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Chikere CB, Omoni VT and Chikere BO (2008). Distribution of potential nosocomial pathogens in a hospital environment. Afr. J. Biotechnol. 7: 3535-3539.

Moran GJ, Amii RN, Abrahamian FM, Talan DA (2005). Methicillinresistant Staphylococcus aureus in community-acquired skin infections. Emerg. Infect. Dis. 11: 928-930.

Pitout JDD, Church DL, Gregson DB, Chow BL, McCracken M, Mulvey M, Laupland KB (2007). Molecular epidemiology of CTXM-producing Escherichia coli in the Calgary Health Region: emergence of CTX-M-15-producing isolates. Antimicrob. Agents Chemother. 51: 1281-1286.

Pelczar JR, Harley JP, Klein DA (1993). Microbiology: Concepts and Applications. McGraw-Hill Inc., New York, pp. 591-603.

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Journal of AIDS and HIV Research

Table of Contents: Volume 5 Number 4 April 2013

ARTICLES

Research Articles

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Journal of AIDS and HIV Research

Full Length Research Paper

Profiles of attendees in integrated counseling and testing centre at Maharani Hospital, Government Medical College, Bastar (Chhattisgarh), India

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This study aims to study the socio demographic profile and risk behaviour of sero-positive attendees of Integrated Counseling Testing Centre (ICTC). The study design used was retrospective study setting on ICTC in the out-patient complex of G.M.C., Jagdalpur. Record of all 1706 attendees of ICTC in the year 2008 and the data of attendees in the years 2007 and 2009 were included in the study to access the time trend of human immunodeficiency virus (HIV). Variables used were age, sex, marital status, educational status, occupation, place of residence and pattern of risk behaviour in relation to HIV/AIDS. Analysis was done by standard statistical method using proportion, chi-square test and other statistical test. Upon analysis of the collected data, it was found out that sero- positivity among males was significantly high in comparison to the females. The percentage of both males and females attendees and their respective sero-positivity was the highest in the 15 to 49 age group. Of the sero-positive subjects, 84.13% were married. Furthermore, 95.22% were either illiterate or had completed studies up to higher secondary school. Majority of the sero-positive lived in urban areas. More than 50% sero-positive held professions like driver, labour or entrepreneur, and 26.98% sero-positives were housewives. Heterosexuality was the most known cause of transmission. Sero-positivity among attendees at ICTC was in increasing order which needs greater attention including the Independent Ethics Committee (IEC) in this tribal heartland of the country.

Key words: Integrated Counseling Testing Centre (ICTC), seropositivity, homosexual.

INTRODUCTION

In the past 30 years, acquired immunodeficiency syndrome (AIDS) has emerged as a devastatingly fatal disease, assuming pandemic proportions sparing no region of the world. It has caused widespread concern amongst the medical professionals and public in general (Park, 2007). According to a World Health Organization (WHO) estimate, about 75% of infections are transmitted through sexual intercourse, 10% perinatally, and another 10% through intravenous (IV) drug use. The pattern is shifting to predominantly heterosexual transmission all over the world (Agarwal et al., 1999). In the recent past, there has been promising development in global efforts to address the AIDS epidemic, including increased access to effective treatment and prevention. Globally, the rate of new infection is dropping. The 2009 report released by the Joint United Nations Programme on HIV/AIDS (UNAIDS) showed that global new HIV infection rates had fallen by 17% in the period between 2001 and 2008 (The Times of India, 2009). According to UNAIDS, this is a correlation of the popularity of HIV awareness

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Table 1. Age and sex profile of attendees and sero-positivity status.

Age (years)	Attendee (n=1706)						Sero-positives (n=63)					
	Male		Female		Total		Male		Female		Total	
	No.	%	No.	%	No.	%	No.	%	No.	%	No.	%
≤14	74	71.84	29	28.16	103	6.04	0	0	3	4.76	3	4.76
15-49	990	74.77	334	25.23	1324	77.61	34	53.96	22	34.92	56	88.88
≥50	237	84.95	42	15.05	279	16.35	4	6.34	0	0.0	4	6.34
Total	1301	76.26	405	23.74	1706	100	38	60.3	25	39.68	63	100

Sex: $\chi^2 = 9.18$, df = 1, $P < 0.005$ (Association significant). Age: $\chi^2 = 14.21$, df = 2, $P < 0.0001$ (Association highly significant).

campaigns. While the all-India figures showed the same trend, the guard still must be maintained. At an all-India level, the prevalence rate for adult women is 0.29% and for men, it is 0.43%. With 2.5 million HIV patients, India has the largest number of persons living with HIV/AIDS in the world (Times of India, 2010).

