get money to build my son a house...It [HIV] has reduced on my usage of all those substances like Kuba and alcohol, and has also made it possible to save money to build my son a home (Boat Loader, age 30).</i> ○ <i>I reduced on the alcohol that I take. In the past I used to drink a lot but when I found out that I have been infected with HIV, I chose to reduce on alcohol since I would have a longer time taking care of my children (Fisherman, age 38).</i>

References

1. World Health Organization. Consolidated guidelines on the use of antiretroviral drugs for treating and preventing HIV infection. Geneva, Switzerland: WHO; 2013.
2. Cohen MS, Chen YQ, McCauley M, Gamble T, Hosseinipour MC, Kumarasamy N, et al. Prevention of HIV-1 infection with early antiretroviral therapy. *N Engl J Med*. 2011;365(6):493-505.
3. World Health Organization. Consolidated Guidelines on the Use of Antiretroviral Drugs for Treating and Preventing HIV Infection: Recommendation for a Public Health Approach. Second Edition. Geneva: WHO; 2016.
4. Uganda MOH. Addendum to the National Antiretroviral Treatment Guidelines. Kampala, Uganda: Uganda Ministry of Health; 2013.
5. Seeley J, Nakyingi-Miir J, Kamali A, Mpendo J, Asiki G, Abaasa A, et al. High HIV incidence and socio-behavioral risk patterns in fishing communities on the shores of Lake Victoria, Uganda. *Sex Transm Dis*. 2012;39(6):433-9.
6. Chang LW, Grabowski MK, Ssekubugu R, Nalugoda F, Kigozi G, Nantume B, et al. Heterogeneity of the HIV epidemic in agrarian, trading, and fishing communities in Rakai, Uganda: an observational epidemiological study. *Lancet*. 2016;3(3):8.
7. Opio A, Muyonga M, Mulumba N. HIV infection in fishing communities of Lake Victoria basin of Uganda – a cross-sectional sero-behavioral survey. *PLoS ONE*. 2013;8(8):e70770.
8. Uganda MOH, ICF International. Uganda AIDS Indicator Survey (AIS) 2011. Kampala, Uganda; Calverton, Maryland, USA: MOH and ICF International; 2012.
9. Kiwanuka N, Ssetaala A, Nalutaaya A, Mpendo J, Wambuzi M, Nanvubya A, et al. High Incidence of HIV-1 infection in a general population of fishing communities around Lake Victoria, Uganda. *PLoS ONE*. 2014;9(5):e94932.
10. Ortego C, Huedo-Medina TB, Llorca J, Sevilla L, Santos P, Rodriguez E, et al. Adherence to highly active antiretroviral therapy (HAART): a meta-analysis. *AIDS Behav*. 2011 Oct;15(7):1381-96. doi: 10.1007/s10461-011-9942-x.
11. Cornell M, McIntyre J, Myer L. Men and antiretroviral therapy in Africa: our blind spot. *Trop Med Int Health*. 2011;16(7):828-9.
12. Shand T, Thomson-de Boer H, van den Berg W, Peacock D, Pascoe L. The HIV blind spot: men and HIV testing, treatment and care in Sub-Saharan Africa. *IDS Bulletin*. 2014;45(1):53-60.

13. Beckham SW, Beyrer C, Luckow P, Doherty M, Negussie EK, Baral SD. Marked sex differences in all-cause mortality on antiretroviral therapy in low- and middle-income countries: a systematic review and meta-analysis. *J Int AIDS Soc.* 2016;19(1):21106.
14. Sileo K, Kintu M, Chanes-Mora P, Kiene S. "Such behaviors are not in my home village, I got them here": a qualitative study of the influence of contextual factors on alcohol and HIV risk behaviors in a fishing community on Lake Victoria, Uganda. *AIDS Behav.* 2016;20(3):537-47.
15. Seeley JA, Allison EH. HIV/AIDS in fishing communities: challenges to delivering antiretroviral therapy to vulnerable groups. *AIDS Care.* 2005;17(6):688-97.
16. Tumwesigye NM, Atuyambe L, Wanyenze RK, Kibira SP, Li Q, Wabwire-Mangen F, et al. Alcohol consumption and risky sexual behaviour in the fishing communities: evidence from two fish landing sites on Lake Victoria in Uganda. *BMC Public Health.* 2012;12:12.
17. Smolak A. A meta-analysis and systematic review of HIV risk behavior among fishermen. *AIDS Care.* 2013;26(3):282-91.
18. Asiki G, Mpendo J, Abaasa A, Agaba C, Nanvubya A, Nielsen L, et al. HIV and syphilis prevalence and associated risk factors among fishing communities of Lake Victoria, Uganda. *Sex Transm Dis.* 2011;87(6):511-5.
19. Samet JH, Cheng DM, Libman H, Nunes DP, Alperen JK, Saitz R. Alcohol consumption and HIV disease progression. *J Acquir Immune Defic Syndr.* 2007;46(2):194-9.
20. Kahler CW, Liu T, Cioe PA, Bryant V, Pinkston MM, Kojic EM, et al. Direct and indirect effects of heavy alcohol use on clinical outcomes in a longitudinal study of HIV patients on ART. *AIDS Behav.* 2017;21(7):1825-1835. doi: 10.1007/s10461-016-1474-y.
21. Baum MK, Rafie C, Lai S, Sales S, Page JB, Campa A. Alcohol use accelerates HIV disease progression. *AIDS Res Hum Retrovir.* 2010;26(5):511-8.
22. Kader R, Govender R, Seedat S, Koch JR, Parry C. Understanding the impact of hazardous and harmful use of alcohol and/or other drugs on ARV adherence and disease progression. *PLOS ONE.* 2015;10(5):e0125088.
23. Hendershot CS, Stoner SA, Pantalone DW, Simoni JM. Alcohol use and antiretroviral adherence: review and meta-analysis. *J Acquir Immune Defic Syndr.* 2009;52(2).
24. Babor TF, Higgins-Biddle JC, Saunders JB, Monteiro MG. The alcohol use disorders identification test: guidelines for use in primary care. Geneva: World Health Organization; 2001.
25. Wandera B, Tumwesigye NM, Nankabirwa JI, Kambugu AD, Parkes-Ratanshi R, Mafigiri DK, et al. Alcohol consumption among HIV-infected persons in a large urban HIV

clinic in Kampala Uganda: a constellation of harmful behaviors. PLoS ONE. 2015;10(5):e0126236.

26. Hahn JA, Emenyonu NI, Fatch R, Muyindike WR, Kekiibina A, Carrico AW, et al. Declining and rebounding unhealthy alcohol consumption during the first year of HIV care in rural Uganda, using phosphatidylethanol to augment self-report. *Addiction*. 2016;111(2):272-9.

27. Kiwanuka N, Ssetaala A, Ssekandi I, Nalutaaya A, Kitandwe PK, Ssempiira J, et al. Population attributable fraction of incident HIV infections associated with alcohol consumption in fishing communities around Lake Victoria, Uganda. *PLoS One*. 2017;12(2):e0171200. doi: 10.1371/journal.pone.0171200. eCollection 2017.

28. Bogart LM, Naigino R, Maistrellis E, Wagner GJ, Musoke W, Mukasa B, et al. Barriers to linkage to HIV care in Ugandan fisherfolk communities: a qualitative analysis. *AIDS Behav*. 2016;20(10):2464-76.

29. Tumwesigye NM, Wanyenze RK, Greenfield TK. Intoxication before last sexual encounter and HIV risk behavior among men and women in Uganda: evidence from a nationwide survey. *Int J Alcohol Drug Res*. 2012;1(1):17.

30. Parsons JT, Rosof E, Mustanski B. The temporal relationship between alcohol consumption and HIV-medication adherence: a multilevel model of direct and moderating effects. *Health Psychol*. 2008;27(5):628-37.

31. Morse JM, Niehaus L. *Mixed Methods Design: Principles and Procedures*. Walnut Creek, CA: Left Coast Press, Inc.; 2009.

32. The World Health Organization (WHO). *The Alcohol Use Disorders Identification Test: Guidelines for Use in Primary Care*. Geneva: WHO; 2001.

33. Braithwaite RS, McGinnis KA, Conigliaro J, Maisto SA, Crystal S, Day N, et al. A temporal and dose-response association between alcohol consumption and medication adherence among veterans in care. *Alcohol Clin Exp Res*. 2005;29(7):1190-7.

34. Tumwesigye NM, Rogers K. *Gender, Alcohol, and Culture International Study (GENACIS) in Uganda; Uganda Country Report*. 2003.

35. National Institute of Alcohol Abuse and Alcoholism. What is a Standard Drink?: Overview of Alcohol Consumption. Retrieved from: <https://www.niaaa.nih.gov/alcohol-health/overview-alcohol-consumption/what-standard-drink>. Accessed on 3 Sept 2017.

36. National Institute on Drug Abuse (NIDA). NIDA-Modified ASSIST V2.0. Retrieved from: [https://www.drugabuse.gov/sites/default/files/files/QuickScreen_Updated_2013\(1\).pdf](https://www.drugabuse.gov/sites/default/files/files/QuickScreen_Updated_2013(1).pdf).

37. Chesney MA, Ickovics JR, Chambers DB, Gifford AL, Neidig J, Zwickl B, et al. Self-reported adherence to antiretroviral medications among participants in HIV clinical trials: The AACTG adherence instruments. *AIDS Care*. 2000;12(3):255-66.

38. Oyugi JH, Byakika-Tusiime J, Ragland K, Laeyendecker O, Mugerwa R, Kityo C, et al. Treatment interruptions predict resistance in HIV-positive individuals purchasing fixed-dose combination antiretroviral therapy in Kampala, Uganda. *AIDS*. 2007;21(8):965-71 10.1097/QAD.0b013e32802e6bfa.
39. Howell DC. Statistical methods in human sciences. New York: Wadsworth; 1998.
40. Smith CP. Content Analysis and Narrative Analysis. In: T. RH, M. JC, editors. *Handbook of Research Methods in Social and Personality Psychology*. New York: Cambridge University Press; 2000. p. 313-35.
41. Braithwaite RS, Conigliaro J, McGinnis KA, Maisto SA, Bryant K, Justice AC. Adjusting alcohol quantity for mean consumption and intoxication threshold improves prediction of nonadherence in HIV patients and HIV-negative controls. *Alcohol Clin Exp Res*. 2008;32(9):1645-51.
42. Sankar A, Wunderlich T, Neufeld S, M. L. Sero-positive African Americans' beliefs about alcohol and their impact on antiretroviral adherence. *AIDS Behav*. 2007;11:195-203.
43. Kalichman SC, Amaral CM, White D, Swetsze C, Pope H, Kalichman MO, et al. Prevalence and clinical implications of interactive toxicity beliefs regarding mixing alcohol and antiretroviral therapies among people living with HIV/AIDS. *AIDS Patient Care STDS*. 2009;23(6):446-59.
44. Kalichman SC, Grebler T, Amaral CM, McNerey M, White D, Kalichman MO, et al. Intentional non-adherence to medications among HIV positive alcohol drinkers: prospective study of interactive toxicity beliefs. *J Gen Intern Med*. 2013;28(3):399.
45. Sileo KM, Simbayi LC, Abrams A, Cloete A, Kiene SM. The role of alcohol use in antiretroviral adherence among individuals living with HIV in South Africa: event-level findings from a daily diary study. *Drug Alcohol Depend*. 2016;167:103-11.
46. Tucker JS, Burnam MA, Sherbourne CD, Kung FY, Gifford AL. Substance use and mental health correlates of nonadherence to antiretroviral medications in a sample of patients with human immunodeficiency virus infection. *Am J Med*. 2003;114(7):573-80.
47. Samet JH, Horton NJ, Meli S, Freedberg KA, Palepu A. Alcohol consumption and antiretroviral adherence among HIV-infected persons with alcohol problems. *Alcohol Clin Exp Res*. 2004;28(4):572.
48. Samet JH, Cheng DM, Libman H, Nunes DP, Alperen JK, Saitz R. Alcohol consumption and HIV disease progression. *J Acquir Immune Defic Syndr*. 2007;46(2):194-9.
49. Truong WR, Schafer JJ, Short WR. Once-daily, single-tablet regimens For the treatment of HIV-1 infection. *P T*. 2015;40(1):44-55.

50. Braithwaite RS, Bryant KJ. Influence of alcohol consumption on adherence to and toxicity of antiretroviral therapy and survival. *Alcohol Res Health*. 2010;33(3):280-7.
51. Babor TF, McRee BG, Kassebaum PA, Grimaldi PL, Ahmed K, Bray J. Screening, brief intervention, and referral to treatment (SBIRT). *Substance Abuse*. 2007;28(3):7-30.
52. Kaner EF, Dickinson HO, Beyer FR. Effectiveness of brief alcohol interventions in primary care populations (review). *Cochrane Database Syst Rev*. 2007;2.
53. Carney T, Myers BJ, Louw J, Okwundu CI. Brief school-based interventions and behavioural outcomes for substance-using adolescents. *Cochrane Database Syst Rev*. 2016(1):Cd008969.
54. Mertens JR, Ward CL, Bresick GF, Broder T, Weisner CM. Effectiveness of nurse-practitioner-delivered brief motivational intervention for young adult alcohol and drug use in primary care in South Africa: a randomized clinical trial. *Alcohol Alcohol*. 2014;49(4):430-8.
55. L'Engle KL, Mwarogo P, Kingola N, Sinkela W, Weiner DH. A randomized controlled trial of a brief intervention to reduce alcohol use among female sex workers in Mombasa, Kenya. *J Acquir Immune Defic Syndr*. 2014;67(4):446-53.
56. Pengpid S, Peltzer K, van der Heever H, Skaal L. Screening and brief interventions for hazardous and harmful alcohol use among university students in South Africa: results from a randomized controlled trial. *International journal of environmental research and public health*. 2013;10(5):2043-57.
57. Peltzer K, Naidoo P, Louw J, Matseke G, Zuma K, McHunu G, et al. Screening and brief interventions for hazardous and harmful alcohol use among patients with active tuberculosis attending primary public care clinics in South Africa: results from a cluster randomized controlled trial. *BMC Public Health*. 2013;13:699.
58. Pengpid S, Peltzer K, Skaal L, Van der Heever H. Screening and brief interventions for hazardous and harmful alcohol use among hospital outpatients in South Africa: results from a randomized controlled trial. *BMC Public Health*. 2013;13:644.
59. Rendall-Mkosi K, Morojele N, London L, Moodley S, Singh C, Girdler-Brown B. A randomized controlled trial of motivational interviewing to prevent risk for an alcohol-exposed pregnancy in the Western Cape, South Africa. *Addiction*. 2013;108(4):725-32.
60. Substance Abuse and Mental Health Services (SAMHSA). AUDIT-C - Overview, Screening Tools. Retrieved from: https://www.integration.samhsa.gov/images/res/tool_auditc.pdf.
61. Neuman MG, Schneider M, Nanau RM, Parry C. HIV-Antiretroviral Therapy Induced Liver, Gastrointestinal, and Pancreatic Injury. *Int J Hepatol*. 2012(760706).

62. Price JC, Thio CL. Liver disease in the HIV infected individual. Clin Gastroenterol Hepatol.8(12):1002-12.
63. Szabo G, Zakhari S. Mechanisms of alcohol-mediated hepatotoxicity in human-immunodeficiency-virus-infected patients. World J Gastroenterol 2011;17(20):2500-6.
64. UNAIDS. 90-90-90: An ambitious treatment target to help end the AIDS epidemic. Geneva: UNAIDS; 2014.

CHAPTER 3: The role of norms of masculinity and gender roles on HIV care engagement

Abstract

Background: Norms of masculinity are recognized as an important driver of men's engagement in HIV care in sub-Saharan Africa. Ugandan fishermen are characterized as a hyper-masculine population at high risk for HIV, and are being prioritized for the scale up of universal HIV testing and treatment. This qualitative study explores the intersection of norms of masculinity and HIV care engagement among fishermen on antiretroviral therapy (ART) in Wakiso District, Uganda.

Methods: We conducted 30 in-depth interviews with men on ART recruited from HIV treatment sites between October 2016 and March 2017, and used a content analysis approach to qualitative analysis.

Results: Since HIV diagnosis and ART initiation, men had adopted masculine identities more conducive with HIV care engagement. Men's role as worker and provider, as husband and sexual partner, and the appearance of physical strength were compromised by HIV, but restored by ART's positive effects on health. Men's role among other male peers also emerged as a facilitator to HIV care, with men supporting each other to seek testing and treatment. However, structural and occupational barriers to HIV care associated with men's role as worker remained a barrier to care engagement.

Conclusions: Our findings suggest emphasizing the benefits of ART on bolstering men's ability to fulfill the roles important to them may improve the effectiveness of HIV testing and treatment messaging for men. Our findings also suggest

the potential for structural-level health service interventions and community-level gender transformative programming to help fishermen engage in HIV care.

Introduction

Epidemiologic studies in sub-Saharan Africa (SSA) have brought to light a significant gender gap across the HIV care continuum (1-4). Despite men's higher social status and greater access to resources, such as education, income, and household decision-making (5), HIV infected men are more likely to access care at an advanced disease stage and have worse treatment outcomes among those in care, including higher mortality compared to HIV infected women (1-4). Norms of masculinity, or social expectations about appropriate roles and behavior for men (6), are recognized as an important driver of men's health behaviors generally (6-9), and a contributing factor to HIV infection among men (10-14). However, more research is needed to understand the ways norms of masculinity may interfere with HIV care engagement and treatment outcomes for HIV-infected men to ultimately inform programming to help men, especially high-risk men, be engaged in HIV care.

Ugandan fisherfolk living and working in Lake Victoria communities are considered a priority population for HIV prevention and treatment efforts in Uganda (15), with prevalence estimated to be as high as 40% (16-18). In addition to numerous structural and social barriers to accessing HIV care, such as frequent mobility and alcohol use (19-21), fishing villages have been characterized as "hyper-masculine" environments (22, 23). Though the construction of masculinity and men's roles has not been empirically studied in this setting, the occurrence of heavy alcohol use and transactional sex have been attributed to masculine norms promoting risk behavior (20, 21, 24), which may also be harmful to men's engagement in HIV care.

Several studies by Siu and colleagues (25-28) have qualitatively examined masculine norms and men's engagement in HIV care in Ugandan mining towns, which are similar to fishing villages in that both report elevated HIV prevalence and are comprised of young and/or single men clustered for work. The authors' draw on Connell's (29, 30) concept of hegemonic masculinity, which is the societal ideal of male roles and traits in a culture that shape both men and women's behavior and the power dynamics between them. They also draw from Wilson's (31) early ethnographic work, which contests that two dominant forms of hegemonic masculinity exist across cultural settings. The ideal "reputation-based" masculine identity includes the belief that males should be dominant over women, aggressive, sexually successful with women, and be perceived as strong and powerful, and in turn healthy (26, 27, 32, 33). Whereas the "respectability-based" masculine identity emphasizes the role of men as providers, and the expectation that men ensure the survival of the family line through childbearing (26, 27, 33). The authors conclude that these different masculine ideologies correspond with Ugandan miners' treatment seeking behaviors. Men adhering to reputation-based gender roles related to strength and sexual prowess were less likely to engage in HIV care. The clinic was viewed as a place for women, and men feared disclosure of their HIV status would make them appear weak and make them less competitive in finding sexual partners compared to HIV negative men (25, 26). In contrast, men whose masculine ideals were centered on the traditional role of father and provider were motivated by these roles to stay healthy by seeking testing and treatment (25-27).

A recent systematic review of 23 qualitative studies across 10 countries in SSA similarly supports norms of masculinity as both barriers and facilitators to HIV care engagement, but found specific norms of masculinity can dually serve as both barriers and facilitators (34). For example, while notions of the "respectability-based" masculine

identity did emerge as a facilitator to care for men who believed antiretroviral treatment (ART) would allow them to reassume masculine roles and relationships, these same norms served as barriers to care for other men. Specifically, men who fear that HIV would threaten these traditional roles avoid HIV testing, treatment uptake, and clinic attendance. Other masculine notions that served as barriers to HIV testing, treatment uptake, and ART adherence included strength and self-reliance, emotional inexpressiveness, and sexual success with women. However, some of these norms similarly emerged as motivating for HIV care engagement in different settings and contexts.

The present study aims to extend current understanding of the association between norms of masculinity and HIV care engagement outcomes by exploring these relationships among fishermen living with HIV in Uganda. The literature suggests norms of masculinity can dually serve as barriers and facilitators to men's engagement in care. Further investigation is needed on the specific circumstances and contexts in which these norms emerge as a facilitator versus a barrier to care. Moreover, fisherfolk represent a high HIV risk population gaining access to widespread HIV testing and the scale up of ART, but for whom little data exist on their level of engagement or specific barriers to HIV care, making them an important population to study. We conducted qualitative in-depth interviews (IDIs) with men on ART to explore the construction of masculinity and men's roles. We examine how HIV and ART affect men's roles, and how notions of masculinity influence men's engagement in HIV care. We hypothesized that for men who view HIV as a threat to their masculine identities related to strength, respect, and sexual successful with women, and their ability to provide/work, reproduce, and marry, would have poorer men's engagement in HIV care. However, we anticipated

these roles would also serve as facilitators to care for men aware of the benefits of ART on their ability to serve as a provider, husband, and father.

Methods

This qualitative study was conducted with HIV infected fishermen and other male fisherfolk on ART in Wakiso District, Uganda. All recruitment activities were done in partnership with Mildmay Uganda, a non-governmental organization that supports the Ugandan Ministry of Health to provide free HIV testing and treatment across Uganda. Participants were drawn from a sample of patients attending Mildmay-supported outreach clinics and public health facilities serving large populations of fisherfolk. There were seven research sites in total, including three sites on land (Kasenyei outreach site, Entebbe Hospital, Kigungu Health Center III) and four island sites on Bussi, Zzinga, and Kachanga Islands (Rapha Health Center, ZZinga Island outreach site, Bussi Health Center, Kachanga Island outreach site).

Recruitment and data collection occurred between October 2016 and March 2017, and was part of a larger mixed methods study that included a quantitative questionnaire with a total sample of 300 men. The data analyzed and presented for this paper includes a subsample of those men completing an IDI (n=30). During HIV clinic days, clinic staff and a trained male research assistant (RA) reviewed clinic records to pre-screen for eligible participants, and non-randomly approached potentially eligible men for further screening. Men were also informed of the study during routine reminder phone calls for upcoming or missed appointments from clinic staff. Patients were eligible to participate in IDIs if they first consented and participated in the quantitative portion of the study, which had the following inclusion criteria: male, at least 18 years of age, fisherman or another occupation supporting the fish industry, HIV infected, on ART for at

least 6 months (to assess adherence). For participation in IDIs, we additionally ensured that at least half of men participating reported difficulty with adherence (self-reporting any missed pills in prior 4 days) and reported any alcohol use in the prior 30 days, in order to explore barriers to ART adherence and the role of alcohol use, which is examined in a separate paper (35). Of the 35 eligible men invited to participate in the IDI, 5 declined participation due to time constraints.

The same male RA carried out all data collection procedures, including recruitment, informed consent, and conducting IDIs. The RA was fluent in English and Luganda, experienced in qualitative data collection, and received further training from the first author. Due to low literacy in the population, the consent form was read aloud to participants, and participants provided a signature or thumbprint to designate informed consent with a witness present. Men then completed a one-on-one IDI with the RA in either English or Luganda (participant's preference). The IDI was conducted in a private setting in the clinic or another agreed upon location, which was audio recorded and lasted approximately 40 minutes. We enrolled men until saturation was reached, which was determined by consultation with the RA and on-going review of the transcribed interviews by the first author. Men received 15,000 Ugandan Shillings (~4 USD) for participating in the IDI. All procedures were approved by San Diego State University's and Makerere School of Public Health's institutional review boards, as well as the Uganda National Council for Science and Technology.

Measures

For the larger study in which our qualitative sample was recruited, participants completed an interviewer-administered quantitative questionnaire with the overall aim of assessing men's level of HIV care engagement (36). In the present paper, we include

selected data from this questionnaire to characterize the sample of 30 men completing IDIs; primarily, socio-demographic characteristics (age, marital status, education, monthly income, months since HIV diagnosis and ART initiation) and items to characterize their overall engagement in HIV care, including their self-reported ART adherence and the proportion of HIV clinic appointments kept over the prior year. The Adult AIDS Clinical Trial Group (AACTG) scale was used to measure self-reported ART adherence (37). The AACTG includes recall questions about ARVs missed for the previous four days prior to the interview and has demonstrated construct validity in Uganda and similar settings (38). We operationalize adherence as the proportion of ARVs taken in the prior four days, out of the total ARVs prescribed, and also report adherence categorized into sub-optimal vs. optimal adherence, with sub-optimal defined as <95% of ARVs taken. We also measured clinic attendance, by extracting the following data from participants' HIV clinic records: the number of clinic visits participants were scheduled for, and the number of those kept as scheduled, in the prior year. We calculated retention as the proportion of kept appointments in the prior year for analysis.

The IDIs followed a semi-structured interview guide, modeled after an interview protocol used for a study with a similar aim in South Africa (11), but adapted for our specific population. Our guide included questions to assess the construction of masculinity, by asking what it means to be a man and what roles men are expected to fulfill in the community. We also asked men to name up to three roles that they felt were the most important to them to fulfill presently or in the future (e.g., fatherhood, fisherman, sexual partner). We probed further into how being diagnosed with HIV affected the participant's sense of manhood and ability to fulfill each of the roles they named. We then asked men to describe how taking ART had positively or negatively affected these roles and how these roles affected their ability to take ART, probing for specific

examples and narratives when possible. This line of questioning was intended to elicit prevalent notions of masculinity and men's expected roles in our sample, and how these constructs might impede or bolster their engagement in HIV care. While we asked about HIV care engagement generally, we focused specifically on ART adherence and HIV clinic attendance.

Data analysis plan

We used frequencies and descriptive statistics in SPSS version 24 to characterize the sample's sociodemographics (e.g., age, education, occupation), and HIV care engagement (ART adherence, clinic attendance).

The RA that conducted the IDIs transcribed and translated verbatim 17 of the 30 audio files from Luganda to English. An additional translator transcribed and translated 13 of the 30 IDIs, with the RA reviewing transcripts if the translator reported any difficulty. We used a content analysis approach to analyze the transcripts (39). We first developed a coding scheme a priori to identify notions of masculinity, informed by Connell's Theory of Hegemonic Gender Roles and Theory of Gender and Power (29, 30) and an existing systematic review of the literature on norms of masculinity and HIV care engagement specific to SSA (34). After reviewing the transcribed data, the coding scheme was modified based on the data. Data were extracted and the narratives coded to indicate the notion of masculinity referenced (e.g., provider, strength), the stage of HIV care referenced (e.g., ARV adherence, clinic attendance), and whether the notion of masculinity had a positive or negative influence on men's engagement (i.e., barrier vs. facilitator). We iteratively reviewed the coded data to identify major themes.

Results

Participant characteristics

Thirty men participated in our study. The average age of men in our sample was approximately 34 years (mean=33.8, SD=6.1). Nearly half of men were married and living with their spouse (46.7%); the other half were never married, divorced, widowed, or separated. The majority of men reported no schooling (60.0%) and 90.0% of men were employed as fishermen, with only three men in other fishing occupations (fish seller, boat operator, boat loader). Men's average monthly income was the equivalent of approximately 75.3 USD (SD=51.3). The mean time spent traveling to the HIV clinic was nearly one hour (mean=58.8 minutes, SD=56.6), and men had been aware of their HIV status for an average of 21.4 months (SD=10.0), and initiated ART soon after diagnosis (mean=18.9 months, SD=19.5). In the prior year, men had kept only half (51.9%, SD=34.8%) of their HIV clinic appointments as scheduled. Over the four-day recall period, men reported taking on average 70.8% of their prescribed ARV pills, with 60.0% of men classified as "sub-optimally adherent" (< 95% of pills taken as prescribed). Participant characteristics are reported in detail in Table 3.1.

Qualitative findings

The construction of masculinity

IDIs revealed men's definitions of masculinity centered on their expected and desired roles in their communities, which consistently included being a financial provider (for wife, children, extended family), father, husband, and worker. Secondary roles included having a place among male peers, heterosexual relationships with women, and being recognized as a community leader. Tangible signifiers of success as a man included having savings, home and land ownership, having children, the ability to

provide an education for children, the ability to do physical labor, and owning a boat or a small business to generate revenue. Sexual success with women also emerged as a signifier of manhood, though less frequently. The most common traits of an ideal man cited included being physically strong, brave, reliable, having a strong work ethic and entrepreneurial skills, and being respected. For example, one fisherman (age 31) described an ideal man as follows: *“That’s when one has got a wife, children. He should also be able to support his family...He should be having developments; for example, businesses that he can show...I think an ideal man is one who is sexually active.”*

Masculinity, HIV/AIDS, and engagement in HIV care

Though men shared a number of ways in which living with HIV/AIDS had both positively and negatively affected their masculinity, the general consensus was that being diagnosed with HIV had overall positive effects on their lives and overtime transformed their definition of what it means to be a man. In the next sections, we describe the notions of masculinity/gender roles that emerged as influencing HIV care engagement, and how both living with HIV and ART has affected these roles, which are presented by most to least frequently endorsed. A reoccurring theme across categories is how ART helped men overcome masculinity-related barriers and transform their definition of masculinity to embrace healthy behaviors and HIV care engagement. Supportive quotations are presented throughout each section.

Men’s role of provider and worker, and ART’s restorative effects. The most commonly cited facilitator to HIV care engagement was men’s desire to fulfill their role as provider. Being diagnosed with HIV motivated men to take this role and their responsibilities to others more seriously, and to begin setting goals, saving money, and planning for the future, as one boat loader (age 30) explained:

Getting HIV has even been helpful, because I would have died in an accident or in a different way, when I don't have any thought of planning for my child, while I am wasted in alcohol. However, after quitting alcohol, I save each penny I get on planning for my child, such that by the time I leave this earth I have bought him a plot of land and built [a house] for him.

While men's role of provider was negatively affected by HIV through reduced strength and ability to do strenuous labor and earn money, men's narratives suggested their fear of failing in the roles important to them was highest after diagnosis, and overtime ameliorated as men experienced improvements in their health due to ART. The majority of men recognized their HIV medication as central to their ability to fulfill these roles and accomplish future goals through the return of their physical strength due to ART, as exemplified by the following quote:

I feel good because I can look after my children and I also still have the energy to fish or do farming such that I can bring for my children food. Before being initiated on ART, I used to not to have energy for digging [in a garden], but now I can take longer hours while digging (fisherman, age 30).

For men with children and wives, the desire to fulfill their role of provider was tied to the value placed on being a husband and father, which was consistently cited as the reason men take their HIV medications. In turn, men expressed an overall reduction in unhealthy behaviors, including alcohol consumption, their number of sexual partners, and generally disassociating with the "party" lifestyle since HIV diagnosis; which many participants said they engaged in prior to their diagnosis, and was perceived as part of the culture of fishermen and life on the islands. Single men cited the desire to find a wife and become a father as their motivation for continued HIV treatment, and had similar aspirations of bettering their financial situation in order to provide for their future family.

In two ways the masculine notions of worker and provider served as barriers to HIV care. First, for a smaller group of men on ART whose energy levels had not fully recovered after ART, side effects of ART (fatigue, dizziness) affected their ability to work. These men were on ART for less than one year (sample average: 19 months). Given most fisherfolk engage in strenuous labor, these side effects were worrisome for men; several men said they skip doses on nights that they fish for this reason, and had considered discontinuing their medication because of its negative effects on their work.

I tried carrying those pills with me, but whenever I swallowed those drugs at work, and remember I would be moving up and down doing this and that, they made me feel a lot of dizziness that after swallowing those drugs I couldn't sail on the lake. In fact I found out that I could even fall into the water! So I cannot hide this from you; if I get a deal of sailing people...since I usually return home at 12am or 1am, I would miss swallowing that day (boat operator, age 32).

Second, the nature of men's work emerged as a barrier to both attending HIV clinic appointments and ARV adherence, including: irregular work schedules, fishing overnight and over several day periods, and frequent mobility for work. Common among men's narratives included stories of being stuck on the lake longer than expected or traveling to distant islands to fish, leading to missed clinic visits or not having enough ARVs with them on the lake. Men's socioeconomic status was an underlying issue in nearly all of the narratives, with men stating that having money and financial stability would reduce these issues significantly, as one boat operator (age 32) explained: *"You see the challenge that most of us have faced is that we are poor; the illness finds us in poverty. So you have to strive hard to look for money and that involves use of a lot of energy, which is a very big challenge"* (boat operator, age 32).

HIV as a threat to marriage and sexual relationships, and the restorative effects of ART. In one-third of the interviews, men shared that their HIV diagnosis had

threatened their role as husband and relationships with women. This most commonly was described as partners leaving them after being diagnosed with HIV, losing partners to HIV/AIDS-related death, feeling that their HIV status hurt their chances in finding new sexual partners/spouses, and experiencing reduced sexual drive or energy for sex due to HIV-related illness and ART side effects. However, with the exception of several men reporting reduced sex drive due to ART side effects, most men noted ART had restored their sex lives and relationships with women by reviving their overall energy levels and sex drive to levels experienced before the onset of HIV-related illness. For example, a fisherman (age 32) explained, *“When I was sick I couldn’t sleep with any woman, but now I have a wife and there is no problem now...no, there isn’t any problem and the other thing is that if you are swallowing these [ARV] drugs, there is a way they boost your libido.”* Relatedly, men who reported no change in their physical or social functioning because of HIV attributed their ability to continue fulfilling these masculine roles to taking their HIV medication as prescribed and following their provider’s guidance. In only a few cases, men described their role as a spouse/partner as a barrier to care engagement. For these men, the fear that disclosure would hurt their relationships led them to hide their HIV medications from spouses and partners in order to preserve these relationships, which sometimes resulted in missing their ARV doses.

The way that it [HIV] affected me is that when you bring in a wife, you will have to sneak around to swallow your pills, but if you are not sick, you freely bring in women without any fear. However, some of us keep the tablets under the bed where we swallow from! (boat loader, age 30).

Male peers encouraging HIV care engagement. When asked about their daily routines, participants described a significant amount of time spent among male peers, coworkers, and male family members, both working together on the lake, and socializing with men outside of work. Men’s role among male peers emerged as important to men’s

engagement in HIV care; when asked what motivated men to test for HIV, several men said they had been encouraged to test by their friends. As one fisherman (age 23) shared, *“Before being diagnosed with HIV, I used to fall sick all the time, yet I know of friends who have already initiated on ART therapy. So my friends would advise me that why don’t you go to a health facility such that you can be checked.”* While wives/partners often served as treatment supporters for men with partners aware of their HIV status, male peers/family members also served in this role. Moreover, participants described assuming the role of treatment supporter themselves for other men since experiencing the benefits of ART, with several promoting HIV awareness and testing even more broadly in the community.

Knowing many other men on ART not only provided men with a network of treatment supporters, but also normalized HIV for men, reducing the fear of experiencing HIV stigma and discrimination as a result of being seen at the clinic or known as HIV positive in the community. Moreover, in interviews men referred to other men living with HIV in the community that they respected and perceived as strong and healthy, as demonstrated by the following quotation: *“I have been seeing very strong men of whom they tell me that they are on ART treatment yet they look very strong, that has encouraged me a lot to continue taking my ARVs. That assures me that I will be in [a] position to build for my children”* (fisherman, age 32). Seeing other men continue to lead normal lives despite being HIV infected served as evidence of the efficacy of ART for men, and gave men hope that they could also live a long, productive life if they remain in care.

The appearance of physical strength, and ART’s restorative effects. When asked about their decision to test for HIV and link to care, the majority of men shared that they had not done so until HIV had taken a visible toll on their body, and the symptoms

worsened to the point of no longer being able to carry out their responsibilities. Men's reliance on physical strength despite other symptoms may therefore play a role in the tendency for men to link to care late, with an advanced disease stage. Though the value men place on their physical strength was clearly tied to their ability to work as described earlier, men separately valued the appearance of physical strength in itself as a marker of a "complete" man and as central to their self-worth. Thus, the restoration of men's physical appearance after ART motivated men to stay engaged in care, with several narratives suggesting a healthy physical appearance and continued functioning in society was protective against HIV stigma for men, as explained by one fisherman (age 25): *"According to the way I initiated on ART, I was looking good. Therefore, I have never got any stigmatizing statement because I stayed looking good."*

Discussion

The findings of this study demonstrate the importance of norms of masculinity in men's engagement in HIV care among Ugandan fishermen on ART. HIV was viewed as threatening to the masculine notions that men should be and appear physically strong, be a financial provider, have a strong work ethic, and maintain relationships with women; other studies in SSA qualitatively link these notions of masculinity and roles with reduced HIV testing and treatment uptake (27, 40-51). However, in our sample, men's narratives suggested the ability to overcome these barriers through ART, which helped men to restore and maintain their masculine roles, and motivated them to remain in care. Though Ugandan fishermen are commonly portrayed as a hyper-masculine sub-culture engaging in high-risk sexual and drinking behavior (21, 23), in our sample, we found men's HIV diagnosis had motivated them to make efforts to reduce risk behaviors, and embrace a healthy lifestyle inclusive of HIV treatment, driven by the desire to better fulfill

the masculine roles important to them. Other studies in the region similarly report HIV may “dent” or damage men’s notions of masculinity, but some men are able to “resuscitate” their masculinity to be more in line with a good patient (42, 44, 51-54).

Our findings support the notion that norms of masculinity are fluid and adaptable (55-57), and can serve as facilitators to HIV care (34). Providing men with safe spaces to cope with their HIV diagnosis and reflect on their health seeking behavior may help facilitate men to restore their masculinity after diagnosis and adopt a masculine identity conducive with treatment engagement. The reshaping of gender norms and promotion of more equitable relationships between men and women through a gender-transformative approach has been used with success in gender-based violence and HIV risk reduction interventions with men and women (55, 56, 58). Fleming et al.’s (59) recent qualitative study demonstrated the potential for transformative programming to help men overcome masculinity-related barriers to HIV testing and treatment uptake; though rigorous evaluations are still needed to test with approach with HIV engagement outcomes. Our study provides data specific to the social context and construction of masculinity for fishermen to inform the development of gender-transformative programming and the tailoring of HIV counseling to men in this setting. Specifically, HIV programming that facilitates men’s understanding of the link between HIV care engagement, good health, and their ability to obtain financial and business success and subsequently provide for their families, may resonate with fishermen.

Our finding that ART helped men live up to the masculine expectations of being strong, a provider, and good worker suggests ART may be key in reducing masculinity-driven unhealthy behaviors through the mechanism of reduced masculine gender role strain. Masculine gender role strain refers to the stress that men experience in trying to fulfill their expected gender roles (60, 61). It is theorized (60, 61) and has been shown

(11, 62) that men engage in HIV risk and other harmful behaviors in response to masculine gender role strain, to compensate for perceived failure in these roles. Future research should explore the effect of ART on masculine gender role strain, and its subsequent effects on HIV care engagement outcomes. The Gender Role Conflict/Stress (GRS/C) scale was recently developed with South African men (63), and can be used to quantitatively test this hypothesis in future studies.

Though men's narratives suggested the ability to overcome normative barriers to care, the conflict between men's role as worker/provider and patient may be more challenging to overcome in this setting. Other studies similarly report clinic services not being tailored to men's needs contribute to men's absence in HIV care (42, 44, 64, 65). Structural barriers are heightened among fishermen, given the mobile nature of fishing occupations and the structural environment of Lake Victoria impeding clinic access (21, 22). Men's narratives suggested these barriers are most detrimental to care access for economically disadvantaged men, highlighting the intersectionality between masculinity and economic status (56). Conflicting and unpredictable work schedules, mobility, and transportation issues may explain the discordance between narratives of "transformed masculinity" and high motivation for HIV treatment among our sample, yet sub-optimal adherence and clinic attendance. There has been a call in the literature for HIV services to accommodate structural barriers that disadvantage men and for policy and institution-level change to address gender inequities in HIV care (1, 3, 56, 66, 67). In our study setting, some gender-sensitive strategies to accommodate fishermen's accessibility were being implemented. However, our findings demonstrate the need to increase such strategies, consider the provision of financial or other incentives for transportation costs/missed work, and generally to innovate new approaches to address male-specific barriers to care.

Our findings also suggest social network/peer-based interventions for fishermen should be explored. With half of our sample unmarried/separated from their partner, we found men rely heavily on a network of male peers for emotional and instrumental support, which may be unique to fishing villages and other settings where men gather for work. Specific to HIV care, male peers encouraged each other to seek HIV testing and treatment, and served as treatment supporters for one another, which has been found in similar mining communities where men gather for work (41). Knowing other HIV-infected men with reputations of being strong, successful, and respected in the community normalized HIV for men and reduced the fear of experiencing stigma if seen at the clinic. Thus, utilizing male peers or “popular opinion leaders” in HIV programming, as commonly employed with other key populations, and with promising effects on HIV care engagement outcomes in SSA settings (68-70), should be explored as a strategy to increase HIV-infected fishermen’s engagement in care.

This study adds to a growing body of research building evidence that norms of masculinity may be driving men’s poor engagement in HIV care. However, quantitative investigations are needed; a recent systematic review demonstrated no quantitative studies in SSA exist with this aim (34). Given the qualitative nature of our study, we cannot infer causation between these constructs nor can we generalize our findings to the broader population. Generalizability is further limited, given the purposive sampling of men experiencing adherence problems and men who drink. In the larger sample from which ours was drawn, alcohol use was associated with missed ARVs (35), and therefore is also an important factor not addressed specifically in this paper. Despite evidence on the intersection of masculinity and risky alcohol use (71-73), men stated alcohol use was not part of their definition of being a man in our sample and no themes emerged related to this association despite probing in IDIs, highlighting an area for

future quantitative research. Since men were recruited from the HIV clinic, our sample did not capture HIV-infected men who never linked to care or were lost to follow up. Thus, our sample may over represent men who are doing better with HIV care engagement overall and may not include men faced with the greatest barriers to care. In addition, fishing villages are often described as having a large population of younger men, but the mean age (34) in our sample was slightly older. Men not engaged in care, and younger men, may display more risk-prone masculinities as fisherfolk have been previously described (22), and have greater difficulty adapting their masculine identities after HIV diagnosis as men in our sample described. Nevertheless, our study provides valuable insight into how masculine norms affect ARV adherence and clinic attendance, and change over time for fishermen on ART, who were still struggling with adherence despite being sampled from the clinic.

Conclusions

The findings of this study demonstrate the importance of norms of masculinity in men's engagement in HIV care among fisherfolk living with HIV. Though HIV emerged as threatening to men's notions of masculinity, ART's ability to restore and maintain their masculine roles motivated men to remain in care. However, occupational and structural barriers specific to men's role as worker remained a barrier for men regardless of their motivation for treatment. Our findings highlight the potential to better tailor HIV testing and treatment messaging to men by emphasizing the benefits of ART on bolstering men's roles and the notions of masculinity important to them. Our findings also support the evaluation of multilevel interventions to engage men in this setting. Specifically, the use of gender transformative counseling with men on ART and at the community-level, a male peer approach to increase treatment support, and health service interventions to

help men overcome structural and occupational barriers to care should be researched further in Ugandan fishing villages.

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Table 3.1: Participant characteristics

	n (%) / Mean	SD	Range
Socio-demographics			
Age	33.8	6.9	20-50
Marital status			
Never married	3 (10.0%)		
Divorced	9 (30.0%)		
Widowed	1 (3.3%)		
Married and separated	3 (10.0%)		
Married and living together	14 (46.7%)		
Education			
No schooling	18 (60.0%)		
Primary level	8 (26.7%)		
Secondary level	4 (13.3%)		
Monthly income (approximate USD)	75.3	51.3	22.2-250.0
Occupation			
Fishermen	27 (90.0%)		
Other (fish seller, boat operator, boat loader)	3 (10.0%)		
Mobility (traveled/slept away in prior year)			
Yes	23 (76.7%)		
No	7 (23.3%)		
Travel time to clinic (minutes)	58.6	56.6	2-240
Months since HIV diagnosis	21.4	10.3	8-46
Months since ART initiation	18.9	19.5	4-45
Engagement outcomes			
Retention (Proportion of kept clinic appointments prior year)	51.9%	34.8%	0-100%
ART adherence (% of pills taken as prescribed)	70.8%	30.9%	0-100%
Optimal adherence			
Yes, at least 95% of pills taken	12 (40.0%)		
No, <95% of pills taken	18 (60.0%)		

Note: ART = antiretroviral therapy

References

1. Cornell M, McIntyre J, Myer L. Men and antiretroviral therapy in Africa: our blind spot. *Trop Med Int Health*. 2011;16(7):828-9.
2. Tromp N, Michels C, Mikkelsen E, Hontelez J, Baltussen R. Equity in utilization of antiretroviral therapy for HIV-infected people in South Africa: a systematic review. *Int J Equity Health*. 2014;13(1):1-17.
3. Shand T, Thomson-de Boor H, van den Berg W, Peacock D, Pascoe L. The HIV Blind Spot: Men and HIV Testing, Treatment and Care in Sub-Saharan Africa. *IDS Bull*. 2014;45(1):53-60.
4. Beckham SW, Beyrer C, Luckow P, Doherty M, Negussie EK, Baral SD. Marked sex differences in all-cause mortality on antiretroviral therapy in low- and middle-income countries: a systematic review and meta-analysis. *J Int AIDS Soc*. 2016;19(1):21106.
5. United Nations Development Program. Africa Human Development Report 2016: Accelerating Gender Equality and Women's Empowerment in Africa. New York: UNDP; 2016.
6. World Health Organization. Engaging men and boys in changing gender-based inequity in health: evidence from programme interventions. Geneva: World Health Organization; 2007.
7. Fleming PJ, Dworkin SL. The importance of masculinity and gender norms for understanding institutional responses to HIV testing and treatment strategies. *AIDS*. 2016;30(1):157-8.
8. Baker P, Dworkin SL, Tong S, Banks I, Shand T, Yamey G. The men's health gap: men must be included in the global health equity agenda. *Bull World Health Org*. 2014;92(8):618-20.
9. Courtenay WH. Constructions of masculinity and their influence on men's well-being: a theory of gender and health. *Soc Sci Med* 2000;50(10):1385-401.
10. Shannon K, Leiter K, Phaladze N, Hlanze Z, Tsai AC, Heisler M, et al. Gender inequity norms are associated with increased male-perpetrated rape and sexual risks for HIV infection in Botswana and Swaziland. *PLoS ONE*. 2012;7(1):e28739.
11. Gottert AL. Gender norms, masculine gender-role strain, and HIV risk behaviors among men in rural South Africa. The University of North Carolina at Chapel Hill; 2014.
12. Dunkle KL, Jewkes RK, Brown HC, Gray GE, McIntyre JA, Harlow SD. Gender-based violence, relationship power, and risk of HIV infection in women attending antenatal clinics in South Africa. *Lancet*. 2004;363(9419):1415-21.