The distribution and spread of disease in India is uneven (Park, 2007). In order to implement the desired interventions in a particular area, the local epidemiology of HIV/AIDS has to be understood with regards to various socio-demographic factors, as well as level l awareness and risk behaviour patterns of the population. To date, it has been demonstrated that the most effective approach for prevention and control of disease is by bringing awareness among the people about the problem and lifestyle changes. The Integrated Counseling and Testing Centre (ICTC) is a non-coercive, confidential and cost-effective key entry point for a range of interventions in HIV prevention and care, which provide people with an opportunity to learn and accept their HIV status in a confidential manner (National AIDS Control Organization, 2000). The data generated in the ICTC may provide the epidemiology of the disease in a particular area/region.

MATERIALS AND METHODS

This study was carried out among the attendees of ICTC of Government Medical College and its affiliated Maharani Hospital, Jagdalpur (C.G.). The study included all the 1706 attendees who attended ICTC from 1st January, 2008 to 31st December, 2008, either voluntarily or through referral from various sources. Anonymous information from the relevant records of the centre was collected on a pre-tested structured proforma in conformity with National AIDS Control Organization (NACO) guidelines. The variables studied were age, sex, marital status, level of education, occupation, place of residence, pattern of risk behavior and HIV sero-status. In addition, data from 2007, 2008 and 2009 was procured to assess the trend of ICTC attendees and their sero-positivity status. Blood samples were collected by the laboratory technician after counseling and by obtaining informed consent from attendees under strict supervision of the designated pathologist. The collected blood samples were subjected for testing by three rapid/spot test: (i) comb-Aids test, (ii) Tri-Dot test, and (iii) Neva-HIV test. Persons whose blood samples showed negative results by comb-Aids test were given post-test counseling and were declared to be sero-negative. Persons showing positive blood sample results to comb-Aids test were subjected to Tri-Dot test and later to Neva-HIV test for declaring sero-positivity (National AIDS Control Organization, 2000). Persons showing negative results in the second and third tests were advised to come after 4 to 8 weeks for review. Data thus collected was compiled and analyzed using standard statistical methods.

RESULTS

Upon analysis of the collected data, it has been observed that 76.26% (1301) of the 1706 attendees were male. The overall positive rate among attendees was found to be 3.69%. Of the 1301 men, 38 (2.92%) were found to be sero-positive in comparison to 25 (1.92%) out of the 405 female attendees. Regarding age, 88.88% sero-positive persons belong to the 15 to 49 age group, who were the most sexually active group, which is more or less in conformity with the national figure. Of the attendees, 3 (4.76%) subjects were female being 14 years of age or younger, and 4 (6.34%) subjects were males of 50 years age or older. However, both age and sex-wise, the distribution pattern of sero-positivity was found to be highly statistically significant (Table 1). Upon further analysis, 34 (89.4%) out of 38 males belonged to the age group of 15 to 49 years, more or less reflecting the same pattern observed among females, that is, 88.00% (22 out of 25).

Marital status

Distribution of sero-positive persons as per marital status showed that 84.13% (50.79% male and 33.33% female) married couples were living together. Upon further analyses, 3 males were unmarried and 3 widowers, and the remaining 4 females were either widow or separated (Table 2). This association was found to be statistically insignificant.

Literacy status

The educational status of sero-positive attendees (Table3) reveals that 22.22% were illiterate, 25.39, 47.61 and 5.55% were educated up to primary, higher secondary

Table 2. Profile of marital and sero-positivity status of attendees.