13. Shattuck D, Burke H, Ramirez C, Succop S, Costenbader B, Attafuah JD, et al. Using the inequitable gender norms scale and associated HIV risk behaviors among men at high risk for HIV in Ghana and Tanzania. *Men Masculinities*. 2013;16(5):540-59.
14. Jewkes RK, Dunkle K, Nduna M, Shai N. Intimate partner violence, relationship power inequity, and incidence of HIV infection in young women in South Africa: a cohort study. *Lancet*. 2010;376(9734):41-8.
15. Uganda Ministry of Health. Consolidated Guidelines for Prevention and Treatment of HIV in Uganda. Kampala, Uganda: MOH; 2016.
16. Asiki G, Mpendo J, Abaasa A, Agaba C, Nanvubya A, Nielsen L, et al. HIV and syphilis prevalence and associated risk factors among fishing communities of Lake Victoria, Uganda. *Sex Transm Dis*. 2011;87(6):511-5.
17. Seeley J, Nakyingi-Miir J, Kamali A, Mpendo J, Asiki G, Abaasa A, et al. High HIV incidence and socio-behavioral risk patterns in fishing communities on the shores of Lake Victoria, Uganda. *Sex Transm Dis*. 2012;39(6):433-9.
18. Opio A, Muyonga M, Mulumba N. HIV sero behavioral survey in fishing communities of the Lake Victoria basin of Uganda. SIDA, MOH, AMREF; 2011.
19. Bogart LM, Naigino R, Maistrellis E, Wagner GJ, Musoke W, Mukasa B, et al. Barriers to linkage to HIV care in Ugandan fisherfolk communities: a qualitative analysis. *AIDS Behav*. 2016;20(10):2464-76.
20. Tumwesigye NM, Atuyambe L, Wanyenze RK, Kibira SP, Li Q, Wabwire-Mangen F, et al. Alcohol consumption and risky sexual behaviour in the fishing communities: evidence from two fish landing sites on Lake Victoria in Uganda. *BMC Public Health*. 2012;12:12.
21. Sileo K, Kintu M, Chanes-Mora P, Kiene S. "Such behaviors are not in my home village, I got them here": a qualitative study of the influence of contextual factors on alcohol and HIV risk behaviors in a fishing community on Lake Victoria, Uganda. *AIDS Behav*. 2016.
22. Seeley JA, Allison EH. HIV/AIDS in fishing communities: challenges to delivering antiretroviral therapy to vulnerable groups. *AIDS Care*. 2005;17(6):688-97.
23. Allison EH, Seeley JA. HIV and AIDS among fisherfolk: a threat to 'responsible fisheries'? *Fish Fisheries*. 2004;5(3):215-34.
24. Kiwanuka N, Ssetaala A, Mpendo J, Wambuzi M, Nanvubya A, Sigirenda S, et al. High HIV-1 prevalence, risk behaviours, and willingness to participate in HIV vaccine trials in fishing communities on Lake Victoria, Uganda. *PLoS ONE*. 2014;9(5):e94932. doi: 10.1371/journal.pone.0094932.

25. Siu GE, Wight D, Seeley JA. Masculinity, social context and HIV testing: an ethnographic study of men in Busia district, rural eastern Uganda. *BMC Public Health*. 2014;14(1):1-11.
26. Siu GE, Wight D, Seeley J. 'Dented' and 'Resuscitated' masculinities: the impact of HIV diagnosis and/or enrolment on antiretroviral treatment on masculine identities in rural eastern Uganda. *Sahara J*. 2014;11(1):211-21.
27. Siu GE, Seeley J, Wight D. Dividuality, masculine respectability and reputation: how masculinity affects men's uptake of HIV treatment in rural eastern Uganda. *Soc Sci Med*. 2013;89:45-52.
28. Siu GE, Wight D, Seeley J. How a masculine work ethic and economic circumstances affect uptake of HIV treatment: experiences of men from an artisanal gold mining community in rural eastern Uganda. *J Int AIDS*. 2012;15(Suppl 1):17368.
29. Connell RW, Messerschmidt JW. Hegemonic masculinity: rethinking the concept. *Gender Soc*. 2005;19(6):829-59.
30. Connell RW. *Gender and Power*. Stanford, CA: Stanford University Press; 1987; 2009.
31. Wilson PJ. Reputation and respectability: a suggestion for Caribbean ethnology. *Man*. 1969;4(1):70e84.
32. Barker G, Ricardo C. Young men and the construction of masculinity in sub-Saharan Africa: implications for HIV/AIDS, conflict, and violence. *Social Development Papers: Conflict Prevention and Reconstruction*, Paper 26. Washington, DC: The World Bank; 2005.
33. Sikweyiya YM, Jewkes R, Dunkle K. Impact of HIV on and the constructions of masculinities among HIV-positive men in South Africa: implications for secondary prevention programs. *Global Health Action*. 2014;7:10.3402/gha.v7.24631.
34. Sileo KM, Fielding-Miller R, Dworking SL, Fleming PJ. The role of gender norms and masculinity on men's engagement in the HIV care continuum in sub-Saharan Africa: A systematic review. Poster session presented at: 9th IAS Conference on HIV Science (IAS 2017); 2017 23-27 July; Paris, France.
35. Sileo, K. M., Wanyenze, R. W., Kizito, W., Reed, L., Stockman, J. K., Musoke, W., Mukasa, B., & Kiene, S. M. A mixed methods study to assess substance use and its effects on HIV treatment adherence among male fisherfolk living with HIV/AIDS in Uganda. Unpublished.
36. Sileo, K. M., Wanyenze, R. W., Kizito, W., Brodine, S. K., Reed, L., Musoke, W., Mukasa, B., & Kiene, S. M. Multi-Level determinants of clinic attendance and antiretroviral treatment adherence among fishermen living with HIV/AIDS in Lake Victoria, Uganda. Unpublished.

37. Chesney MA, Ickovics JR, Chambers DB, Gifford AL, Neidig J, Zwickl B, et al. Self-reported adherence to antiretroviral medications among participants in HIV clinical trials: the AACTG adherence instruments. *AIDS Care*. 2000;12(3):255-66.
38. Oyugi JH, Byakika-Tusiime J, Ragland K, Laeyendecker O, Mugerwa R, Kityo C, et al. Treatment interruptions predict resistance in HIV-positive individuals purchasing fixed-dose combination antiretroviral therapy in Kampala, Uganda. *AIDS*. 2007;21(8):965-71 10.1097/QAD.0b013e32802e6bfa.
39. Smith CP. Content analysis and narrative analysis. In: T. RH, M. JC, editors. *Handbook of Research Methods in Social and Personality Psychology*. New York: Cambridge University Press; 2000. p. 313-35.
40. DiCarlo AL, Mantell JE, Remien RH, Zerbe A, Morris D, Pitt B, et al. 'Men usually say that HIV testing is for women': gender dynamics and perceptions of HIV testing in Lesotho. *Culture Health Sex*. 2014;16(8):867-82.
41. Siu GE, Wight D, Seeley JA. Masculinity, social context and HIV testing: an ethnographic study of men in Busia district, rural eastern Uganda. *BMC Public Health*. 2014;14:33.
42. Skovdal M, Campbell C, Madanhire C, Mupambireyi Z, Nyamukapa C, Gregson S. Masculinity as a barrier to men's use of HIV services in Zimbabwe. *Globalization Health*. 2011;7:13.
43. Van Heerden A, Msweli S, Van Rooyen H. "Men don't want things to be seen or known about them": a mixed-methods study to locate men in a home based counselling and testing programme in KwaZulu-Natal, South Africa. *Afr J AIDS Res*. 2015;14(4):353-9.
44. Zisette S, Watt MH, Prose NS, Mntambo N, Moshabela M. 'If you don't take a stand for your life, who will help you?': men's engagement in HIV care in KwaZulu-Natal, South Africa. *Psychol Men Masculinity*. 2016.
45. Parrott FR, Mwafurirwa C, Ngwira B, Nkhwazi S, Floyd S, Houben RM, et al. Combining qualitative and quantitative evidence to determine factors leading to late presentation for antiretroviral therapy in Malawi. *PLoS One*. 2011;6(11):e27917.
46. Wyrod R. Masculinity and the persistence of AIDS stigma. *Cult Health Sex*. 2011;13(4):443-56.
47. Skovdal M, Campbell C, Nyamukapa C, Gregson S. When masculinity interferes with women's treatment of HIV infection: a qualitative study about adherence to antiretroviral therapy in Zimbabwe. *J Int AIDS Soc*. 2011;14:29.
48. Simpson A. Christian identity and men's attitudes to antiretroviral therapy in Zambia. *Afr J AIDS Res*. 2010;9(4):397-405.

49. Siu GE, Wight D, Seeley J. How a masculine work ethic and economic circumstances affect uptake of HIV treatment: experiences of men from an artisanal gold mining community in rural eastern Uganda. *J Int AIDS Soc.* 2012;15 Suppl 1:1-9.
50. Russell S, Zalwango F, Namukwaya S, Katongole J, Muhumuza R, Nalugya R, et al. Antiretroviral therapy and changing patterns of HIV stigmatisation in Entebbe, Uganda. *Soc Health Illness.* 2016;38(1):58-72.
51. Siu GE, Wight D, Seeley J. 'Dented' and 'resuscitated' masculinities: the impact of HIV diagnosis and/or enrolment on antiretroviral treatment on masculine identities in rural eastern Uganda. *SAHARA.* 2014;11:211-21.
52. Lynch I, Brouard PW, Visser MJ. Constructions of masculinity among a group of South African men living with HIV/AIDS: reflections on resistance and change. *Cult Health Sex.* 2010;12(1):15-27.
53. Bhagwanjee A, Govender K, Reardon C, Johnstone L, George G, Gordon S. Gendered constructions of the impact of HIV and AIDS in the context of the HIV-positive seroconcordant heterosexual relationship. *J Int AIDS Soc.* 2013;16:18021.
54. Connell RW. *Masculinities.* Berkeley, CA: University of California Press; 1995.
55. Dworkin SL, Treves-Kagan S, Lippman SA. Gender-transformative interventions to reduce HIV risks and violence with heterosexually-active men: a review of the global evidence. *AIDS Behav.* 2013;17(9):2845-63.
56. Dworkin SL, Fleming PJ, Colvin CJ. The promises and limitations of gender-transformative health programming with men: critical reflections from the field. *Cult Health Sex.* 2015;17(2):128-43.
57. Barker G, Ricardo C, Nascimento M, Olukoya A, Santos. C. Questioning gender norms with men to improve health outcomes: evidence of impact. *Global Public Health.* 2010;5(5):539–53.
58. Barker G, Ricardo C, Nascimento M. *Engaging Men and Boys in changing gender based inequity in health: evidence from programme interventions.* Geneva: WHO; 2007.
59. Fleming PJ, Colvin C, Peacock D, Dworkin SL. What role can gender-transformative programming for men play in increasing men's HIV testing and engagement in HIV care and treatment in South Africa? *Cult Health Sex.* 2016:1-14.
60. Pleck JH. *The myth of masculinity.* Cambridge: MIT Press; 1981.
61. Pleck JH. The gender role strain paradigm: an update. In: Levant R, Pollack W, editors. *A new psychology of men.* 11-32. New York: BasicBooks; 1995.
62. Fleming PJ, Barrington C, Gottert A, Perez M, Donastorg Y, Moya M, et al. *Masculine gender role strain and HIV-related behaviors among male*

steady partners of female sex workers living with HIV in the Dominican Republic. Poster presented at the: XX International AIDS Conference; Melbourne, Australia 2014.

63. Gottert A, Barrington C, Pettifor A, McNaughton-Reyes HL, Maman S, MacPhail C, et al. Measuring men's gender norms and gender role conflict/stress in a high HIV-prevalence South African setting. *AIDS Behav.* 2016;20(8):1785-95.
64. Stern E, Clarfelt A, Buikema R. The use of sexual history narratives to assess processes of hegemonic masculinity among South African men in the context of HIV/AIDS. *Men Masculinities.* 2015;18(3):340-62.
65. Bila B, Egrot M. Gender asymmetry in healthcare-facility attendance of people living with HIV/AIDS in Burkina Faso. *Soc Sci Med.* 2009;69(6):854-61.
66. Dovel K, Yeatman S, Watkins S, Poulin M. Men's heightened risk of AIDS-related death: the legacy of gendered HIV testing and treatment strategies. *AIDS.* 2015;29:1123-5.
67. Fleming PJ, Dworkin SL. The importance of masculinity and gender norms for understanding institutional responses to HIV testing and treatment strategies. *AIDS.* 2016;30(1):157-8.
68. Latkin CA, Davey-Rothwell MA, Knowlton AR, Alexander KA, Williams CT, Boodram B. Social network approaches to recruitment, HIV prevention, medical care, and medication adherence. *J Acquir Immune Defic Syndr.* 2013;63(0 1):S54-S8.
69. Govindasamy D, Meghij J, Negussi EK, Baggaley RC, Ford N, Kranzer K. Interventions to improve or facilitate linkage to or retention in pre-ART (HIV) care and initiation of ART in low- and middle-income settings – a systematic review. *J Int AIDS Soc.* 2014;17(1):19032.
70. Simoni JM, Nelson KM, Franks JC, Yard SS, Lehavot K. Are Peer Interventions for HIV Efficacious? A Systematic Review. *AIDS Behav.* 2011;15(8):1589-95.
71. Morojele NK, Kachieng'a MA, Mokoko E, Nkoko MA, Parry CDH, Nkowane AM, et al. Alcohol use and sexual behaviour among risky drinkers and bar and shebeen patrons in Gauteng province, South Africa. *Soc Sci Med.* 2006;62(1):217-27.
72. Rich EP, Nkosi S, Morojele NK. Masculinities, alcohol consumption, and sexual risk behavior among male tavern attendees: a qualitative study in North West Province, South Africa. *Psychol Men Masculinity.* 2015;16(4):382.
73. Hughes TL, Wilsnack SC, Kantor LW. The influence of gender and sexual orientation on alcohol use and alcohol-related problems: toward a global perspective. *Alc Res: Curr Rev.* 2016;38(1):121.

CHAPTER 4: Multi-level determinants of clinic attendance and antiretroviral treatment adherence

Abstract

Background: The social and physical environment of Lake Victoria fishing communities may pose significant challenges to men's engagement in HIV care. This cross-sectional study assessed and compared the effect of factors at different levels of the social ecological model on HIV clinic appointment attendance and antiretroviral treatment (ART) adherence among male fisherfolk on ART in Wakiso District, Uganda.

Methods: We conducted an interviewer-administered structured questionnaire with 300 men recruited from one of seven ART clinics on fish landing sites and islands on Lake Victoria. Data were analyzed in SPSS version 24.

Results: Multi-level factors associated with missed HIV clinic visits included those at the individual (age, AOR=0.98, 95% CI: 0.97-0.99), interpersonal (being single, AOR: 1.25, 95% CI: 1.01-1.54), normative (anticipated HIV stigma, AOR: 1.55, 95% CI: 1.05-2.29) and physical/built environment-level (travel time to the HIV clinic, AOR: 1.11, 95% CI: 1.02-1.20; structural-barriers to ART adherence, AOR: 1.27, 95% CI: 1.04-1.56; accessing care on a landing site, AOR: 1.35, 95% CI: 1.08-1.67). Factors associated with ART non-adherence included those at the individual (age, β : -0.01, η^2 =0.03; monthly income, β : -0.01, η^2 =0.02) and normative levels (anticipated HIV stigma, β : 0.10, η^2 =0.02; enacted HIV stigma, β : 0.11, η^2 =0.02).

Conclusions: Differentiated models of ART delivery that bring services closer to men in the community and integrate stigma reduction and peer-based social support

should be explored in this setting to reduce multi-level barriers to accessing HIV care and ART adherence.

Introduction

Ugandan fisherfolk are significantly more likely to be infected with HIV/AIDS than the general adult population, with HIV prevalence estimated between 22-40% (1-4) compared to 7.3%, respectively (5). Thus, fisherfolk are a most-at-risk population (MARF) being prioritized in national and global recommendations for immediate initiation of antiretroviral treatment (ART) upon HIV diagnosis (6, 7). Immediate ART initiation has significant benefits on individual health and can reduce HIV incidence on a population-level (6, 8). The success of these guidelines, however, depends greatly on our ability to engage and retain MARFs across all stages of the HIV care continuum. In addition, there is a particular need to increase engagement among men in sub-Saharan Africa (SSA), as they present later to care, have worse ART adherence, and are more likely to be lost-to-follow up than women (9-11). Optimal ART adherence (95% of pills taken as prescribed) is needed to achieve sustained viral suppression, and therefore prevent disease progression (12) and development of drug resistance (13). Similarly, clinic appointment attendance, essential for treatment monitoring, adherence counseling, and the receipt of antiretroviral (ARV) refills, is also associated with viral suppression (14). The consequences of men's poor engagement in the care continuum are apparent in health outcomes for men living with HIV; a recent meta-analysis reported a 41% increased risk of death for men while on ART compared to women in SSA (15).

For men in general, a number of interrelated barriers have been identified as potentially driving poor engagement, such as conflicts with work responsibilities and inconvenient clinic hours, financial constraints, and transportation issues, and HIV

stigma (16, 17). Men employed in the fish industry (e.g., fishermen, fish sellers, boat operators) may face even greater barriers to care than men generally, given their frequent mobility, the nature of their work, and the structural environment of fishing villages. However, little research has examined HIV care engagement within this MARP. Given the unique setting of fishing communities, barriers to HIV care engagement likely occur at multiple levels of the social ecological model (SEM) (18-20), which has been used to understand HIV health behavior generally (21), including HIV medication adherence and retention in HIV care (22-24). An ecological perspective recognizes factors external to the individual and outside of their control as influencing health behavior and outcomes, including individual, interpersonal, normative, environmental, and policy level factors (18-20). It also highlights interactions between factors within and between SEM levels. Applied to the literature from SSA, individual-level knowledge of the efficacy of ART, concern about side effects, and motivation for HIV treatment (25-28), as well as socio-demographics (e.g., older age, higher education, employment, being female), have been shown to predict better engagement in care (29-34). However, reviews of the literature in SSA also demonstrate the salience of higher-level SEM factors on HIV care engagement; including interpersonal-level social support, normative-level HIV stigma, health system and environmental factors (e.g., drug stock out, distance to the clinic, quality of care, human resource availability and training), and societal-level policies affecting ART eligibility (24, 28, 35-41).

In the context of HIV fishing villages, an array of multi-level factors have been identified in research on linkage to HIV care, uptake of HIV testing, and sexual risk behavior (42-49) that likely also affect adherence to clinic appointments and ART. At the individual-level, heavy alcohol use is reported (2, 50-52), which has been shown in other settings to impede optimal ART adherence (53, 54). Interpersonal-level social support

may also be important. For example, HIV status disclosure and the use of treatment supporters is associated with greater ART adherence, as well as increased access to emotional and instrumental support (transportation, money) to get to HIV appointments (55, 56). However, men in fishing communities are often single or separated from their families for work (43, 44, 57); thus, the networks of support available to them may be limited.

In the normative environment, fishing villages have been characterized as having high levels of HIV stigma (44, 49). HIV stigma has been associated with reduced linkage to care and uptake of community-based HIV testing in this setting (47, 48), and is associated with poor adherence and engagement more broadly in SSA (58, 59). For example, experiencing prejudice and discrimination first hand from others, known as enacted stigma (60), emerged as a driver of treatment interruption among ART patients in Malawi (61). Other constructs of HIV stigma, including anticipated HIV stigma (i.e., the perceived likelihood of experiencing HIV-related prejudice or discrimination in the future) (60), and internalized HIV stigma (i.e., endorsement of negative beliefs and feelings associated with HIV among people living with HIV [PLHIV]) (60), are also associated with delayed care seeking, poor retention, and poor treatment adherence (62, 63), and may be especially influential for men (64, 65).

Finally, the physical and built environment of Lake Victoria poses a number of challenges to clinic access, including a lack of proximity to local services and the geo-spatial characteristics of fishing villages; for example many communities are on islands, only accessible by boat (42, 43). Bogart et al., (47, 48) identified few clinics with ART availability in close proximity to island outreach testing on Lake Victoria, and thus distance and transportation to the clinic were key barriers to timely linkage to HIV care. The fishing occupation itself includes frequent mobility, irregular work schedules, and an

inconsistent cash-based income which varies based on season-dependent fish yields (42, 44-46), all of which are likely to also affect men's ability to attend their appointments and take their pills as prescribed.

The overall goal of this study is to identify determinants of HIV care engagement among male fisherfolk on ART; our outcomes include HIV clinic attendance and ART adherence. Using a social ecological perspective, we examine individual, interpersonal, normative environment, and physical and built environment determinants to care, as well as interactions between factors. We hypothesized individual level factors (younger age, lower education, lower income, less time on ART, alcohol use, internalized HIV stigma, greater individual-level barriers to adherence), interpersonal (being single, lack of social support, non-disclosure of HIV status), normative (enacted and anticipated HIV stigma), and physical and built environment factors (greater distance to the clinic, mobility, accessing care on an island, greater structural barriers to ART adherence) would be associated with worse engagement in HIV care. We also explore the role of individual and interpersonal factors in moderating the associations between normative and physical and built environment factors and engagement outcomes, hypothesizing that older age, greater income, longer time on ART, greater social support, and HIV status disclosure would mitigate the effects of HIV stigma and structural factors on ART adherence and HIV clinic attendance.

Methods

We conducted a cross-sectional study with male fisherfolk receiving HIV care from one of seven ART clinics in Wakiso District, Uganda. We partnered with Mildmay Uganda, a nonprofit organization that works with the Ugandan Ministry of Health to provide free HIV testing and treatment throughout Uganda, to purposively sample

participants at Mildmay-supported HIV clinics serving fishing populations between October 2016 and March 2017. Research sites included a mix of governmental public health facilities (Bussi Health Center III [HCIII], Entebbe Hospital, Kigungu HCIII, Rapha HCIII), and Mildmay “outreach clinics” (Zzinga, Kachanga, Kasenyi). The outreach clinics are Mildmay established and operated sites that provide HIV treatment typically once a week or biweekly in communities with poor access to health facilities. An outreach team made up of a doctor, lab technician, pharmacist, and records manager moves from site to site to provide ART clinics at established community sites that serve as a temporary clinic (e.g., vacant schools or churches). Three of our research sites were on land (Entebbe Hospital, Kasenyi outreach, Kigungu HCIII), and six were on one of three islands on Lake Victoria accessible only by boat (Bussi Island, Kachanga Island, Zzinga Island).

Men were eligible to participate if they were: at least 18 years of age, a fisherman or engaged in another occupation supporting the fishing industry (e.g., fishtrader, boat operator), HIV positive, and on ART for at least 6 months (to allow us to assess ART adherence and clinic retention). We limited participation to fisherfolk, a MARP, as we were interested in their unique barriers to care engagement. We also include only men, based on data of a gender disparity in HIV care engagement among men throughout SSA (9).

On ART clinic days, a trained research assistant (RA) together with clinic providers reviewed patient records for men who presented to care for eligibility. The RA approached potentially eligible men, informed them of the study, screened further for eligibility, and obtained written informed consent for men agreeing to participate. In order to reach men not regularly attending the clinic, during routine reminder calls for clinic appointments, we invited men to participate in the study during their next clinic

appointment, or to meet elsewhere for the interview. Of the 322 eligible men approached and invited to participate, 22 declined for the following reasons: did not have time/other responsibilities (n=14), did not want to disclose sensitive information (n=4), intoxicated at the time of interview (n=1), hearing impairment (n=1) wanted more compensation (n=1), wanted to be interviewed with wife (n=1). After providing written consent, participants completed an interviewer-administered questionnaire with the RA in a private space in or around the clinic. The RA read each question aloud and entered responses in real-time using computer assisted personal interviewing (CAPI) programming in Questionnaire Development Software version 3.0 (QDS, Nova Research). Men received 10,000 Ugandan Shillings (~3 USD) for their participation. Institutional review boards at San Diego State University and Makerere University School of Public Health, and the Uganda National Council for Science and Technology, approved the study protocol.

Measures

The questionnaire included items measuring men's engagement in HIV care, and individual, interpersonal, community, and structural factors hypothesized to affect engagement. The **individual-level** items measured and used in the present analysis include: age (continuous), monthly income (continuous, 1 unit equates to 50,000 shillings), education (no education vs. primary or secondary level), occupation (fishermen vs. other fishing occupation), months on ART (continuous, 1 unit equates to 6 months), and number of pills prescribed (once vs. twice daily dosing). We used WHO's Alcohol Use Disorders Identification Test (AUDIT) to assess alcohol use (66), which has been shown reliable among PLHIV in Uganda ($\alpha = 0.71$) (67) (present sample, $\alpha = 0.63$). The AUDIT includes cut-off scores to categorize individuals at different levels of risky drinking, including: hazardous alcohol use (score of 8 or more), high risk or harmful use

(16-19), and dependence (20 or more) (68). For analyses, we sum participants' total AUDIT score (continuous). Internalized HIV stigma, or the endorsement of negative beliefs and feelings associated with HIV about themselves among PLHIV, was measured using Earnshaw's HIV stigma framework measures ($\alpha = 0.79$ in present sample) (69). We used Chesney's (70) AIDS Clinical Trials Group (ACTG) adherence questionnaire to measure individual-level barriers to ART adherence. The scale includes a mix of individual (e.g., forgot, side effects, lost pills) and social/structural factors (e.g., transportation, fear of being seen at the clinic, long wait times) barriers to ART adherence. Participants responded to the frequency (4 point scale, never to often) that they encountered specific barriers to ART adherence. For analysis, we divided the items into two separate variables, one measuring individual-level barriers and the other measuring social/structural barriers, comprised of the mean of items in these two categories.

Among **interpersonal-level** factors measured, marital status was dichotomized into married and living together vs. not married or separated. Marriage was defined as legal marriage, as well as civil unions or relationships that were legally unofficial, but considered marriage or a lifelong commitment by men. Social support was measured through the Social Support Scale (71), which contains 6 items on emotional support and 4 items on instrumental social support. This scale was adapted from the Duke-UNC Functional Social Support Questionnaire (72) and has been validated among PLHIV in rural Rwanda (73), and shown reliable in the present sample ($\alpha = 0.67$). A single item assessed HIV disclosure, capturing the total number of people the participant disclosed their status to.

In the **normative environment**, we measure two dimensions of HIV stigma using Earnshaw's HIV stigma framework measures (69), including enacted HIV stigma

(perceived degree of prejudice and discrimination experienced by PLHIV) and anticipated HIV stigma (expectation among PLHIV that they will experience prejudice and discrimination in the future) (α = enacted: 0.65, anticipated: 0.65).

Independent variables in the broader **built and physical environment** included mobility, measured with an item asking the participant if they have traveled and slept away from the community in the prior year (yes/no). We accounted for the differences in research site, or the HIV clinics the men were recruited in, by specifically examining the differences for men accessing a clinic on an island compared to on land (referred to as a “landing site”). Average travel time to HIV clinic was measured with one item asking the participant how long in minutes it takes them to get to the clinic (continuous, 1 unit equates 30 minutes). Note, for continuous items of income, months on ART, travel time to HIV clinic, outliers were truncated to highest value within 3 standard deviations of the mean for analysis (74). We used Chesney’s (70) AIDS Clinical Trials Group (ACTG) adherence questionnaire to measure structural-barriers to ART adherence (e.g., transportation, fear of being seen at the clinic, long wait times), as described above.

Our two **outcomes** include missed HIV clinic visits and ART non-adherence. We collected data on missed HIV clinic visits using participants’ HIV clinic records. The RA extracted the number of clinic appointments scheduled in the prior year from HIV clinic cards, and which of these visits were kept as scheduled vs. missed. The data was extracted and recorded during the interviewer-administered questionnaire, entered by the RA into CAPI software. We used participant self-report if data were missing or conflicted with participant’s own account.

We use Chesney’s (70) AIDS Clinical Trials Group (ACTG) questionnaire to measure self-reported adherence. The scale includes items on participants’ regimen and number of pills taken per day, which we confirmed using participants’ HIV clinic cards.

The ACTG asks for the number of pills missed over a four-day recall period (yesterday, one day ago, two days ago, three days ago), and an additional four-items on adherence more broadly, including when was the participant's last missed dose, frequency of missed pills on weekends, difficulty taking pills as scheduled (e.g., 2 times a day), and difficulty following special instructions (e.g., take with food, empty stomach, with fluids). We calculated a non-adherence index score used in large clinical trials (75, 76), which incorporates more items than the four-day recall period (see data analysis section), and has been shown to correlate more with plasma HIV RNA than the four day recall period alone (76).

Data analysis approach

Following Reynolds et al.'s methodology (76), we used the full ACTG scale to create a non-adherence index score by conducting a principle component (PC) analysis, approximating a latent variable. The index score was standardized on a scale from 0-100, with greater scores equating to worse adherence. For analysis, we used the square root method to transform the variable so that it met the assumptions for normality needed for linear regression modeling. We modeled missed HIV visits, using an events/trial format in logistic regression; the denominator represented the total number of visits scheduled over the prior year, and the numerator included the total number of visits missed over the same time period.

In SPSS version 24, we calculated participant characteristics using descriptive statistics for continuous variables and frequencies for categorical variables. We used linear regression for our continuous outcome (non-adherence index score) and logistic regression for our dichotomous outcome (missed HIV clinic visits), for both bivariate and multivariate analyses. We assessed the unadjusted associations between independent

variables with missed clinic visits and non-adherence, respectively. Statistically significant ($p < 0.10$) factors identified in bivariate models were included in multivariate models for our two outcomes, and interactions between independent variables were tested. We present trimmed models in our results, removing non-significant variables ($p > 0.10$). For missed clinic visits, Odds Ratios (OR) and Adjusted Odds Ratios (AOR) from bivariate and multivariate logistic regression analysis with 95% CI are presented. Betas (β) and standard errors (SE) are presented for bivariate and multivariate linear models assessing non-adherence index score. The eta squared (η^2) is included as a measure of effect size for each individual variable, and R^2 is reported for the multivariate model's overall model fit.

Results

Participant characteristics

The majority of our sample worked as fishermen (82.00%), and most men reported having no schooling (67.30%). On average, men were 36.86 years old ($SD=8.58$), and about half were married and living with their spouse (49.00%), while the other half were divorced (26.00%), never married (10.00%), separated (10.00%), or widowed (5.30%). The average monthly income of men was approximately 62.12 USD ($SD=29.73$). Men had been on ART an average of nearly 2 years (22.90 months, $SD=13.50$). The average AUDIT score was 4.45 ($SD=5.13$), suggesting low-level drinking with 30.70% of men meeting AUDIT criterion for “hazardous” drinking (score of 8 or greater). The average time men traveled to the HIV clinic was 41.4 minutes ($SD=39.56$), and over one-third of men reported traveling and sleeping away from home in the prior year (64.7%). Men scored higher on the anticipated HIV stigma scale (mean=0.86, $SD=0.53$) compared to internalized HIV stigma (mean=0.61, $SD=0.53$) and

enacted HIV stigma (mean=0.62, SD=0.48), but stigma scores were overall low. In the prior year, men had missed 39.00% of their scheduled clinic appointments. When assessing ART engagement using the 4-day recall period of missed pills, men had taken 87.79% of their pills (SD=21.46%), making 31.00% “sub-optimally adherent” (<95% of ARVs taken as prescribed). The average score on the non-adherence index score was 41.70 (SD=79), with greater scores indicating worse adherence (range 0-100). Detailed participant characteristics are presented in Table 4.1.

Generalized logistic regression models testing independent variables at each level of the social ecological model and missed HIV clinic visits

All independent variables identified in bivariate models remained associated with missed clinic visits in the adjusted model, with the exception of number of pills prescribed, AUDIT score, HIV disclosure, and mobility (see Table 4.2 for detailed bivariate statistics).

In the final multivariate model, the **individual-level factor** age was negatively associated with missed visits (AOR=0.98, 95% CI=0.97-0.99, p=0.01); with younger men more likely to miss clinic appointments than older men. At the **interpersonal-level**, single men or those separated from their partner were 1.25 times more likely to report missed clinic visits in the prior year compared to married men living with their partner (AOR= 1.25, 95% CI: 1.01-1.54, p=0.03). Anticipated HIV stigma remained positively associated with missed clinic appointments in the **normative environment** (AOR: 1.55, 95% CI: 1.05-2.29, p=0.03). **Physical and built environment-level factors** with significant main effects included travel time to the clinic, landing site, and structural barriers to ART adherence. For every 30-minute increase in time spent traveling to the

clinic, men were 1.11 times more likely to report missed clinic visits (AOR: 1.11, 95% CI: 1.02-1.20, $p=0.02$). The odds of missed HIV clinic appointments were 1.35 times greater for men accessing HIV care at a landing site compared to on a island (AOR: 1.35, 95% CI: 1.08-1.67, $p=0.008$). Greater scores on the structural barriers to ART adherence scale were associated with increased odds of missed visits (AOR=1.27, 95% CI=1.04-1.56, $p=0.02$). Finally, there was a statistically significant interaction between months on ART and anticipated HIV stigma, with anticipated stigma having a greater effect on missed clinic visits for men more recently initiated on ART (AOR=0.88, 95% CI 0.81-0.98, $p = 0.02$). See Table 4.2 for detailed statistics, and Figure 4.1 for a graphic depiction of the months on ART by anticipated HIV stigma interaction.

Linear regression models testing independent variables at each level of the social ecological model and non-adherence index score

Less time on ART, taking one pill per day (compared to twice/day), greater AUDIT score, less social support, mobility, structural barriers to ART adherence, and the proportion of missed clinic visits in the prior year were associated with greater non-adherence in bivariate models ($p < 0.10$), but did not remain in adjusted models (see Table 3 for statistics).

All other associations remained in the multivariate model, displayed in Table 4.3. At the **individual-level**, age ($\beta=-0.01$, $SE=0.00$, $p=0.002$, $\eta^2=0.03$) and income ($\beta=-0.02$, $SE=0.01$, $p=0.04$, $\eta^2=0.02$), were both negatively associated with the non-adherence index score. That is, younger men and men with lower income had worse adherence. Greater scores on the individual-level barriers to adherence scale ($\beta=0.14$, $SE=0.09$, $\eta^2=0.01$) were also associated with non-adherence, but only marginally ($p=0.09$). The only **interpersonal-level factor** that remained in the model was HIV disclosure ($\beta=-$

0.02, SE=0.01, $\eta^2=0.01$), though the association was only marginally significant ($p=0.08$). Finally, at the **normative-level**, greater scores on the anticipated HIV stigma scale ($\beta=0.10$, SE=0.04, $p=0.03$, $\eta^2=0.02$) and enacted HIV stigma scale ($\beta=0.11$, SE=0.05, $p=0.03$, $\eta^2=0.02$) were associated with greater non-adherence. No barriers in the physical and built environment remained in the final model, and no interactions were identified between factors. Taken together, the total model explained 16% of variation in non-adherence ($R^2 = 0.16$).

Discussion

This study is among the first to assess HIV clinic attendance and ART adherence with fishermen on ART. This group represents a most-at-risk population being prioritized by national efforts for the scale up of universal test and treat programs in Uganda (77), but whose HIV care engagement has not been previously studied beyond initial linkage to care (47). Using the social ecological model to frame our analysis, we examined the influence of factors at different levels of the SEM, and found support for the influence of multi-level factors on HIV care engagement for men in this setting. For HIV clinic attendance, individual, interpersonal, normative, and physical/built environment factors were associated with missed clinic visits. For ART adherence, individual and normative-level factors had the greatest effect. These findings can inform the development of multi-level strategies to reduce barriers to attending HIV clinic appointments and to improve ART adherence for this population. Our study justifies the need for such efforts by highlighting less than optimal engagement among men. Men had missed a significant portion (39%) of their HIV clinic visits over the prior year. Moreover, a third of men reported sub-optimal adherence (31%) as assessed by the AIDS Clinical Trials Group (ACTG) adherence questionnaire (70).

In the model predicting HIV clinic attendance, the greatest number of factors fell within the physical and built environment-level. Specifically, reporting more structural barriers to adherence (e.g., work responsibilities, traveling), more travel time to the clinic, and accessing care on a landing site were associated with a greater likelihood of missed appointments. The development of differentiated care models specific to fishermen may help to overcome these barriers client-centered approach that simplifies and adapts HIV services to reflect the preferences of specific populations, while reducing burdens on the health system (78). Differentiated ART models for MARPs are typically centered on the decentralization of HIV clinic services through out-of-facility models and task shifting (78, 79). In our study setting, an out-of-facility approach was being implemented through Mildmay Uganda's outreach model. However, structural barriers and distance were still impeding access to these services for men, highlighting the need for research to compare the effectiveness and costing of different models of community-based ART delivery to maximize men's access to care, while reducing costs and health system burden (79-81). For example, the provision of ART refills through lay-counselors at community drug distribution points in Uganda (78, 82-84) and other client or health worker-led approaches to delivering ART in the community, such as community adherence groups (CAGs) and adherence clubs (AC) (85-87) show promising results specific to retention in care and viral suppression.

Our finding that clinic attendance was not associated with ART adherence in the final model, however, suggests that men may be able to maintain optimal treatment adherence without attending all of their scheduled clinic appointments. Therefore, implementing differentiated models of care for fishermen that reduce the number of clinic visits needed for men, while maintaining optimal treatment adherence, should be explored. The expansion of multi-month refills could be one such approach, allowing

stable patients to come to the clinic every 3 or 6 months, as opposed to monthly. Future research should examine the optimal level of multi-month refills and its effect on treatment outcomes, which would reduce the burden of frequent visits not only on men, but also on the broader health system.

Though physical and built environment-level barriers affected men's ability to keep their HIV clinic appointments, they did not remain in the final model predicting ART adherence. In contrast, factors at the individual and normative-level were most influential for ART adherence, which also remained in the models predicting HIV clinic attendance with comparable effect sizes to environmental-level factors. Consistent with the broader literature (29-34), at the individual-level, our findings highlight the need for efforts to focus on younger men and men of lower income, who had more trouble with adherence and clinic attendance. At the normative-level, HIV stigma was influential for both outcomes. Anticipated HIV stigma was significantly associated with missed visits, and both enacted and anticipated HIV stigma predicted missed ARVs. We also found anticipated HIV stigma had a greater affect on missed clinic appointments among men more recently initiated on ART. This finding supports other research that shows after the initiation of ART, HIV stigma may decrease over time (88). These findings also suggest strategies for HIV stigma reduction should occur soon after diagnosis and treatment initiation to prevent men from dropping out of care. CAGs and adherence clubs, and other community-based approaches discussed earlier as potential solutions to structural barriers to care, may also reduce HIV stigma (89, 90) by leveraging or expanding patient's existing support networks (91-93).

Relatedly, our findings also highlight the importance of interpersonal-level factors in increasing men's engagement in HIV care; namely, being married and living with a partner was associated with better clinic attendance, perhaps because spouses served

as treatment supporters for men. Though not significant in the final models, greater scores on the social support scale and HIV status disclosure were also associated with better engagement outcomes. In our study setting, men were encouraged to identify and utilize treatment supporters, but with half of our sample single, there is a need to enhance networks of support available to men. The integration of a peer support program in this setting may be beneficial to men, which is well supported by research in other MARPs and in SSA generally (94-96). While it can be difficult to engage men in treatment support groups and counseling that are often viewed as feminine (65, 97, 98), qualitative exploration with our sample suggests it may be acceptable in this particular setting, as men often encouraged each other to test and seek treatment for HIV (99). A recent study in Kenyan fishing villages reported promising improvements in care retention in an evaluation of “microclinic interventions,” which included 10 sessions of social support and education, and bolstered social capital and reduced HIV stigma by using patient-defined support networks (89). Such a model could be integrated with the CAG model, and thus simultaneously improve support while reducing HIV stigma and the number of visits needed and travel-related barriers.

While our study provides support for the effect of multi-level factors on men’s engagement in HIV care, this study provides a narrow look into the potential factors that affect men’s health seeking behavior. Each individual variable had a small effect size, and the overall variance explained by our multivariate model for ART adherence was also low (16%). In addition, variables that have been shown important to HIV outcomes in this context in qualitative research, such as alcohol use and mobility (42), did not remain in our final models. Future research is needed to replicate our findings, and to assess other factors not included in our study that may be contributing to HIV care engagement, especially those in the policy-environment, which was not assessed in this

study. Moreover, though we take an ecological perspective to frame this paper, our variables were measured at the patient-level. Future research on barriers to HIV care engagement should consider other methodology to gain a more comprehensive picture of the context of fishing villages, such as capturing health system factors from the health system itself as opposed to the individual.

While our clinic attendance measure was objective (collected through patient records), our measure of ART adherence would have been strengthened through the collection of viral load samples. We attempted to collect viral load data from patient clinic records, but found the data too incomplete to use. Though Chesney's (70) AIDS Clinical Trials Group (ACTG) questionnaire has been shown to predict viral load (76), future research should explore these constructs against biological outcomes, and use longitudinal designs to infer temporality between factors measured. The generalizability of our study is also limited to a specific geographic location and occupational group, and by the fact that this was a non-random sample recruited directly from the clinic. Twenty-two men declined participation, mainly due to time limitations; these men may face greater barriers to care than those sampled. Nevertheless, this study provided insight into multi-level barriers to care for fisherfolk on ART, who despite being sampled from the clinic, struggled with clinic attendance and achieving optimal adherence. Notably, other studies in SSA with men in the general population similarly demonstrate younger age, lower income, concerns about HIV stigma, financial restraints, and structural barriers to care are among the major barriers to men (16), suggesting our findings may be applicable to men generally.

Conclusions

In line with global HIV guidelines (100, 101), Uganda is moving towards the scale up of universal antiretroviral treatment (ART) for all (7), making efforts to engage and retain PLHIV along the care continuum a growing priority. Understanding factors influencing engagement in care among most-at-risk populations is especially needed, as achieving population viral load suppression in high prevalence settings would optimize the effectiveness of treatment as prevention, and ultimately slow the epidemic (102, 103). This study begins to fill a gap in the literature on determinants of HIV care engagement among Ugandan fishermen, and highlights the need for multi-level interventions to improve men's ability to attend the HIV clinic and take their medications as prescribed. Differentiated service models, such as expanding multi-month refills, that reduce the number of visits needed for men to achieve optimal treatment adherence should be studied for feasibility, acceptability, and cost-effectiveness in this setting. We recommend future research also explore the integration of peer-based support into community-based models of ART delivery to increase social support and reduce HIV stigma for fishermen on ART.

Acknowledgements

Chapter 4, in full, is currently being prepared for submission for publication of the material. Sileo KM; Wanyenze RK; Kizito W; Brodine SK; Reed E; Musoke W; Mukasa B; Kiene SM. The dissertation author was the primary investigator and author of this material.