Marital profile	Attendee						Sero-positive					
	Male		Female		Total		Male		Female		Total	
	No.	%	No.	%	No.	%	No.	%	No.	%	No.	%
Married	966	56.62	288	16.88	1254	73.5	32	50.79	21	33.33	53	84.13
Unmarried	219	12.83	60	3.51	279	16.35	3	4.76	-	0	3	4.76
Others												
(i) Widow												
(ii) Widower	116	6.79	57	3.34	173	10.14	3	4.76	4	6.34	7	11.11
(iii) Divorce												
(iv) N/A												
Total	1301	76.24	405	23.73	1706	100	38	60.31	25	39.67	63	100

χ^2 = 6.51, df = 2, P > 0.05 (Association not significant).

Table 3. Profile of educational and sero-positivity status of attendees.

Education	Attendee		Sero-positive	
	No.	%	No.	%
Illiterate	486	28.48	14	22.22
Primary	393	23.03	16	25.39
H.S.	667	29.09	30	47.61
College	138	8.09	2	5.55
NA	22	12.89	1	1.58
Total	1706	100	63	100

χ^2 = 4.32, df = -42, P > 0.005 (Association not significant).

Table 4. Profile of place distribution and sero-positivity status of attendees.

Place	Attendee		Sero-positive	
	No.	%	No.	%
Urban	721	42.26	35	55.56
Rural	985	57.74	28	44.44
Total	1706	100	63	100

χ^2= 64.52, df = -1, P < 0.0001 (Association significant).

and college levels, respectively. However, this association was also found statistically insignificant.

Residential

As per residential status of sero-positives, 55.56 and 44.44% had rural and urban backgrounds, respectively, and this was found statistically significant (Table 4).

Occupation

Occupation (Table 5) reveals that 17 (26.98%) sero-positive were housewives, 16 (25.34%) drivers and 10 (15.87%) laborers and farmers. The table further shows that 9.52% of sero-positives belonged to the business community. The association of different occupations was found statistically significant.

Risk behaviour of sero-positives

Of the sero-positives, 33% were heterosexual, 3.18% had a history of blood transfusions, and 1.59% was the spouse of sero-positive partner. The risk behaviour for the remaining 61.90% sero-positives was not known. Upon further analysis, it was noted that many attendees had more than one high risk behaviour. On statistical analysis, the association of various occupations was found highly significant (P<0.001) (Table 6).

Referral services

Doctors referred 23 (19 male and 04 females) sero-positive attendees to ICTC in comparison to 27 (16 males and 11 females) from Designated Microscopic Centre of RNTCP (Table 7). Figure 1, on statistical analysis association, was found highly significant (P < 0.001).

Data collected for the assessment of trends and sero-positive of the attendees of ICTC in the years 2007, 2008 and 2009 were also analyzed and it was found out that the number of attendees tested at ICTC has shown an increasing trend from 2007 to 2009 (Figure 2). A similar trend was also noted for sero-positive of the attendees for the corresponding period diagram (Table 8).

DISCUSSION

The number of attendees tested at ICTC has shown an increase every year from 2007 to 2009. Similarly, the

Table 5. Occupational profile of attendees and their sero-positivity status.

Occupation	Attendee		Sero-positive	
	No.	%	No.	%
House wife	212	12.42	17	26.98
Labour/Farmer	607	35.58	10	15.87
Driver	89	5.22	16	25.34
Rixa puller	26	1.52	1	1.59
Student	166	9.73	2	3.17
Business	118	6.92	6	9.52
Unemployed	77	4.51	1	1.59
Government/ Private job	268	15.71	5	7.7.94
Police/CGPS	71	4.16	2	3.17
Health personal	13	0.76	0	0
Other	59	3.46	3	4.76
Total	1706	100	63	100

χ^2 = 77.46, df = -10, P < 0.001 (Association significant).

Table 6. Pattern of risk behaviour and sero-positivity status of attendees.

Risk behaviour	Attendee		Sero-positive	
	No.	%	No.	%
Heterosexual	34	1.99	21	33.33
Parentally	2	0.12	0	0
Spouse	1	0.06	1	1.59
Blood Transfusion	2	0.12	2	3.18
Not known	1667	97.71	39	61.6
Total	1706	100	63	100

χ^2 = 409, df = -4, P < 0.001 (Highly significant).