Table 4.1: Participant characteristics, N=300

	% (n)/Mean	SD	Range
Individual-level factors			
Age	36.86	8.58	20-70
Education			
No schooling	202 (67.30%)		
Primary level	84 (28.00%)		
Secondary level	14 (4.70%)		
Occupation (other vs. fishermen)			
Fishermen	246 (82.00%)		
Fish seller, cleaner, dryer	35 (11.67%)		
Boat operator, repairer, loader	19 (6.33%)		
Monthly income (in USD)	62.16	29.73	4.14- 160.35
Months on ART	22.90	13.50	2-55
Number of pills prescribed			
Once daily	260 (86.67%)		
Twice daily	40 (13.33%)		
AUDIT score	4.45	5.13	0.00-20.00
Internalized stigma	0.61	0.53	0.00-2.17
Individual-level barriers to ART adherence	0.35	0.24	0.00-1.42
Interpersonal-level factors			
Marital status			
Never married	30 (10.00%)		
Divorced	78 (26.00%)		
Widowed	16 (5.30%)		
Married and separated most of the time	29 (9.70%)		
Married and living together most of the time	147 (49.00%)		
Social support	1.43	0.44	0.30-3.00
Total number of people disclosed HIV status to	2.04	1.59	0.00-8.00
Community-level factors			
Anticipated stigma	0.86	0.53	0.00-2.83
Enacted stigma	0.62	0.48	0.00-3.00
Structural-level factors			
Mobility (traveled/slept out of the community in prior 12 months)			
Yes	194 (64.67%)		
No	106 (35.33%)		
Average travel time to HIV clinic (minutes)	41.40	39.56	2-180
Structural-level barriers to ART adherence	1.11	0.57	0.00-2.67

Note: ART= antiretroviral therapy

Table 4.1: Continued

	% (n)/Mean	SD	Range
Structural-level factors			
Research site			
Island	175 (58.30%)		
Landing site	125 (41.70%)		
HIV care engagement outcomes			
Non-adherence index score (greater score indicating worse ART adherence)	41.79	25.95	0-100%
Proportion of missed clinic appointments (prior year)	39.00%	28.79%	0-100%
ART adherence (% of pills taken over 4 day recall period)	87.79%	21.46%	0-100%

Note: ART= antiretroviral therapy

Table 4.2: Bivariate and multivariate models testing independent variables at each level of the social ecological model and missed HIV clinic visits, Uganda 2016-17, N=300

	Bivariate models			Multivariate model		
	OR (95% CI)	χ^2	p	AOR (95% CI)	χ^2	p
Individual-level factors						
Age						
Monthly income (50,000 UGX/unit)	0.97 (0.96-0.99)	18.36	<0.001	0.98 (0.97-0.99)	6.00	0.01
Education (no education vs. any education)	0.98 (0.94-1.03)	0.57	0.45			
Any schooling						
No schooling (reference)	1.14 (0.92-1.40)	1.46	0.23			
Occupation (other vs. fishermen)						
Fishermen	1.06 (0.82-1.37)	0.18	0.67			
Other fisherfolk (reference)						
Months on ART (6 month/unit)	0.92 (0.88-0.97)	11.71	0.001	1.07 (0.97-1.17)	1.72	0.19
Number of pills prescribed						
Twice daily	0.72 (0.53-0.96)	4.95	0.03			
Once daily (reference)						
AUDIT score	1.02 (1.01-1.04)	5.88	0.02			
Internalized stigma	1.14 (0.95-1.37)	1.85	0.17			
Individual-level barriers to ART adherence	1.36 (0.89-2.08)	2.01	0.16			
Interpersonal-level factors						
Marital status						
Not married or separated	1.30 (1.06-1.58)	6.61	0.01	1.25 (1.01-1.54)	4.30	0.03
Married and living together (reference)						

Note: OR= Odds Ratio; AOR= Adjusted Odds Ratio; χ^2 = Wald chi square; Bolded text is used to indicate statistically significant associations at the $p < 0.05$ level; * is used to indicate statistically significant associations at the $p < 0.10$ level; AUDIT = The Alcohol Use Disorders Identification Test; ART = antiretroviral treatment.

Table 4.2: Continued

	Bivariate models			Multivariate model		
	OR (95% CI)	χ^2	p	AOR (95% CI)	χ^2	p
Interpersonal-level factors						
Social support	0.74 (0.58-0.93)	6.60	0.01			
Total number of people HIV disclosed status to	0.93 (0.88-0.99)	5.07	0.02			
Community-level factors						
Anticipated stigma	1.23 (1.02-1.49)	4.71	0.03	1.55 (1.05-2.29)	4.83	0.03
Enacted stigma	1.16 (0.95-1.42)	2.00	0.16			
Structural-level factors						
Mobility (traveled/slept out of the community in prior 12 months)						
Yes	1.27 (1.03-1.57)	5.05	0.03			
No (reference)						
Average travel time to HIV clinic (30 minute/unit)	1.12 (1.04-1.21)	8.49	0.004	1.11 (1.02-1.20)	5.93	0.02
Interactions						
Months on ART x anticipated HIV stigma	-	-	-	0.89 (0.81-0.98)	5.72	0.02
Mobility (traveled/slept out of the community in prior 12 months)						

Note: OR= Odds Ratio; AOR= Adjusted Odds Ratio; χ^2 = Wald chi square; Bolded text is used to indicate statistically significant associations at the $p < 0.05$ level; † is used to indicate statistically significant associations at the $p < 0.10$ level; AUDIT = The Alcohol Use Disorders Identification Test; ART = antiretroviral treatment.

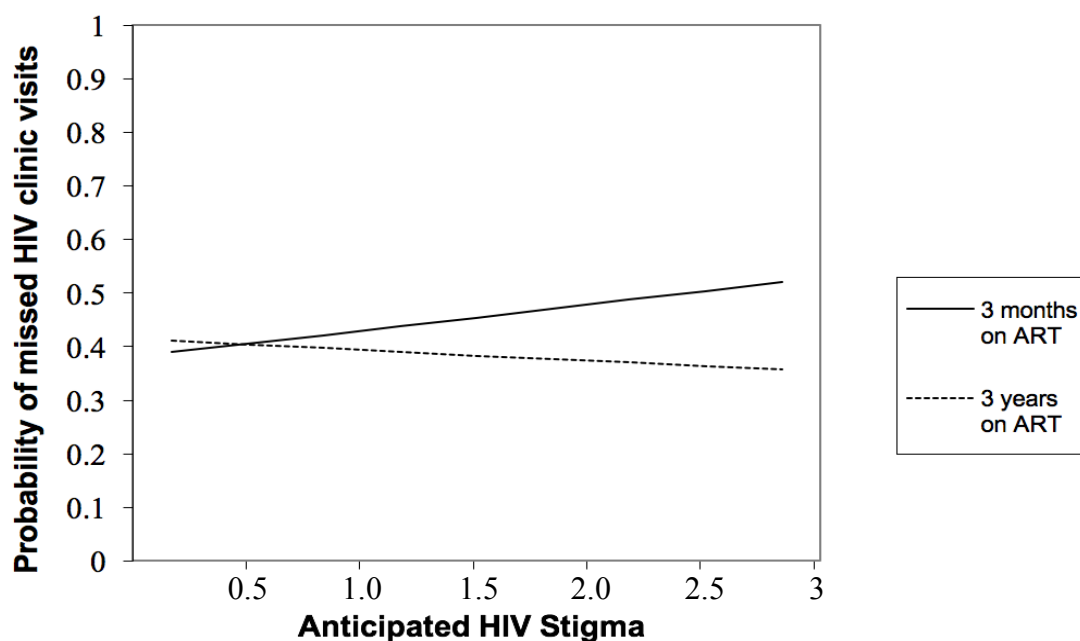


Figure 4.1: Interaction between anticipated HIV stigma and months on antiretroviral treatment (ART) on the probability of missed HIV clinic visits in the prior year, controlling for covariates. Men newly initiated on ART are more likely to missed their HIV clinic visits due to anticipated HIV stigma compared to men on ART for a longer time period. The figure displays this difference for men on ART for 3 months compared to men on ART for 3 years.

Table 4.3: Bivariate and multivariate models testing independent variables at levels of the social ecological model and ART non-adherence index score, Uganda 2016-17, N=300

	Bivariate models					Multivariate model				
	β	Std. Error	p	η^2		β	Std. Error	p	η^2	
Individual-level factors										
Age	-0.01	0.00	<0.004	0.05		-0.01	0.00	0.002	0.03	
Monthly income (50,000 UGX/unit)	-0.03	0.01	0.004	0.03		-0.01	0.01	0.04	0.02	
Education (no education vs. any education)										
Any schooling	0.03	0.05	0.62	0.001						
No schooling (reference)										
Occupation (other vs. fishermen)										
Fishermen	0.07	0.06	0.26	0.004						
Other fishermen (reference)										
Months on ART (6 month/unit)	-0.02	0.01	0.08 [†]	0.01						
Number of pills prescribed										
Twice daily	-0.13	0.07	0.05 [†]	0.01						
Once daily (reference)										
AUDIT score	0.01	0.00	0.03	0.02						
Internalized stigma	0.04	0.04	0.32	0.003						
Individual-level barriers to ART adherence	0.23	0.88	0.009	0.02		0.14	0.09	0.09 [†]	0.01	

Note: β = Beta, Std. error = standard error; Bolded text is used to indicate statistically significant associations at the $p < 0.05$ level; [†] is used to indicate statistically significant associations at the $p < 0.10$ level; AUDIT = The Alcohol Use Disorders Identification Test; ART = antiretroviral treatment.

Table 4.3: Continued

	Bivariate models					Multivariate model				
	β	Std. Error	p	η^2	β	Std. Error	p	η^2		
Interpersonal-level factors										
Marital status										
Not married or separated	0.03	0.05	0.47	0.002						
Married and living together (reference)										
Social support	-0.23	0.05	<0.001	0.06						
Total number of people HIV disclosed status to	-0.38	0.02	0.009	0.02	-0.02	0.01	0.08 [†]	0.01		0.01
Community-level factors										
Anticipated stigma	0.17	0.04	<0.001	0.05	0.10	0.04	0.03	0.04		0.02
Enacted stigma	0.19	0.05	<0.001	0.05	0.11	0.05	0.03	0.05		0.02
Structural-level factors										
Mobility (traveled/slept out of the community in prior 12 months)										
Yes	0.15	0.05	0.002	0.03						
No (reference)										
Average travel time to HIV clinic (30 minute/unit)	0.01	0.02	0.49	0.002						
Research site										
Landing site	0.07	0.05	0.12	0.01						
Island (ref)										
Structural barriers to ART adherence	0.14	0.04	<0.001	0.05						
Proportion of missed clinic appointments (prior year)	0.27	0.08	0.001	0.04	0.06	0.07	0.40	0.06		0.003

Note: β = Beta, Std. error = standard error; Bolded text is used to indicate statistically significant associations at the $p < 0.05$ level; [†] is used to indicate statistically significant associations at the $p < 0.10$ level; AUDIT = The Alcohol Use Disorders Identification Test; ART = antiretroviral treatment.

References

1. Asiki G, Mpendo J, Abaasa A, Agaba C, Nanvubya A, Nielsen L, et al. HIV and syphilis prevalence and associated risk factors among fishing communities of Lake Victoria, Uganda. *Sex Transm Dis*. 2011;87(6):511-5.
2. Seeley J, Nakyingi-Miir J, Kamali A, Mpendo J, Asiki G, Abaasa A, et al. High HIV incidence and socio-behavioral risk patterns in fishing communities on the shores of Lake Victoria, Uganda. *Sex Transm Dis*. 2012;39(6):433-9.
3. Opio A, Muyonga M, Mulumba N. HIV sero behavioral survey in fishing communities of the Lake Victoria basin of Uganda. SIDA, MOH, AMREF; 2011.
4. Chang LW, Grabowski MK, Ssekubugu R, Nalugoda F, Kigozi G, Nantume B, et al. Heterogeneity of the HIV epidemic in agrarian, trading, and fishing communities in Rakai, Uganda: an observational epidemiological study. *Lancet*. 2016;3(3):8.
5. Uganda MOH, ICF International. Uganda AIDS Indicator Survey (AIS) 2011. Kampala, Uganda; Calverton, Maryland, USA: MOH and ICF International; 2012.
6. The World Health Organization (WHO). Guidelines on when to start antiretroviral therapy and on pre-exposure prophylaxis for HIV. Geneva: WHO; 2015.
7. Uganda Ministry of Health. Consolidated Guidelines for Prevention and Treatment of HIV in Uganda. Kampala, Uganda: MOH; 2016.
8. World Health Organization. Consolidated guidelines on the use of antiretroviral drugs for treating and preventing HIV infection. Geneva, Switzerland: WHO; 2013.
9. Shand T, Thomson-de Boor H, van den Berg W, Peacock D, Pascoe L. The HIV blind spot: men and HIV testing, treatment and care in sub-Saharan Africa. *IDS Bulletin*. 2014;45(1):53-60.
10. Cornell M, McIntyre J, Myer L. Men and antiretroviral therapy in Africa: our blind spot. *Trop Med Int Health*. 2011;16(7):828-9.
11. Tromp N, Michels C, Mikkelsen E, Hontelez J, Baltussen R. Equity in utilization of antiretroviral therapy for HIV-infected people in South Africa: a systematic review. *Int J Equity Health*. 2014;13(1):1-17.
12. Bangsberg DR, Perry S, Charlebois ED, Clark RA, Roberston M, Zolopa AR, et al. Non-adherence to highly active antiretroviral therapy predicts progression to AIDS. *AIDS*. 2001;15(9):1181-3.
13. Gardner EM, Burman WJ, Steiner JF, Anderson PL, Bangsberg DR. Antiretroviral medication adherence and the development of class-specific antiretroviral resistance. *23*. 2009;9(1035-1046).

14. Mugavero MJ, Amico KR, Westfall AO, Crane HM, Zinski A, Willig JH, et al. Early retention in HIV care and viral load suppression: implications for a test and treat approach to HIV prevention. *J Acquir Immune Defic Syndr*. 2012;59(1):86-93.
15. Beckham SW, Beyrer C, Luckow P, Doherty M, Negussie EK, Baral SD. Marked sex differences in all-cause mortality on antiretroviral therapy in low- and middle-income countries: a systematic review and meta-analysis. *J Int AIDS Soc*. 2016;19(1):21106.
16. Sharma M, Barnabas RV, Celum C. Community-based strategies to strengthen men's engagement in the HIV care cascade in sub-Saharan Africa. *PLOS Medicine*. 2017;14(4):e1002262.
17. Sileo KM, Fielding-Miller R, Dworking SL, Fleming PJ, editors. The role of gender norms and masculinity on men's engagement in the HIV care continuum in sub-Saharan Africa: a systematic review. 9th IAS Conference on HIV Science (IAS 2017); 2017 23-27 July; Paris, France.
18. Brofenbrenner U. Toward an experimental ecology of human development. *Am Psychol*. 1977;32(513-531).
19. McLeroy KR BD, Steckler A, Glanz K. A.,. An ecological perspective on health promotion programs. *Health Educ Q*. 1988;15(4):351-77.
20. Stokols D. Establishing and maintaining healthy environments: toward a social ecology of health promotion. *Am Psychol*. 1992;47(1):6-22.
21. Kaufman M, Cornish F, Zimmerman R, Johnson B. Health behavior change models for HIV prevention and AIDS care: practical recommendations for a multi-level approach. *J Acquir Immune Defic Syndr*. 201;66 Suppl 3:S250-8. doi: 10.1097/QAI.0000000000000236.
22. Castro EM, Santiago LE, Jiménez JC, Dávila-Vargas D, Rosal MC. A social-ecological view of barriers and facilitators for HIV treatment adherence: interviews with Puerto Rican HIV patients. *PLOS ONE*. 2015;10(9):e0125582.
23. Berger MB, Sullivan KA, Parnell HE, Keller J, Pollard A, Cox ME, et al. Barriers and facilitators to retaining and reengaging HIV clients in care. *J Int Assoc Provid AIDS Care*. 2015;15(6):486-93.
24. Hoffmann CJ, Mabuto T, McCarthy K, Maulsby C, Holtgrave DR. A framework to inform strategies to improve the HIV care continuum in low- and middle-income countries. *AIDS Edu Prev*. 2016;28(4):351-64.
25. Hornschuh S, Dietrich JJ, Tshabalala C, Laher F. Antiretroviral treatment adherence: knowledge and experiences among adolescents and young adults in Soweto, South Africa. *AIDS Res Treat*. 2017;5192516. doi: 10.1155/2017/5192516. Epub 2017 Mar 20.

26. Marcellin F, Abé C, Loubière S, Boyer S, Blanche J, Koulla-Shiro S, et al. Delayed first consultation after diagnosis of HIV infection in Cameroon. *AIDS*. 2009;15(23):1015-9.
27. Nyanzi-Wakholi B, Medina Lara A, Munderi P, Gilks C, on behalf of the DTT. The charms and challenges of antiretroviral therapy in Uganda: the DART experience. *AIDS Care*. 2012;24(2):137-42.
28. Gourlay A, Birdthistle I, Mburu G, Iorpenda K, Wringe A. Barriers and facilitating factors to the uptake of antiretroviral drugs for prevention of mother-to-child transmission of HIV in sub-Saharan Africa: a systematic review. *J Int AIDS Soc*. 2013;16.
29. Bassett IV, Wang B, Chetty S, Mazibuko M, Bearnot B, Giddy J, et al. Loss to care and death before antiretroviral therapy in Durban, South Africa. *J Acquir Immune Defic Syndr*. 2009;51(2):135-9.
30. Cornell M, Grimsrud A, Fairall L, Fox MP, van Cutsem G, Giddy J, et al. Temporal changes in programme outcomes among adult patients initiating antiretroviral therapy across South Africa, 2002-2007. *AIDS*. 2010;24(14):2263-70.
31. Van Cutsem G, Ford N, Hildebrand K, Goemaere E, Mathee S, Abrahams M, et al. Correcting for mortality among patients lost to follow up on antiretroviral therapy in South Africa: a cohort analysis. *PLoS One*. 2011;6(2):e14684.
32. Wang B, Losina E, Stark R, Munro A, Walensky RP, Wilke M, et al. Loss to follow-up in a community clinic in South Africa--roles of gender, pregnancy and CD4 count. *S Afr Med J*. 2011;101(4):253-7.
33. Charurat M, Oyegunle M, Benjamin R, Habib A, Eze E, Ele P, et al. Patient retention and adherence to antiretrovirals in a large antiretroviral therapy program in Nigeria: a longitudinal analysis for risk factors. *PLoS One*. 2010;5(5):e10584.
34. Cornell M, Myer L, Kaplan R, Bekker LG, Wood R. The impact of gender and income on survival and retention in a South African antiretroviral therapy programme. *Trop Med Int Health*. 2009;14(7):722-31.
35. Mills EJ, Nachega JB, Buchan I, et al. Adherence to antiretroviral therapy in sub-Saharan Africa and North America: A meta-analysis. *JAMA*. 2006;296(6):679-90.
36. Nachega JB, Mills EJ, Schechter M. Antiretroviral therapy adherence and retention in care in middle-income and low-income countries: current status of knowledge and research priorities. *Curr Opin HIV AIDS*. 2010;5(1):70-7.
37. Geng EH, Bangsberg DR, Musinguzi N, Emenyonu N, Bwana MB, Yiannoutsos CT, et al. Understanding reasons for and outcomes of patients lost to follow-up in antiretroviral therapy programs in Africa through a sampling-based approach. *J Acquir Immune Defic Syndr*. 2010;53(3):405-11.

38. Croome N, Ahluwalia M, Hughes LD, Abas M. Patient-reported barriers and facilitators to antiretroviral adherence in sub-Saharan Africa. *AIDS*. 2017;31(7):995-1007.
39. Muhamadi L, Nsabagasani X, Tumwesigye MN, Wabwire-Mangen F, Ekström A-M, Peterson S, et al. Inadequate pre-antiretroviral care, stock-out of antiretroviral drugs and stigma: policy challenges/bottlenecks to the new WHO recommendations for earlier initiation of antiretroviral therapy in eastern Uganda. *Health Policy*. 2010;97(2):187-94.
40. Colvin CJ, Konopka S, Chalker JC, Jonas E, Albertini J, Amzel A, et al. A systematic review of health system barriers and enablers for antiretroviral therapy (ART) for HIV-infected pregnant and postpartum women. *PLOS ONE*. 2014;9(10):e108150.
41. Dovel K YS, Watkins S, Poulin M,. Men's heightened risk of AIDS-related death: the legacy of gendered HIV testing and treatment strategies. *AIDS*. 2015;29(1123-1125).
42. Sileo K, Kintu M, Chanes-Mora P, Kiene S. "Such behaviors are not in my home village, I got them here": a qualitative study of the influence of contextual factors on alcohol and HIV risk behaviors in a fishing community on Lake Victoria, Uganda. *AIDS Behav*. 2016;20(3):537-47.
43. Seeley JA, Allison EH. HIV/AIDS in fishing communities: challenges to delivering antiretroviral therapy to vulnerable groups. *AIDS Care*. 2005;17(6):688-97.
44. Allison EH, Seeley JA. HIV and AIDS among fisherfolk: a threat to 'responsible fisheries'? *Fish Fisheries*. 2004;5(3):215-34.
45. Nunan F. Mobility and fisherfolk livelihoods on Lake Victoria: implications for vulnerability and risk. *Geoforum*. 2010;41(5):776-85.
46. Kwena ZA, Camlin CS, Shisanya CA, Mwanzo I, Bukusi EA. Short-term mobility and the risk of HIV infection among married couples in the fishing communities along Lake Victoria, Kenya. *PLoS ONE*. 2013;8(1):e54523.
47. Bogart LM, Naigino R, Maistrellis E, Wagner GJ, Musoke W, Mukasa B, et al. Barriers to linkage to HIV care in Ugandan fisherfolk communities: a qualitative analysis. *AIDS Behav*. 2016;20(10):2464-76.
48. Bogart LM, Wagner GJ, Musoke W, Naigino R, Linnemayr S, Maistrellis E, et al. A comparison of home-based versus outreach event-based community HIV testing in Ugandan fisherfolk communities. *AIDS Behav*. 2017;21(2):547-60.
49. Mack N, Odhiambo J, Wong CM, Agot K. Barriers and facilitators to pre-exposure prophylaxis (PrEP) eligibility screening and ongoing HIV testing among target populations in Bondo and Rarieda, Kenya: results of a consultation with community stakeholders. *BMC Health Serv Res*. 2014;14:231. doi: 10.1186/1472-6963-14-231.
50. Tumwesigye NM, Atuyambe L, Wanyenze RK, Kibira SP, Li Q, Wabwire-Mangen F, et al. Alcohol consumption and risky sexual behaviour in the fishing communities:

evidence from two fish landing sites on Lake Victoria in Uganda. *BMC Public Health*. 2012;12:12.

51. Smolak A. A meta-analysis and systematic review of HIV risk behavior among fishermen. *AIDS Care*. 2013;26(3):282-91.

52. Kiwanuka N, Ssetaala A, Nalutaaya A, Mpendo J, Wambuzi M, Nanvubya A, et al. High Incidence of HIV-1 infection in a general population of fishing communities around Lake Victoria, Uganda. *PLoS ONE*. 2014;9(5):e94932.

53. Sileo KM, Simbayi LC, Abrams A, Cloete A, Kiene SM. The role of alcohol use in antiretroviral adherence among individuals living with HIV in South Africa: event-level findings from a daily diary study. *Drug Alcohol Depend*. 2016;167:103-11.

54. Hendershot CS, Stoner SA, Pantalone DW, Simoni JM. Alcohol use and antiretroviral adherence: review and meta-analysis. *J Acquir Immune Defic Syndr*. 2009;52(2).

55. Kunutsor S, Walley J, Katabira E, Muchuro S, Balidawa H, Namagala E, et al. Improving clinic attendance and adherence to antiretroviral therapy through a treatment supporter intervention in Uganda: a randomized controlled trial. *AIDS Behav*. 2011;15(8):1795-802.

56. Nachega JB, Knowlton AR, Deluca A, Schoeman JH, Watkinson L, Efron A, et al. Treatment supporter to improve adherence to antiretroviral therapy in HIV-infected South African adults: a qualitative study. *J Acquir Immune Defic Syndr*. 2006;43:S127-S33.

57. Seeley J, Tumwekwase G, Grosskurth H. Fishing for a living but catching HIV: AIDS and changing patterns of the organization of work in fisheries in Uganda. *Anthropol Work Rev*. 2009;30(2):66-76.

58. Katz IT, Ryu AE, Onuegbu AG, Psaros C, Weiser SD, Bangsberg DR, et al. Impact of HIV-related stigma on treatment adherence: systematic review and meta-synthesis. *J Int AIDS Soc*. 2013;16(3Suppl 2):18640.

59. Bonnington O, Wamoyi J, Ddaaki W, Bukenya D, Ondenge K, Skovdal M, et al. Changing forms of HIV-related stigma along the HIV care and treatment continuum in sub-Saharan Africa: a temporal analysis. *Sex Transm Infect*. 2017;93(3):e052975.

60. Earnshaw VA, Chaudoir SR. From conceptualizing to measuring HIV stigma: a review of HIV stigma mechanism measures. *AIDS Behav*. 2009;13(6):1160-77.

61. Tabatabai J, Namakhoma I, Tweya H, Phiri S, Schnitzler P, Neuhaan F. Understanding reasons for treatment interruption amongst patients on antiretroviral therapy--a qualitative study at the Lighthouse Clinic, Lilongwe, Malawi. *Glob Health Action*. 2014;30(2):24795.

62. Lyimo RA, Stutterheim SE, Hospers HJ, de Glee T, van der Ven A, de Bruin M. Stigma, disclosure, coping, and medication adherence among people living with HIV/AIDS in Northern Tanzania. *AIDS Patient Care STDs*. 2014;28(2):98-105.
63. Treves-Kagan S, Steward WT, Ntswane L, Haller R, Gilvydis JM, Gulati H, et al. Why increasing availability of ART is not enough: a rapid, community-based study on how HIV-related stigma impacts engagement to care in rural South Africa. *BMC Public Health*. 2016;16(1):87.
64. Wyrod R. Masculinity and the persistence of AIDS stigma. *Cult Health Sex*. 2011;13(4):443-56.
65. Mburu G, Ram M, Siu G, Bitira D, Skovdal M, Holland P. Intersectionality of HIV stigma and masculinity in eastern Uganda: implications for involving men in HIV programmes. *BMC Public Health*. 2014;14 1061.
66. The World Health Organization (WHO). The Alcohol Use Disorders Identification Test: Guidelines for Use in Primary Care. Geneva: WHO; 2001.
67. Martinez P, Andia I, Emenyonu N, Hahn JA, Hauff E, Pepper L, et al. Alcohol use, depressive symptoms and the receipt of antiretroviral therapy in southwest Uganda. *AIDS Behav*. 2008;12(4):605-12.
68. Babor TF, Higgins-Biddle JC, Saunders JB, Monteiro MG. The alcohol use disorders identification test: guidelines for use in primary care. Geneva: World Health Organization; 2001.
69. Earnshaw VA, Smith LR, Chaudoir SR, Amico KR, Copenhaver MM. HIV Stigma Mechanisms and Well-Being among PLWH: A Test of the HIV Stigma Framework. *AIDS Behav*. 2013;17(5):1785-95.
70. Chesney MA, Ickovics JR, Chambers DB, Gifford AL, Neidig J, Zwickl B, et al. Self-reported adherence to antiretroviral medications among participants in HIV clinical trials: the AACTG adherence instruments. *AIDS Care*. 2000;12(3):255-66.
71. Antelman G, Smith Fawzi MC, Kaaya S, Mbwambo J, Msamanga GI, Hunter DJ, et al. Predictors of HIV-1 serostatus disclosure: a prospective study among HIV-infected pregnant women in Dar es Salaam, Tanzania. *AIDS*. 2001;15(14):1865-74.
72. Broadhead WE, Gehlbach SH, Gruy FVd, Berton HK. The Duke-UNC functional social support questionnaire: measurement of social support in family medicine patients. *medical care*. 1988;26(7):709-23.
73. Epino HM, Rich ML, Kaigamba F, Hakizamungu M, Socci AR, Bagiruwigize E, et al. Reliability and construct validity of three health-related self-report scales in HIV-positive adults in rural Rwanda. *AIDS Care*. 2012;24(12):1576-83.
74. Howell DC. Statistical methods in human sciences. New York: Wadsworth; 1998.

75. Safren SA, Biello KB, Smeaton L, Mimiaga MJ, Walawander A, Lama JR, et al. Psychosocial predictors of non-adherence and treatment failure in a large scale multi-national trial of antiretroviral therapy for HIV: data from the ACTG A5175/PEARLS trial. *PLOS ONE*. 2014;9(8):e104178.
76. Reynolds NR, Sun J, Nagaraja HN, Gifford AL, Wu AW, Chesney MA. Optimizing measurement of self-reported adherence with the ACTG adherence questionnaire: a cross-protocol analysis. *J Acquir Immune Defic Syndr*. 2007;46(4):402-9.
77. Uganda MOH. Addendum to the National Antiretroviral Treatment Guidelines. Kampala, Uganda: Uganda Ministry of Health; 2013.
78. International AIDS Society (IAS). Differentiated care for HIV: a decision framework for antiretroviral. Available from: http://www.differentiatedcare.org/Portals/0/adam/Content/yS6M-GKB5EWs_uTBHk1C1Q/File/Decision Framework.pdf. 2016.
79. Macdonald V, Verster A, Baggaley R. A call for differentiated approaches to delivering HIV services to key populations. *J Int AIDS Soc*. 2017;20(4):28-31.
80. Barker C, Dutta A, Klein K. Can differentiated care models solve the crisis in HIV treatment financing? analysis of prospects for 38 countries in sub-Saharan Africa. *J Int AIDS Soc*. 2017;20(4):68-79.
81. Prust ML, Banda CK, Nyirenda R, Chimbwandira F, Kalua T, Jahn A, et al. Multi-month prescriptions, fast-track refills, and community ART groups: results from a process evaluation in Malawi on using differentiated models of care to achieve national HIV treatment goals. *Journal of the International AIDS Society*; Vol 20 Supplement 4 (2017). 2017.
82. Mpiima D AS, Ngolobe M (2011) editor Community drug distribution points (CDDPs) for decongestion of facility clinics, improve ART accessibility, quality and community collaboration. 6th IAS Conference on HIV. Pathogenesis and Treatment Abstract No. CDD042.2011.
83. Mbonye M, Seeley J, Ssembajja F, Birungi J, Jaffar S. Adherence to antiretroviral therapy in Jinja, Uganda: a six-year follow-up study. *PLOS ONE*. 2013;8(10):e78243.
84. Okoboi S, Ding E, Persuad S, Wangisi J, Birungi J, Shurgold S, et al. Community-based ART distribution system can effectively facilitate long-term program retention and low-rates of death and virologic failure in rural Uganda. *AIDS Res Ther*. 2015;12:37. doi: 10.1186/s12981-015-0077-4. eCollection 2015.
85. Jobarteh K, Shiraishi RW, Malimane I, Samo Gudo P, Decroo T, Auld AF, et al. Community ART support groups in Mozambique: the potential of patients as partners in care. *PLOS ONE*. 2016;11(12):e0166444.

86. Tsondai PR, Wilkinson LS, Grimsrud A, Mdlalo PT, Ullauri A, Boule A. High rates of retention and viral suppression in the scale-up of antiretroviral therapy adherence clubs in Cape Town, South Africa. *J Int AIDS Soc.* 2017;20(4):51-57.
87. Decroo T KO, Remartinez D, dos Santos N, Dezembro S, Jofrisse M, Rasschaert F, Biot M, Laga M,. Four-year retention and risk factors for attrition among members of community ART groups in Tete, Mozambique. *Trop Med Int Health.* 2014;19(5):514-21.
88. Tsai AC, Bangsberg DR, Bwana M, Haberer JE, Frongillo EA, Muzoora C, et al. How does antiretroviral treatment attenuate the stigma of HIV? evidence from a cohort study in rural Uganda. *AIDS Behav.* 2013;17(8):2725-31.
89. Hickey MD SC, Omollo D, Mattah B, Fiorella KJ, Geng EH, Bacchetti P, Blat C, Ouma GB, Zoughbie D, Tessler RA, Salmen MR, Campbell H, Gandhi M, Shade S, Njoroge B, Bukusi EA, Cohen CR,. Implementation and operational research: pulling the network together: quasiexperimental trial of a patient-defined support network intervention for promoting engagement in HIV care and medication adherence on Mfangano Island, Kenya. *J Acquir Immune Defic Syndr.* 2015;69(4):e127-34.
90. O'Laughlin KN, Wyatt MA, Kaaya S, Bangsberg DR, Ware NC. How treatment partners help: social analysis of an African adherence support intervention. *AIDS Behav.* 2012;16(5):1308-5.
91. Stangl AL, Lloyd JK, Brady LA, Holland CE, Baral S. A systematic review of interventions to reduce HIV-related stigma and discrimination from 2002 to 2013: how far have we come? *J Int AIDS Soc.* 2013;16(2):18734.
92. Tshabalala J, Visser M. Developing a cognitive behavioural therapy model to assist women to deal with HIV and stigma. *South African J Psychol.* 2011;41(1):17-28.
93. Takada S, Weiser SD, Kumbakumba E, Muzoora C, Martin JN, Hunt PW, et al. The dynamic relationship between social support and HIV-related stigma in rural Uganda. *Ann Behav Med.* 2014;48(1):26-37.
94. Latkin CA, Davey-Rothwell MA, Knowlton AR, Alexander KA, Williams CT, Boodram B. Social network approaches to recruitment, HIV prevention, medical care, and medication adherence. *J Acquir Immune Defic Syndr.* 2013;63(0 1):S54-S8.
95. Govindasamy D, Meghij J, Negussi EK, Baggaley RC, Ford N, Kranzer K. Interventions to improve or facilitate linkage to or retention in pre-ART (HIV) care and initiation of ART in low- and middle-income settings – a systematic review. *J Int AIDS Soc.* 2014;17(1):19032.
96. Simoni JM, Nelson KM, Franks JC, Yard SS, Lehavot K. Are peer interventions for HIV efficacious? a systematic review. *AIDS Behav.* 2011;15(8):1589-95.
97. Siu GE, Seeley J, Wight D. Dividuality, masculine respectability and reputation: how masculinity affects men's uptake of HIV treatment in rural eastern Uganda. *Soc Sci Med.* 2013;89:45-52.

98. Skovdal M, Campbell C, Madanhire C, Mupambireyi Z, Nyamukapa C, Gregson S. Masculinity as a barrier to men's use of HIV services in Zimbabwe. *Global Health*. 2011;7:13.
99. Sileo KM, Wanyenze RK, Kizito W, Reed L, Wagman JA, Musoke W, et al. "I take my medication well, so I don't even have a single doubt of fulfilling that role": A qualitative study on masculine roles and engagement in HIV care among male fisherfolk in Uganda. Unpublished.
100. UNAIDS. 90-90-90: An ambitious treatment target to help end the AIDS epidemic. Geneva: UNAIDS; 2014.
101. World Health Organization. Consolidated Guidelines on the Use of Antiretroviral Drugs for Treating and Preventing HIV Infection: Recommendation for a Public Health Approach. Second Edition. Geneva: WHO; 2016.
102. Maheu-Giroux M, Vesga JF, Diabaté S, Alary M, Baral S, Diouf D, et al. Population-level impact of an accelerated HIV response plan to reach the UNAIDS 90-90-90 target in Côte d'Ivoire: Insights from mathematical modeling. *PLOS Medicine*. 2017;14(6):e1002321.
103. Mishra S ME, Pickles M, Vickerman P, Shastri S, Gilks C, Dhingra NK, Washington R, Becker ML, Blanchard JF, Alary M, Boily MC; Strategic Epi-ART in India Modelling Team,. Exploring the population-level impact of antiretroviral treatment: the influence of baseline intervention context. *AIDS*. 2014;28(1):S61-72.

CHAPTER 5: DISCUSSION

Despite fisherfolk being a MARP and priority population for the scale up of HIV prevention, testing, and treatment delivery, a dearth of information on men's HIV care engagement exists for this population. This dissertation provides data on men's HIV clinic attendance and ART adherence, which were sub-optimal. Men reported missing 39% of their clinic appointments in the prior year, and a third of the sample reported sub-optimal ART adherence (<95% of pills taken as prescribed). Both clinic attendance and ART adherence are critical to achieving viral suppression (1, 2), which is imperative to the health of PLHIV (3), as well as the potential to reduce HIV incidence on a population-level through the scale up of ART (3-5). Thus, this dissertation highlights an urgent need for strategies to improve HIV care engagement through public health intervention. We found factors at all levels examined of the SEM contributed to our outcomes, providing evidence to support the effect of multi-level factors that contribute to men's HIV care engagement. Younger age, lower income, consuming higher quantities of alcohol, interpersonal relationships, norms of masculinity, HIV stigma, and barriers in the physical and built environment were among the main determinants identified through quantitative and qualitative methods. See Figure 5.1 for a depiction of this dissertation's primary findings mapped onto the SEM. These findings, and their contribution to the scientific literature, are described in more detail below.

At the individual-level, our findings mirror that of the broader literature in SSA; we found men of younger age and lower income (6-11) and those consuming high quantities of alcohol (12-16) were at an increased risk of non-engagement in HIV/AIDS care. Though alcohol use did not remain in the full model in aim 3, our mixed methods exploration in aim 1 suggests alcohol is still an important determinant of ART adherence.

Moreover, these findings contributed to several knowledge gaps in the alcohol-ART adherence literature. First, existing evidence for the role of risk levels/drinking quantity on ART adherence is mixed. Some studies have shown lower levels of drinking or any drinking drive the alcohol-ART association (13, 17-21), while others have shown risk of non-adherence is greater with higher levels of alcohol consumption (12, 13, 15). Our study supports the latter, with risk for non-adherence increasing with increased consumption, and a greater effect of higher levels of drinking on adherence for men on twice daily regimens compared to once daily (12, 19). Our mixed methods study design also allowed us to explore the mechanisms in which alcohol use leads to non-adherence, a research question that has not received enough attention previously (12). In addition to missing doses unintentionally when drinking, we found that men intentionally skip doses to avoid perceived negative interactions between alcohol and their ARVs, a finding mirrored in several other settings (17, 22, 23). This finding is an important contribution to the literature, as counseling for men who drink may not be addressing this knowledge gap.

At the interpersonal level, we found men who were unmarried or separated were more likely to miss their clinic appointments than married men living with their spouse. In our study setting, providers were encouraging men to identify a treatment supporter to help remind them to take their medications on schedule and pick up ART refills. In the broader literature, the use of treatment supporters is associated with greater emotional support and better treatment adherence (24, 25). Thus, married men in our sample likely had better clinic attendance because of the emotional and instrumental support received from their spouses. Other interpersonal-level variables (i.e., HIV disclosure, social support) did not remain statistically significant in the final multivariate models in aim 3. However, the qualitative findings of aims 1 and 2 provided further insight into men's

broader social networks. Aim 1 highlighted the influence of male peers in men's alcohol consumption, while aim 2 suggested men supported one another to engage in HIV testing and treatment, and served as treatment supporters to one another. Other studies have demonstrated the influence of male peers in men's health behaviors in similar settings where men cluster for work (26-28). Taken together, these findings suggest the interpersonal level plays an important role in men's engagement in both healthy and unhealthy behaviors, and may be leveraged/intervened on in public health programming (discussed further under "Implications for public health practice").

At the normative level, though the overall prevalence of HIV stigma was reportedly low in our sample, HIV stigma was still identified as a barrier to both HIV clinic attendance and ART adherence in aim 3. Specifically, anticipating HIV stigma from others negatively affected HIV clinic attendance, and both anticipating and experiencing HIV stigma (i.e., enacted stigma) was associated with poorer treatment adherence. These findings are in line with that of prior studies that report HIV stigma reduced men's uptake of HIV testing and timely linkage to HIV care in fishing villages (29, 30), and more broadly contribute to a large literature in SSA supporting HIV stigma's negative effect on engagement across the care continuum (31-35), which may be particularly true for men in SSA (36-40). Our qualitative findings from aim 2 provided more insight into the role of HIV stigma in treatment adherence, demonstrating men who were able to fulfill their masculine roles through ART in our sample felt protected from HIV stigma and discrimination from others. Others studies on the intersection of masculinity and HIV stigma provide qualitative evidence that a fear of HIV stigma is heightened among men in SSA because of HIV's damaging effects on men's notions of masculinity, including respect, strength, and the ability to fulfill their masculine roles (37, 38, 41). Our findings

suggest ART may reduce HIV stigma overtime (42), in part through the revival of men's masculine identities.

This dissertation provides further qualitative evidence for the role of norms of masculinity and men's socially prescribed gender roles on men's engagement in HIV care. Gender norms stem from the broader cultural and community levels to influence individual attitudes and health seeking behaviors (43). In sum, being infected with HIV threatened notions of masculinity and norms of masculinity served as barriers to care in some cases. However, overtime men were able to adopt a masculine identity that embraced HIV care and healthy living and recognized the importance of ART in their ability to fulfill the socially prescribed roles important to them, namely the roles of husband, father, provider, and worker. These findings add to our current understanding of the role of masculinities in men's health seeking behavior, which is of particular public health relevance as the need to understand and address men's absence in the HIV care continuum in SSA is becoming increasingly recognized (44, 45).

In contrast to a sizeable literature highlighting the role of "harmful" notions of masculinity in perpetuating HIV transmission (46-50) and deterring men from HIV care (41), our findings highlight how masculinity and men's roles can enhance men's HIV care engagement. Focusing solely on the negative aspects of masculinity in health behavior may result in the "blaming" of men in perpetuating the HIV/AIDS epidemic (51). Further, as Dworkin et al. (52) explains, a focus on harmful individualized masculinities "places onus on individual men to overcome complex and entrenched societal-level problems." It is important not to lose sight of the higher-level system of gender norms that hold women as vulnerable and men as invulnerable (51-54), and ultimately shape both men and women's behavior. Such norms disadvantage men by making it less acceptable for them to seek health care (51). Therefore, while "harmful" notions of

masculinity and the behaviors that result from them should be intervened on, they must be viewed and treated as a structural factor, and not an individual construct (51). Our findings therefore contribute to the literature support for the positive influences of masculinity on men's health, which together with similar findings reported in other studies (27, 36), have important implications for the potential to harness masculinities to motivate men for HIV care engagement through health promotion messaging and counseling. Further, these findings support the need for higher-level interventions that address societal-level gender norms driving health disparities between men and women (discussed further in "Implications for public health practice").

Finally, this dissertation examined influences in the physical and built environment on HIV clinic attendance and ART adherence in aim 3. The fishing communities in which this research took place are characterized by poverty, frequent mobility among fishermen, poor infrastructure, and limited access to health services. In such settings, environmental-level barriers related to the health system and built environment are often perceived as most prominent in their effect on health behavior and service utilization (55, 56). We found environmental factors were influential in HIV clinic attendance, though their effect size was comparable to factors at other levels of the SEM. It makes sense that environmental factors, including distance to the clinic and endorsing barriers related to work responsibilities and transportation, would interfere with HIV clinic attendance, as accessing the HIV clinic requires men to overcome barriers in their social and physical environment. ART adherence, in contrast, was not influenced by environmental -level factors, but by factors more proximal to the individual. In addition, we found HIV clinic attendance was not associated with ART adherence, suggesting men may be able to maintain optimal treatment adherence without going to all of their clinic appointments. However, environmental barriers to care emerged as a

major barrier to both men's clinic attendance and adherence in qualitative narratives in aim 2. It is possible our quantitative measure for adherence, while it did incorporate more than the 4-day recall measure alone, did not have a long enough of a recall period to capture the effects of structural influences on being able to pick up ART refills.

The evidence of multi-level determinants of HIV care engagement put forth by this dissertation is in line with a shift in the HIV/AIDS field observed over the past decade; the field has moved away from individual-level models of health behavior toward a more comprehensive view of social determinants of health (57-59). Early research on HIV risk behaviors focused primarily on individual knowledge, motivation, and self-efficacy for condom use and other HIV prevention behaviors; constructs central to popular theories of health behavior change, such as Social Cognitive Theory (60, 61), the Theory of Reasoned Action and Behavior (62, 63), and the Information, Motivation, and Behavior Skills (IMB) Model (64, 65). These theories are still essential in our understanding of health behavior, as they have been shown to be predictive of HIV risk and HIV behavior change across settings (66-69). However, there is now wide recognition in HIV/AIDS research that HIV risk and treatment engagement involve complex factors from multiple levels, including more upstream factors (57, 58, 70, 71). As shown by this dissertation, higher-level factors may be particularly important to consider for HIV clinic attendance, or other health service utilization behaviors, which may be more broadly affected by factors external to individual knowledge and decision-making. Whereas, health behaviors more proximal to individual knowledge and decision-making, such as ART adherence, may be better predicted by individual-level models of behavior change. The IMB model has been adapted and empirically validated specifically for ART adherence (72, 73), and been shown predictive of adherence in South Africa and other developing countries (74-77).

Relatedly, there is also a growing recognition in the HIV/AIDS field of a confluence of factors that both individually and together influence HIV health behaviors, known as a syndemic. More specifically, a syndemic is defined as the co-occurrence of two or more epidemics, which interact and together synergistically contribute to excess burden of disease in a population (78). The role of HIV/AIDS syndemics may be especially salient in high HIV prevalence settings, such as fishing villages, where poverty and a number of psychosocial conditions may cluster and interact to contribute to HIV outcomes. In similar high risk settings in SSA, research demonstrates the effect of a syndemic of social conditions (e.g., substance use, depression, food insecurity, violence, HIV stigma) on HIV risk (79, 80), as well as ART adherence and viral load suppression (81). We did not use a syndemics approach to analyze the multiple determinants of HIV care engagement identified in this dissertation, and thus cannot speak specifically to the synergistic effects of these factors on our outcomes. However, the observed occurrence of alcohol use, HIV stigma, norms of masculinity, and structural barriers to HIV care in our study setting suggests HIV care engagement may be affected by a larger syndemic of co-occurring psychosocial problems common in high-risk HIV settings.