Table 7. Profile of referral of attendees and their sero-positivity status.

Referral profile	Attendee		Sero-positive	
	No.	%	No.	%
Doctor	1132	66.35	23	36.5
DWC (Directly)	429	25.15	27	42.86
Family and spouse	38	2.23	9	14.29
Microscopic Centre (RNTCP)	91	5.33	4	6.35
Others	16	0.94	-	0
Total	1706	100	63	100

χ^2 = 60, df = -4, P < 0.001 (Highly significant).

percentage of female attendees who were tested at ICTC also increased from 2007 to 2009. This may be because of increased awareness about HIV/AIDS or less stigma and greater urgency to get tested, because of Independent Ethics Committee (IEC) carried out for HIV/AIDS. Another reason may be increased access of testing services within their reach. But the main difference in male and female attendees for testing at ICTC showed that female are still lagging behind their male counterparts in getting tested. This may be due to the status of women in the society. This factor needs greater attention in our IEC planning.

Findings of the study conducted by Joardar et al. (2006) and Jayaram et al. (2009) as per age and sex were more or less in conformity with the findings of the present study. Regarding marital status of the attendees,

Table 8. Trend of attendees and their sero-positivity status (2007-2009).

Year	Attendee					Sero-positive					
	Male	%	Female	%	Total	Male	%	Female	%	Total	%
2007	911	65.49	480	34.51	1391	32	62.75	19	37.3	51	3.67
2008	1301	76.26	405	23.74	1706	38	60.32	25	39.7	63	3.69
2009	1419	66.37	719	33.63	2138	38	46.34	44	53.7	82	3.84

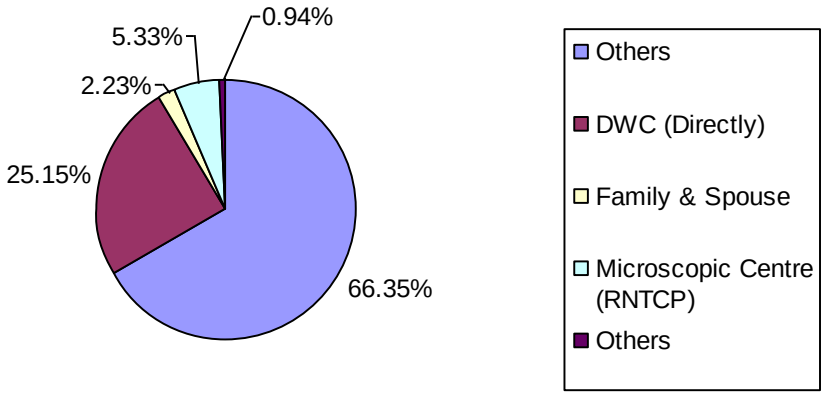

Figure 1. Source of referral attendees.

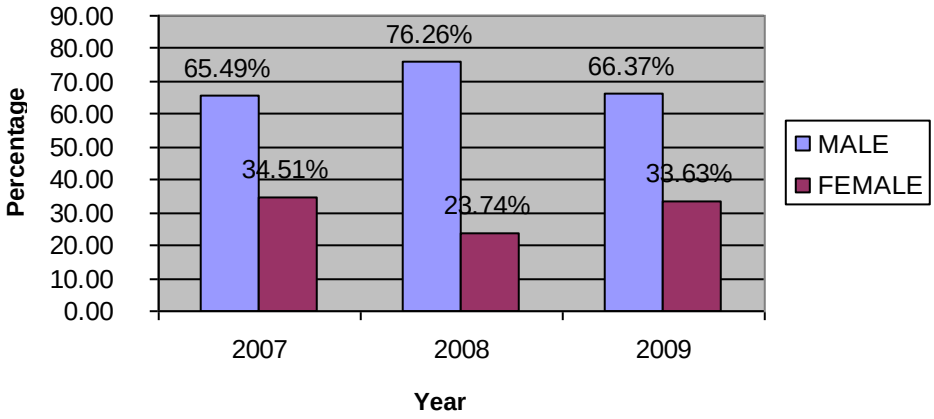

Figure 2. Sex-wise attendees that attended ICTC.