Implications for public health practice

Our findings point to the need for the development of differentiated HIV care models that integrate a multi-level, tailored approach to care delivery to meet the needs of fisherfolk. Differentiated care is defined as “a client-centered approach that simplifies and adapts HIV services across the cascade to reflect the preferences and expectations of various groups of PLHIV while reducing unnecessary burdens on the health system” (82). There has been a recent movement towards the development and scale up of differentiated models of care in SSA based on recognition that achieving the “90-90-90”

goals will require improved efficiency and tailored services. That is, there is a need to move away from a “one size fits all” approach to HIV service delivery in SSA, especially for MARPs facing unique social and structural barriers to HIV care (82, 83). Our findings demonstrate the need for differentiated services for fisherfolk, and highlights challenges specific to this group that can inform the development of HIV services tailored to their needs. Specifically, our findings imply alcohol use, masculinity and gendered barriers specific to men, HIV stigma, and structural factors need to be considered in the delivery of HIV care for fishermen. Further, our findings have implications for ways to increase men’s motivation for HIV treatment through counseling and messaging for men, and the potential benefits of leveraging or expanding men’s existing social networks to provide more support for care engagement. Though our findings are specific to men in a unique occupational group and geographic location, they may also have implications for the HIV community’s response to the gender gap observed in the HIV care continuum for the general population, as the broader literature on men’s poor engagement in HIV care similarly highlights masculinity, HIV stigma, and structural factors as key barriers (40).

In the next section, we recommend a package of interventions that could be implemented at the health system and community-level to help fishermen overcome barriers identified in this dissertation, including: the integration of screening and brief intervention for alcohol use into HIV care, gender-transformative counseling, reducing the conflict between men’s work and clinic attendance, and the use of peer-based models to improve social support and potentially reduce HIV stigma. In recognition of the interrelated, synergistic nature between many of the determinants of HIV care identified in this dissertation, and the need for integrated solutions that minimize additional burden on limited resources for health in this setting, we highlight interventions with the potential to influence multiple factors together where possible.

First, evidence of high levels of hazardous alcohol use, and alcohol's negative effect on ART adherence in our sample supports the integration of screening and brief intervention (SBI) (84) into HIV clinical care in fishing communities. For those drinking at lower-levels of risk (i.e., hazardous levels) as observed in our sample, SBI includes the provision of motivational interviewing (MI), which has been shown effective at alcohol reduction in others settings (85, 86). Our findings suggest alcohol reduction and adherence intervention efforts with men reporting higher quantities of alcohol consumption may optimize SBI with this population. Further, our data suggests alcohol SBI is especially needed for men on twice-daily regimens, and points to the need for counseling to address the alcohol-ARV toxicity misconception identified in this setting. While the provision of alcohol treatment is challenging in Uganda, as options for referrals are few and expensive, lay counselors and clinicians can deliver SBI and MI in short windows of time, thus its adoption in resource-limited settings may be possible. However, more research is needed on SBI's effectiveness and implementation in this setting, as randomized trials in SSA have mixed results (87-92). Moreover, multiple MI sessions may be most effective (93), which would be a challenge for mobile fishermen.

In addition, our data points to the potential benefits of facilitating the rejection of notions of masculinity that serve as barriers to HIV care, and the adoption of those more in line with optimal care engagement. Thus, HIV care engagement counseling with men may be improved through a gender transformative approach (52, 94, 95). Counseling that focuses on the restorative effects on men's ability to fulfill their masculine roles may be especially motivating for men. We propose future research explores the use of this approach as a strategy not only to improve ART adherence and HIV clinic attendance for fishermen, but as an integrated approach to engagement in care, alcohol reduction, and HIV stigma reduction. We found men were motivated to reduce their alcohol use for the

same reasons they were motivated to take their ARVs: to better fulfill their masculine roles. Though alcohol use did not emerge as central to men's definition of masculinity in our qualitative data, the link between risky alcohol use and masculinity is documented in similar settings (96-98). Relatedly, men who were able to fulfill their masculine roles through ART in our sample felt protected from HIV stigma and discrimination from others. As discussed earlier, other studies with men in SSA have identified HIV stigma as a barrier to care because of HIV's damaging effects on men's notions of masculinity, including respect, strength, and ability to fulfill their masculine roles (37, 38, 41). Thus a gender transformative approach to ART adherence counseling that understands and addresses the underlying role of norms of masculinity on the intersection of alcohol use, HIV stigma, and HIV care engagement could address multiple barriers together for men, but more research is needed to add to our understanding of these relationships and the structure of such an intervention. Gender transformative interventions aiming to alter norms at the community and structural-level, as well as with individuals, may be most effective (52). Therefore, in addition to individual-level counseling, community-level campaigns that challenge norms of masculinity that deter men from care, while promoting how ART may enhance a man's ability to serve as husband and father, worker, and provider, may affect community-level norms of masculinity and HIV stigma, and have a wider impact than individual-level approaches alone.

While we found norms of masculinity and men's roles overall served as a facilitator to care for men, the responsibilities that come with men's role as worker and provider served as barriers. Specifically, traveling for work and conflicting work schedules made it difficult to access care and take their ARVs on time in qualitative interviews. Aim 3 further highlighted the need to address structural barriers to HIV clinic attendance. Health system-level solutions could include the integration of financial

incentives or transport reimbursement to offset the compounding effects of poverty, gender expectations for men, and structural barriers to care (99, 100). This approach may be especially helpful given men with lower income were shown to have worse clinic attendance in aim 3.

Differentiated ART delivery models, such as Community ART groups (CAGs) and adherence groups (AGs), may also help to reduce men's occupational and structural barriers, by bringing ART closer to the community through its distribution in community groups (101). This approach reduces the frequency of clinic visits needed, and may reduce costs and burden on the health system (82, 102) while improving long-term retention and viral suppression (103-105). Our finding that clinic attendance, as well as environmental barriers, did not influence ART adherence, however, suggests the need for more research on whether bringing ART services to the community is needed for optimal treatment adherence in this setting, especially since HIV services were already being delivered through an outreach model on some islands. CAGs or AGs could, however, increase social support and decrease HIV stigma by leveraging or expanding men's social networks (106-108). Our findings from aims 1 and 2 demonstrated peer influence in men's adoption of both healthy and unhealthy behaviors, and knowing other men on ART normalized HIV for men and was protective against HIV stigma. Thus, the integration of a peer support program or the use of male opinion leaders in this setting may be beneficial to men, which is well supported by research in other MARPs and in SSA generally (109-111). However, there is a need for more research to compare the effectiveness and costing of different models of community-based ART delivery on men's access to HIV care, ART retention, and secondary effects on social support and HIV stigma.

Dissertation Limitations

This dissertation has several limitations to consider. Our sample represents men specifically working in fishing occupations in the Lake Victoria region of Uganda; thus, our findings are not generalizable beyond this population and setting. Men were not randomly sampled. Therefore, we cannot be sure if our sample was representative of the broader population of fisherfolk. Further, we were not able to capture an accurate estimate of the number of men screened for eligibility through clinic records, which further limits our assessment of how representative our sample might be of the total clinic sample.

We used a convenience sample of men recruited directly from HIV clinics. Thus, our results are specific to men enrolled in HIV care, who may represent those with better HIV care engagement overall. Men with poor attendance or who had fallen out of care likely have greater or different barriers to HIV clinic attendance than the men enrolled in this study. We attempted to mitigate this bias by offering to meet men outside of the HIV clinic if they wanted to participate, but did not want to return to the HIV clinic, and by recruiting men via telephone in addition to those presenting to the clinic. A total of 64 men of our sample of 300 (22%) came to the clinic to participate after being invited via telephone, which may have allowed us to capture men with more difficulty in clinic attendance; though we were not able to assess differences between these groups. Further, a total of 22 of 322 eligible men invited to participate in the study declined. We do not have demographic data to characterize and compare differences between the men who declined to participate compared to those who accepted participation. It is possible men who declined had greater barriers to HIV care than those who accepted, especially for the 14 of men who declined because of time constraints or other responsibilities. Nevertheless, this study provides valuable information about barriers

and facilitators to clinic attendance and ART adherence for men enrolled in HIV care. Despite being recruited from HIV clinics, we still found less than optimal engagement in HIV care in this population, and identified ways to improve HIV service delivery to increase men's engagement and access to HIV care.

This study was cross-sectional, which limits our ability to infer causation. The use of a longitudinal study design would have strengthened our confidence in the causality and direction of relationships between the factors examined by linking them temporally. However, employing a mixed methods study design allowed us to corroborate study findings through two different methods. For example, our qualitative data supported the observed quantitative association between alcohol use and missed ARVs, and shed light on the potential causal pathways between these two constructs. Further, using a mixed method study allowed us to answer specific research questions and test hypotheses with quantitative data, while using qualitative data to probe further into the observed associations and add rich context to men's experiences with qualitative narratives. This allowed us to gain a broader perspective and understanding of the phenomena examined than the use of one method alone.

The data collected for this dissertation were mainly self-reported measures, which may introduce social desirability and recall bias. Collection of viral load samples would have increased our confidence in the accuracy of our outcome of ART adherence over the use of self-reported ART adherence. We attempted to collect viral load data from participants' HIV clinic records; however, the data was too incomplete to use. We used clinic data for our measure of HIV clinic attendance, as well as the collection of a number of other important variables (e.g., time since diagnosis, time on ART, ART regimen), which was corroborated by men's self-report. While clinic record data may provide a more objective measure free from the participant's social desirability and recall

bias, these measures are not free from other biases, such as missing data or data entry errors.

The use of self-reported ART adherence, alcohol use, and other independent variables may have resulted in underreporting of missed pills or other behaviors viewed unfavorably. This may be especially true since men were interviewed in the HIV clinics with health providers present; though, we made sure men were in a private area and reassured men that their responses would be kept confidential and would not affect their medical care. Further, the Adult AIDS Clinical Trial Group (AACTG) scale used to measure self-reported ARV adherence (112) has been validated and shown reliable in other settings. We used the measure two different ways, including the four-day recall period, which has demonstrated construct validity in Uganda and similar settings (113). In addition, we used the non-adherence index score, which incorporates more items than the four-day recall period, has been used in large clinical trials (114, 115), and has been shown to correlate with plasma HIV RNA (115). Each method yielded similar results in terms of their associations with independent variables.

Other limitations in our measurement included differences in recall periods between the independent variables and the outcome variables. For example, the AUDIT for alcohol use assessed alcohol consumption behavior over the prior year, while our adherence measure in aim 2 assessed missed pills over only a four-day recall period, which may have weakened this association. However, the findings were replicated using the measure of alcohol quantity assessed over the prior 30 days. Our alcohol measures also required men to estimate the number of drinks they typically consume. While the interviewer explained to participants the typical size of each type of alcohol assessed during the structured interview, men's accuracy in this assessment may have varied. Further, since this is a dissertation, our qualitative data analysis was coded and

analyzed by only one person. It is best practice in qualitative data analysis to have at least two individuals independently code and identify major themes, in order to reduce the introduction of error or personal biases. The secondary coding of this data and assessment of inter-rater reliability is ongoing, but not reported in this dissertation.

In addition, though we frame this dissertation using the SEM, we only measure variables at the individual-level. For example, measures of “normative-level” norms of masculinity are more accurately the manifestation of such norms into individual-level attitudes and viewpoints. Future research could explore the use of other methodologies to assess the role of higher-level factors in men’s HIV care engagement, such as measuring health system factors directly from the health system or the use of GPS data to assess distance traveled to the clinic. Finally, this dissertation provides valuable information on determinants of HIV care engagement for men; however, it is far from a comprehensive picture of the factors at play. We measured a select number of variables at different levels of the SEM that we hypothesized to be important, but more research is needed to explore other factors not included in this study. This study in particular does not speak to factors at the highest societal-level of the SEM, such as national-level policy and broader socio-political factors.

Areas for Future Research

The identification of determinants of HIV care engagement is critical in the development of interventions to increase access to care and improve ART adherence among men. While this dissertation highlighted a number of contributing factors, more research is needed to corroborate and expand on our findings, especially given the lack of prior studies with this aim. Moreover, our findings provide formative data to inform the

development of strategies to increase fisherfolks' engagement in HIV care as described in our recommendations for public health practice, however, pilot interventions are needed to assess the efficacy of innovative strategies with little evidence to date of their impact, and implementation research is needed to assess the feasibility, acceptability, and optimal delivery and structure of the interventions with a strong evidence base. The setting of fishing communities includes resource and time constraints in HIV clinical care, cultural and social norms specific to this setting, occupational influences, and physical elements of Lake Victoria and its islands that need to be considered; thus formative research to inform the tailoring of services to these communities is essential.

These findings are specific to fishermen and other men in fishing occupations attending HIV clinics. As discussed in "Dissertation Limitations," this study did not capture men who had never linked to HIV after diagnosis, or who had dropped out of care altogether. This group represents an important population that may be facing the greatest barriers to care, and therefore, should be the focus of future research. However, reaching this population for research and service delivery alike remains a major challenge and area in need of research attention. Relatedly, future research should focus on the experiences of younger men in this community, who were at greater risk for missed clinic visits and missed ARVs in our sample. Finally, future research should explore the same research questions posed by this study, but for women in fishing villages. We focused on men, given their specific occupational and normative barriers, and evidence for men's worse engagement in care compared to women. However, women in these communities may face their own unique set of challenges to care engagement, such as relationship power and economic vulnerabilities, which should be explored in future research in this setting to inform service delivery for women.

Conclusions

This dissertation makes an important contribution to the HIV/AIDS literature as the first study to our knowledge to assess determinants of clinic attendance and ART adherence among male fisherfolk in Uganda. Our findings highlight an urgent need for strategies to improve engagement in HIV care among this most-at-risk population. We identified sub-optimal HIV clinic attendance and ART adherence among men enrolled in HIV care, and multi-level determinants contributing to these outcomes. Younger age, lower income, consuming higher quantities of alcohol, interpersonal relationships, norms of masculinity, HIV stigma, and factors in the physical and built environment were among the main determinants identified. We suggest a package of interventions that may be integrated into differentiated service delivery specific to this most-at-risk population. Specifically, brief screening and intervention for alcohol reduction, gender transformative programming, reducing the conflict between men's work and clinic schedules, and integrated peer-based to increase social support and reduce HIV stigma should be explored as strategies to reduce the barriers identified in this dissertation to HIV clinic attendance and ART adherence, which would ultimately improve the health of fishermen, and contribute to the control of the broader HIV/AIDS epidemic in Uganda.

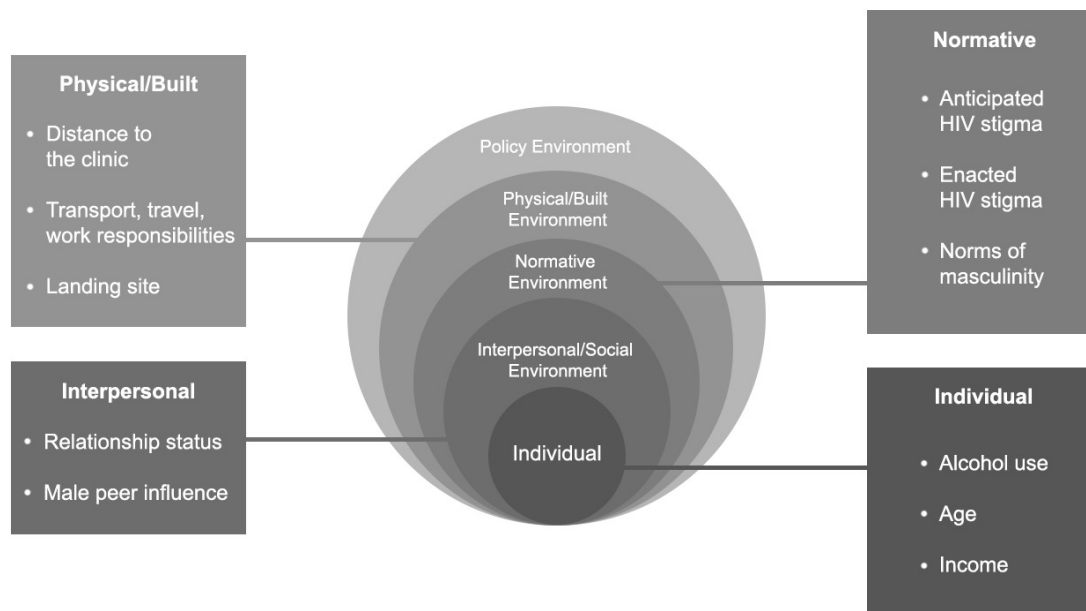


Figure 5.1: Dissertation's primary findings mapped onto the social ecological model

References

1. Bangsberg DR, Perry S, Charlebois ED, Clark RA, Roberston M, Zolopa AR, et al. Non-adherence to highly active antiretroviral therapy predicts progression to AIDS. *AIDS*. 2001;15(9):1181-3.
2. Mugavero MJ, Amico KR, Westfall AO, Crane HM, Zinski A, Willig JH, et al. Early retention in HIV care and viral load suppression: implications for a test and treat approach to HIV prevention. *J Acquir Immune Defic Syndr*. 2012;59(1):86-93.
3. Panel on Antiretroviral Guidelines for Adults and Adolescents. Guidelines for the use of antiretroviral agents in HIV-1-infected adults and adolescents. Department of Health and Human Services. Available at <http://www.aidsinfo.nih.gov/ContentFiles/AdultandAdolescentGL.pdf>. Accessed 1 Sept 2017. 2016.
4. World Health Organization. Consolidated guidelines on the use of antiretroviral drugs for treating and preventing HIV infection. Geneva, Switzerland: WHO; 2013.
5. Cohen MS, Chen YQ, McCauley M, Gamble T, Hosseinipour MC, Kumarasamy N, et al. Prevention of HIV-1 infection with early antiretroviral therapy. *N Engl J Med*. 2011;365(6):493-505.
6. Bassett IV, Wang B, Chetty S, Mazibuko M, Bearnot B, Giddy J, et al. Loss to care and death before antiretroviral therapy in Durban, South Africa. *J Acquir Immune Defic Syndr*. 2009;51(2):135-9.
7. Cornell M, Grimsrud A, Fairall L, Fox MP, van Cutsem G, Giddy J, et al. Temporal changes in programme outcomes among adult patients initiating antiretroviral therapy across South Africa, 2002-2007. *AIDS*. 2010;24(14):2263-70.
8. Van Cutsem G, Ford N, Hildebrand K, Goemaere E, Mathee S, Abrahams M, et al. Correcting for mortality among patients lost to follow up on antiretroviral therapy in South Africa: a cohort analysis. *PLoS One*. 2011;6(2):e14684.
9. Wang B, Losina E, Stark R, Munro A, Walensky RP, Wilke M, et al. Loss to follow-up in a community clinic in South Africa--roles of gender, pregnancy and CD4 count. *S Afr Med J*. 2011;101(4):253-7.
10. Charurat M, Oyegunle M, Benjamin R, Habib A, Eze E, Ele P, et al. Patient retention and adherence to antiretrovirals in a large antiretroviral therapy program in Nigeria: a longitudinal analysis for risk factors. *PLoS One*. 2010;5(5):e10584.
11. Cornell M, Myer L, Kaplan R, Bekker LG, Wood R. The impact of gender and income on survival and retention in a South African antiretroviral therapy programme. *Trop Med Int Health*. 2009;14(7):722-31.

12. Hendershot CS, Stoner SA, Pantalone DW, Simoni JM. Alcohol use and antiretroviral adherence: review and meta-analysis. *J Acquir Immune Defic Syndr*. 2009;52(2).
13. Sileo KM, Simbayi LC, Abrams A, Cloete A, Kiene SM. The role of alcohol use in antiretroviral adherence among individuals living with HIV in South Africa: Event-level findings from a daily diary study. *Drug Alcohol Depend*. 2016;167:103-11.
14. Braithwaite RS, McGinnis KA, Conigliaro J, Maisto SA, Crystal S, Day N, et al. A temporal and dose-response association between alcohol consumption and medication adherence among veterans in care. *Alcohol Clin Exp Res*. 2005;29(7):1190-7.
15. Braithwaite RS, Conigliaro J, McGinnis KA, Maisto SA, Bryant K, Justice AC. Adjusting alcohol quantity for mean consumption and intoxication threshold improves prediction of nonadherence in HIV patients and HIV-negative controls. *Alcohol Clin Exp Res*. 2008;32(9):1645-51.
16. Braithwaite RS, Bryant KJ. Influence of alcohol consumption on adherence to and toxicity of antiretroviral therapy and survival. *Alcohol Res Health*. 2010;33(3):280-7.
17. Sankar A, Wunderlich T, Neufeld S, M. L. Sero-positive African Americans' Beliefs about alcohol and their impact on anti-retroviral adherence. *AIDS Behav*. 2007;11:195-203.
18. Tucker JS, Burnam MA, Sherbourne CD, Kung FY, Gifford AL. Substance use and mental health correlates of nonadherence to antiretroviral medications in a sample of patients with human immunodeficiency virus infection. *Am J Med*. 2003;114(7):573-80.
19. Parsons JT, Rosof E, Mustanski B. The temporal relationship between alcohol consumption and HIV-medication adherence: a multilevel model of direct and moderating effects. *Health Psychol*. 2008;27(5):628-37.
20. Samet JH, Horton NJ, Meli S, Freedberg KA, Palepu A. Alcohol consumption and antiretroviral adherence among HIV-infected persons with alcohol problems. *Alcohol Clin Exp Res*. 2004;28(4):572.
21. Samet JH, Cheng DM, Libman H, Nunes DP, Alperen JK, Saitz R. Alcohol consumption and HIV disease progression. *J Acquir Immune Defic Syndr*. 2007;46(2):194-9.
22. Kalichman SC, Grebler T, Amaral CM, McNerey M, White D, Kalichman MO, et al. Intentional non-adherence to medications among HIV positive alcohol drinkers: prospective study of interactive toxicity beliefs. *J Gen Intern Med*. 2013;28(3):399.
23. Kalichman SC, Amaral CM, White D, Swetsze C, Pope H, Kalichman MO, et al. Prevalence and clinical implications of interactive toxicity beliefs regarding mixing alcohol and antiretroviral therapies among people living with HIV/AIDS. *AIDS Patient Care STDS*. 2009;23(6):446-59.

24. Kunutsor S, Walley J, Katabira E, Muchuro S, Balidawa H, Namagala E, et al. Improving clinic attendance and adherence to antiretroviral therapy through a treatment supporter intervention in Uganda: a randomized controlled trial. *AIDS Behav.* 2011;15(8):1795-802.
25. Nachega JB, Knowlton AR, Deluca A, Schoeman JH, Watkinson L, Efron A, et al. Treatment supporter to improve adherence to antiretroviral therapy in HIV-infected South African adults: a qualitative study. *J Acquir Immune Defic Syndr.* 2006;43:S127-S33.
26. Siu GE, Wight D, Seeley J. How a masculine work ethic and economic circumstances affect uptake of HIV treatment: experiences of men from an artisanal gold mining community in rural eastern Uganda. *Journal of the International AIDS Society.* 2012;15(Suppl 1):17368.
27. Siu GE, Seeley J, Wight D. Dividuality, masculine respectability and reputation: how masculinity affects men's uptake of HIV treatment in rural eastern Uganda. *Soc Sci Med.* 2013;89:45-52.
28. Siu GE, Wight D, Seeley JA. Masculinity, social context and HIV testing: an ethnographic study of men in Busia district, rural eastern Uganda. *BMC Public Health.* 2014;14(1):1-11.
29. Bogart LM, Wagner GJ, Musoke W, Naigino R, Linnemayr S, Maistrellis E, et al. A comparison of home-based versus outreach event-based community HIV testing in Ugandan fisherfolk communities. *AIDS Behav.* 2017;21(2):547-60.
30. Bogart LM, Naigino R, Maistrellis E, Wagner GJ, Musoke W, Mukasa B, et al. Barriers to linkage to HIV care in Ugandan fisherfolk communities: a qualitative analysis. *AIDS Behav.* 2016;20(10):2464-76.
31. Barnabas RV, van Rooyen H, Tumwesigye E, Brantley J, Baeten JM, van Heerden A, et al. Uptake of antiretroviral therapy and male circumcision after community-based HIV testing and strategies for linkage to care versus standard clinic referral: a multisite, open-label, randomised controlled trial in South Africa and Uganda. *Lancet.* 2016;3(5):e212-20.
32. Govindasamy D, Ford N, Kranzer K. Risk factors, barriers and facilitators for linkage to antiretroviral therapy care: a systematic review. *AIDS.* 2012;26(16):2059-67.
33. Treves-Kagan S, Steward WT, Ntswane L, Haller R, Gilvydis JM, Gulati H, et al. Why increasing availability of ART is not enough: a rapid, community-based study on how HIV-related stigma impacts engagement to care in rural South Africa. *BMC Public Health.* 2016;16(1):87.
34. Roura M, Urassa M, Busza J, Mbata D, Wringe A, Zaba B. Scaling up stigma? the effects of antiretroviral roll-out on stigma and HIV testing: early evidence from rural Tanzania. *Sex Transm Infect.* 2009;85(4):308-12.

35. Sweeney S, Venable P. The association of HIV-related stigma to HIV medication adherence: a systematic review and synthesis of the literature. *AIDS Behav.* 2016;1-22; 20(1):29-50.
36. Siu GE, Wight D, Seeley J. 'Dented' and 'resuscitated' masculinities: the impact of HIV diagnosis and/or enrolment on antiretroviral treatment on masculine identities in rural eastern Uganda. *SAHARA J.* 2014;11(1):211-21.
37. Mburu G, Ram M, Siu G, Bitira D, Skovdal M, Holland P. Intersectionality of HIV stigma and masculinity in eastern Uganda: implications for involving men in HIV programmes. *BMC Public Health.* 2014;14 1061.
38. Wyrod R. Masculinity and the persistence of AIDS stigma. *Cult Health Sex.* 2011;13(4):443-56.
39. Matovu JK, Wanyenze RK, Wabwire-Mangen F, Nakubulwa R, Sekamwa R, Masika A, et al. "Men are always scared to test with their partners ... it is like taking them to the police": motivations for and barriers to couples' HIV counselling and testing in Rakai, Uganda: a qualitative study. *J Int AIDS Soc.* 2014;17:19160.
40. Sharma M, Barnabas RV, Celum C. Community-based strategies to strengthen men's engagement in the HIV care cascade in sub-Saharan Africa. *PLOS Medicine.* 2017;14(4):e1002262.
41. Sileo KM, Fielding-Miller R, Dworking SL, Fleming PJ, editors. The role of gender norms and masculinity on men's engagement in the HIV care continuum in sub-Saharan Africa: a systematic review. 9th IAS Conference on HIV Science (IAS 2017); 2017 23-27 July; Paris, France.
42. Tsai AC, Bangsberg DR, Bwana M, Haberer JE, Frongillo EA, Muzoora C, et al. How does antiretroviral treatment attenuate the stigma of HIV? evidence from a cohort study in rural Uganda. *AIDS Behav.* 2013;17(8):2725-31.
43. Connell RW. *Masculinities.* Berkeley, CA: University of California Press; 1995.
44. Shand T, Thomson-de Boer H, van den Berg W, Peacock D, Pascoe L. The HIV blind spot: men and HIV testing, treatment and care in Sub-Saharan Africa. *IDS Bulletin.* 2014;45(1):53-60.
45. Cornell M, McIntyre J, Myer L. Men and antiretroviral therapy in Africa: our blind spot. *Trop Med Int Health.* 2011;16(7):828-9.
46. Shannon K, Leiter K, Phaladze N, Hlanze Z, Tsai AC, Heisler M, et al. Gender inequity norms are associated with increased male-perpetrated rape and sexual risks for HIV infection in Botswana and Swaziland. *PLoS ONE.* 2012;7(1):e28739.
47. Gottert AL. Gender norms, masculine gender-role strain, and HIV risk behaviors among men in rural South Africa: The University of North Carolina at Chapel Hill; 2014.

48. Dunkle KL, Jewkes RK, Brown HC, Gray GE, McIntyre JA, Harlow SD. Gender-based violence, relationship power, and risk of HIV infection in women attending antenatal clinics in South Africa. *Lancet*. 2004;363(9419):1415-21.
49. Shattuck D, Burke H, Ramirez C, Succop S, Costenbader B, Attafuah JD, et al. Using the inequitable gender norms scale and associated HIV risk behaviors among men at high risk for HIV in Ghana and Tanzania. *Men Masculinities*. 2013;16(5):540-59.
50. Jewkes RK, Dunkle K, Nduna M, Shai N. Intimate partner violence, relationship power inequity, and incidence of HIV infection in young women in South Africa: a cohort study. *Lancet*. 2010;376(9734):41-8.
51. Fleming PJ, Dworkin SL. The importance of masculinity and gender norms for understanding institutional responses to HIV testing and treatment strategies. *AIDS*. 2016;30(1):157-8.
52. Dworkin SL, Fleming PJ, Colvin CJ. The promises and limitations of gender-transformative health programming with men: critical reflections from the field. *Cult Health Sex*. 2015;17(2):128-43.
53. Dworkin SL. Who is epidemiologically fathomable in the HIV/AIDS epidemic? gender, sexuality, and intersectionality in public health. *Cult Health Sex*. 2005;7(6):615-23.
54. Higgins JA, Hoffman S, Dworkin SL. Rethinking gender, heterosexual men, and women's vulnerability to HIV/AIDS. *Am J Public Health* 2010;100(3):435-45.
55. Kagee A, Remien RH, Berkman A, Hoffman S, Campos L, Swartz L. Structural barriers to ART adherence in Southern Africa: challenges and potential ways forward. *Glob Public Health*. 2011;6(1):83-97.
56. Geng EH, Bangsberg DR, Musinguzi N, Emenyonu N, Bwana MB, Yiannoutsos CT, et al. Understanding reasons for and outcomes of patients lost to follow-up in antiretroviral therapy programs in Africa through a sampling-based approach. *J Acquir Immune Defic Syndr*. 2010;53(3):405-11.
57. Kaufman M, Cornish F, Zimmerman R, Johnson B. Health behavior change models for HIV prevention and AIDS care: practical recommendations for a multi-level approach. *J Acquir Immune Defic Syndr*. 201;66 Suppl 3:S250-8. doi: 10.1097/QAI.0000000000000236.
58. Albarracin D, Rothman AJ, Di Clemente R, del Rio C. Wanted: a theoretical roadmap to research and practice across individual, interpersonal, and structural levels of analysis. *AIDS Behav*. 2010;14(2):185-8.
59. Willard N, Chutuape K, Stines S, Ellen J, The Adolescent Medicine Trials Network for HIV/AIDS Interventions. Bridging the gap between individual level risk for HIV and structural determinants: using root cause analysis in strategic planning. *J Prev Interv Comm*. 2012;40(2):10.1080/10852352.2012.660122.

60. Bandura A. *Social Foundations of Thought and Action: A Social Cognitive Theory*. Upper Saddle River, NJ: Prentice Hall, Inc.; 1986.
61. Bandura A. Social cognitive theory and exercise of control over HIV infection. In: DiClemente RJ PJ, editor. *Preventing AIDS: Theories and Methods of Behavioral Interventions*. New York, New York: Plenum Press; 1994. p. 25–59.
62. Ajzen I, Madden TJ. Prediction of goal-directed behavior: attitudes, intentions and perceived behavioral control. *J Exp Social Psychol*. 1986;22:453–74.
63. Fishbein M, Ajzen I. *Belief, Attitude, Intention and Behavior: An Introduction to Theory and Research*. Reading, MA: Addison-Wesley; 1975.
64. Fisher JD, Fisher WA. Changing AIDS-risk behavior. *Psychological Bulletin*. 1992;111(3):455-74.
65. Fisher JD, Fisher WA. Theoretical Approaches to Individual-Level Change in HIV Risk Behavior. In: Peterson JL, DiClemente RJ, editors. *HIV Prevention Handbook*. New York: Kluwer Academic; 2000. p. 3-55.
66. Johnson WD, Diaz RM, Flanders WD, Goodman M, Hill AN, Holtgrave D, et al. Behavioral interventions to reduce risk for sexual transmission of HIV among men who have sex with men. *Cochrane Database Syst Rev*. 2008(3):CD001230.
67. Johnson BT, Scott-Sheldon LA, Carey MP. Meta-synthesis of health behavior change meta-analyses. *Am J Public Health*. 2010;100(11):2193-8.
68. Johnson BT, Scott-Sheldon LA, Huedo-Medina TB, Carey MP. Interventions to reduce sexual risk for human immunodeficiency virus in adolescents: a meta-analysis of trials, 1985-2008. *Arch Pediatr Adolesc Med*. 2011;165(77-84).
69. Noar SM. Behavioral interventions to reduce HIV-related sexual risk behavior: review and synthesis of meta-analytic evidence. *AIDS Behav*. 2008;12:335-53.
70. Latkin C, Weeks MR, Glasman L, Galletly C, Albarracin D. A dynamic social systems model for considering structural factors in HIV prevention and detection. *AIDS Behav*. 2010;14(2):222-38.
71. Glanz K, Bishop DB. The role of behavioral science theory in development and implementation of public health interventions. *Annu Rev Public Health*. 2010;31:399-418.
72. Fisher JD, Fisher WA, Amico KR, Harman JJ. An information-motivation-behavioral skills model of adherence to antiretroviral therapy. *Health Psychol*. 2006;25(4):462-73.
73. Amico KR, Toro-Alfonso J, Fisher JD. An empirical test of the information, motivation and behavioral skills model of antiretroviral therapy adherence. *AIDS Care*. 2005;17(6):661-73.

74. Simon MD, Altice FL, Moll AP, Shange M, Friedland GH. Preparing for highly active antiretroviral therapy rollout in rural South Africa: an assessment using the information, motivation, and behavioral skills model. *AIDS Care*. 2010;22(4):462-74.
75. Peltzer K, Friend-du Preez N, Ramlagan S, Anderson J. Antiretroviral treatment adherence among HIV patients in KwaZulu-Natal, South Africa. *BMC Public Health*. 2010;10(1):111.
76. Rongkavilit C, Naar-King S, Kaljee LM, Kaljee LM, Panthong A, Koken JA, et al. Applying the information-motivation-behavioral skills model in medication adherence among Thai youth living with HIV: a qualitative study. *AIDS Patient Care STDS*. 2010 Dec;24(12):787-94. doi: 10.1089/apc.2010.0069. Epub 2010 Nov 22.
77. Santillan Torres Torija C, Villagran Vazquez G, Robles Montijo SS, de Lourdes Eguiluz Romo L. The information and motivation and behavioral skills model of ART adherence among HIV-positive adults in Mexico. *J Int Assoc AIDS Care*. 2015;14(4):335-42.
78. Singer M, Clair S. Syndemics and public health: Reconceptualizing disease in bio-social context. *Med Anthropol Q*. 2003;17(4):423-41.
79. Pitpitan E, Kalichman S, Eaton L, Cain D, Sikkema K, Watt M, et al. Co-occurring psychosocial problems and HIV risk among women attending drinking venues in a South African township: a syndemic approach. *Annals of behavioral medicine : a publication of the Society of Behavioral Medicine*. 2013;45(2):153-62.
80. Kiene SM, Lule H, Sileo KM, Silmi KP, Wanyenze RK. Depression, alcohol use, and intimate partner violence among outpatients in rural Uganda: vulnerabilities for HIV, STIs and high risk sexual behavior. *BMC Infectious Diseases*. 2017;17(1):88.
81. Kuhns Lisa M., Hotton Anna L., Garofalo Rob, Muldoon Abigail L., Jaffe Kaitlyn, Bouris Alida, et al. An index of multiple psychosocial, syndemic conditions is associated with antiretroviral medication adherence among HIV-positive youth. *AIDS Patient Care STDS*. 2016;30(4):185-92.
82. International AIDS Society (IAS). Differentiated care for HIV: a decision framework for antiretroviral. Available from:http://www.differentiatedcare.org/Portals/0/adam/Content/yS6M-GKB5EWs_uTBHk1C1Q/File/Decision Framework.pdf. 2016.
83. Macdonald V, Verster A, Baggaley R. A call for differentiated approaches to delivering HIV services to key populations. *J Int AIDS Soc*. 2017;20(4):28-31.
84. Babor TF, McRee BG, Kassebaum PA, Grimaldi PL, Ahmed K, Bray J. Screening, brief intervention, and referral to treatment (SBIRT). *Substance Abuse*. 2007;28(3):7-30.

85. Kaner EF, Dickinson HO, Beyer FR. Effectiveness of brief alcohol interventions in primary care populations (review). *Cochrane Database Syst Rev.* 2007;2.
86. Carney T, Myers BJ, Louw J, Okwundu CI. Brief school-based interventions and behavioural outcomes for substance-using adolescents. *Cochrane Database Syst Rev.* 2016(1):Cd008969.
87. Mertens JR, Ward CL, Bresick GF, Broder T, Weisner CM. Effectiveness of nurse-practitioner-delivered brief motivational intervention for young adult alcohol and drug use in primary care in South Africa: a randomized clinical trial. *Alcohol Alcohol.* 2014;49(4):430-8.
88. L'Engle KL, Mwarogo P, Kingola N, Sinkela W, Weiner DH. A randomized controlled trial of a brief intervention to reduce alcohol use among female sex workers in Mombasa, Kenya. *J Acquir Immune Defic Syndr.* 2014;67(4):446-53.
89. Pengpid S, Peltzer K, van der Heever H, Skaal L. Screening and brief interventions for hazardous and harmful alcohol use among university students in South Africa: results from a randomized controlled trial. *International journal of environmental research and public health.* 2013;10(5):2043-57.
90. Peltzer K, Naidoo P, Louw J, Matseke G, Zuma K, McHunu G, et al. Screening and brief interventions for hazardous and harmful alcohol use among patients with active tuberculosis attending primary public care clinics in South Africa: results from a cluster randomized controlled trial. *BMC Public Health.* 2013;13:699.
91. Pengpid S, Peltzer K, Skaal L, Van der Heever H. Screening and brief interventions for hazardous and harmful alcohol use among hospital outpatients in South Africa: results from a randomized controlled trial. *BMC Public Health.* 2013;13:644.
92. Rendall-Mkosi K, Morojele N, London L, Moodley S, Singh C, Girdler-Brown B. A randomized controlled trial of motivational interviewing to prevent risk for an alcohol-exposed pregnancy in the Western Cape, South Africa. *Addiction.* 2013;108(4):725-32.
93. Wandera B, Tumwesigye NM, Nankabirwa JI, Mafigiri DK, Parkes-Ratanshi RM, Kapiga S, et al. Efficacy of a single, brief alcohol reduction intervention among men and women living with HIV/AIDS and using alcohol in Kampala, Uganda: a randomized trial. *J Int Assoc Provid AIDS Care.* 2016.
94. Dworkin SL, Treves-Kagan S, Lippman SA. Gender-transformative interventions to reduce HIV risks and violence with heterosexually-active men: a review of the global evidence. *AIDS Behav.* 2013;17(9):2845-63.
95. Barker G, Ricardo C, Nascimento M. Engaging Men and Boys in Changing Gender Based Inequity in Health: Evidence from Programme Interventions. Geneva: WHO; 2007.

96. Morojele NK, Kachieng'a MA, Mokoko E, Nkoko MA, Parry CDH, Nkowane AM, et al. Alcohol use and sexual behaviour among risky drinkers and bar and shebeen patrons in Gauteng province, South Africa. *Soc Sci Med*. 2006;62(1):217-27.
97. Rich EP, Nkosi S, Morojele NK. Masculinities, alcohol consumption, and sexual risk behavior among male tavern attendees: a qualitative study in North West Province, South Africa. *Psychol Men Masculinity*. 2015;16(4):382.
98. Hughes TL, Wilsnack SC, Kantor LW. The influence of gender and sexual orientation on alcohol use and alcohol-related problems: toward a global perspective. *Alcohol Res: Curr Rev*. 2016;38(1):121.
99. Bogart LM, Naigino R, Maistrellis E, Wagner GJ, Musoke W, Mukasa B, et al. Barriers to linkage to HIV care in Ugandan fisherfolk communities: a qualitative analysis. *AIDS Behav*. 2016;20(10):2464-76.
100. Bogart LM, Wagner GJ, Musoke W, Naigino R, Linnemayr S, Maistrellis E, et al. A comparison of home-based versus outreach event-based community HIV testing in Ugandan fisherfolk communities. *AIDS Behav*. 2017;21(2):547-60.
101. Grimsrud A, Sharp J, Kalombo C, Bekker L-G, Myer L. Implementation of community-based adherence clubs for stable antiretroviral therapy patients in Cape Town, South Africa. *J Int AIDS Soc*. 2015;18(1).
102. Barker C, Dutta A, Klein K. Can differentiated care models solve the crisis in HIV treatment financing? analysis of prospects for 38 countries in sub-Saharan Africa. *J Int AIDS Soc*. 2017;20(4):68-79.
103. Jobarteh K, Shiraishi RW, Malimane I, Samo Gudo P, Decroo T, Auld AF, et al. Community ART support groups in Mozambique: the potential of patients as partners in care. *PLOS ONE*. 2016;11(12):e0166444.
104. Tsondai PR, Wilkinson LS, Grimsrud A, Mdlalo PT, Ullauri A, Boule A. High rates of retention and viral suppression in the scale-up of antiretroviral therapy adherence clubs in Cape Town, South Africa. *J Int AIDS Soc*. 2017;20(4).
105. Decroo T KO, Remartinez D, dos Santos N, Dezembro S, Jofrisse M, Rasschaert F, Biot M, Laga M,. Four-year retention and risk factors for attrition among members of community ART groups in Tete, Mozambique. *Trop Med Int Health*. 2014;19(5):514-21.
106. Hickey MD SC, Omollo D, Mattah B, Fiorella KJ, Geng EH, Bacchetti P, Blat C, Ouma GB, Zoughbie D, Tessler RA, Salmen MR, Campbell H, Gandhi M, Shade S, Njoroge B, Bukusi EA, Cohen CR,. Implementation and operational research: pulling the network together: quasiexperimental trial of a patient-defined support network intervention for promoting engagement in HIV care and medication adherence on Mfangano Island, Kenya. *J Acquir Immune Defic Syndr*. 2015;69(4):e127-34.

107. O'Laughlin KN, Wyatt MA, Kaaya S, Bangsberg DR, Ware NC. How treatment partners help: social analysis of an African adherence support intervention. *AIDS Behav.* 2012;16(5):1308-5.
108. Sileo KM, Wanyenze RK, Kizito W, Reed L, Wagman JA, Musoke W, et al. "I take my medication well, so I don't even have a single doubt of fulfilling that role": A qualitative study on masculine roles and engagement in HIV care among male fisherfolk in Uganda. Unpublished.
109. Latkin CA, Davey-Rothwell MA, Knowlton AR, Alexander KA, Williams CT, Boodram B. Social network approaches to recruitment, HIV prevention, medical care, and medication adherence. *J Acquir Immune Defic Syndr.* 2013;63(0 1):S54-S8.
110. Govindasamy D, Meghij J, Negussi EK, Baggaley RC, Ford N, Kranzer K. Interventions to improve or facilitate linkage to or retention in pre-ART (HIV) care and initiation of ART in low- and middle-income settings – a systematic review. *J Int AIDS Soc.* 2014;17(1):19032.
111. Simoni JM, Nelson KM, Franks JC, Yard SS, Lehavot K. Are peer interventions for HIV efficacious? a systematic review. *AIDS Behav.* 2011;15(8):1589-95.
112. Chesney MA, Ickovics JR, Chambers DB, Gifford AL, Neidig J, Zwickl B, et al. Self-reported adherence to antiretroviral medications among participants in HIV clinical trials: The AACTG adherence instruments. *AIDS Care.* 2000;12(3):255-66.
113. Oyugi JH, Byakika-Tusiime J, Ragland K, Laeyendecker O, Mugerwa R, Kityo C, et al. Treatment interruptions predict resistance in HIV-positive individuals purchasing fixed-dose combination antiretroviral therapy in Kampala, Uganda. *AIDS.* 2007;21(8):965-71 10.1097/QAD.0b013e32802e6bfa.
114. Safren SA, Biello KB, Smeaton L, Mimiaga MJ, Walawander A, Lama JR, et al. Psychosocial predictors of non-adherence and treatment failure in a large scale multi-national trial of antiretroviral therapy for HIV: data from the ACTG A5175/PEARLS trial. *PLOS ONE.* 2014;9(8):e104178.
115. Reynolds NR, Sun J, Nagaraja HN, Gifford AL, Wu AW, Chesney MA. Optimizing measurement of self-reported adherence with the ACTG adherence questionnaire: a cross-protocol analysis. *J Acquir Immune Defic Syndr.* 2007;46(4):402-9.