Vyas et al. (2009), Gupta (2009) and Jayaram et al. (2009) noted that majority of the attendees of both sexes were married, which was again in accordance with the findings of the present study. Those sero-positives who were unmarried are likely to get married in the near future, and then there will be a greater risk of mother to child HIV transmission.

In the present study, 2.88% of the sero-positives were illiterate while Jayaram et al (2009) found 2.6 and 3.0% in 2005 and 2006 illiterate sero-positive, respectively. This is more or less similar to the findings of the present study.

In the present study, 55.56 and 44.44% of the sero-positives belong to urban and rural areas, respectively. The difference was statistically significant. It showed that (a) people residing in urban areas were more engaged in high risk behavior; (b) there are more testing facilities in urban areas and (c) IEC activities are more concentrated in urban areas. In future planning of IEC, we have to take into consideration the aforementioned findings.

Truck drivers constituted the second highest figures of

sero-positives in the present study, which is in accordance with the findings of Mishra et al. (2009), where they found out that truck drivers who remain out of their home for most of the time indulge in sexual activities with partners other than their spouses. Similarly, 9.52% of businessmen were found sero-positive. This could be because businessmen used travel for their business purposes and are thus away from their houses and have the chance to be engaged in extramarital sex. They can then get HIV and transfer to their wives at home, which are supported by the findings in the present study that found 21 married women sero-positives. It means that there is need of intensified IEC for this section of the society.

Heterosexual risk behaviour was noted as the most common mode of transmission of HIV/AIDS in the present study, which is again in conformity with the findings of the study conducted by Lal (2003) and Vyas et al. (2009).

Conclusion

From the aforementioned observations and discussion, the authors reached the conclusion that, although HIV cases are on decline globally and nationally in India, it is increasing in the Tribal heartland. This needs greater attention and area-specific planning including from the IEC. Health behaviours of tribal peoples are different from those of their rural and urban counterparts. There is a wide gap between the knowledge and practices of the people, which is the matter of real concern. Every effort must be made to bridge this gap (Bansal and Garg, 2001). There is an urgent need for the proper management of information system (MIS), which play an important role in the collection, analysis and transmission of the information to persons in places where it is required within a shorter timeframe (Garg et al., 2001). For any health problems, people of this area approach Baiga-Guniya's (Local healers). In order for our efforts to be successful, the health providers have to intermingle with these Baiga-Guniya's. Only then will we be able to penetrate this difficult-to-reach area.

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Full Length Research Paper

Human immunodeficiency virus (HIV) associated lipodystrophy: The prevalence, severity and phenotypes in patients on highly active anti-retroviral therapy (HAART) in Kenya

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Highly active antiretroviral therapy (HAART) is widely accessible to human immunodeficiency virus (HIV)-infected individuals in Kenya. Their long term use is associated with chronic complications such as lipodystrophy which may lead to stigmatization, reduced self esteem and poor adherence to HAART. This cross-sectional study described the prevalence of lipodystrophy, the phenotypes and severity among adult HIV infected patients on chronic HAART at a HIV clinic in Kenya. Data were collected using an investigator administered questionnaire and anthropometric measurements done using a protocol based on the Third National Health and Nutrition Examination Survey. The prevalence of lipodystrophy was 51.3% (confidence interval (CI) 45.6 to 57.6). Lipoatrophy occurred in 44%, lipohypertrophy in 15% and mixed syndrome in 41% of patients with lipodystrophy. Facial atrophy occurred in 75.7% of patients with lipodystrophy, upper limb atrophy in 48.5%, and lower limb atrophy in 36.8%. Abdominal obesity occurred in 40.4% of patients with lipodystrophy, breast enlargement in 30.9% and dorsocervical fat accumulation in 5.1%. Most patients had severe lipoatrophy, whereas lipohypertrophy was described as mild to moderate using the HIV out-patient study (HOPS) scale. HIV associated lipodystrophy was common in HIV-infected patients on chronic HAART. The main phenotype was lipoatrophy which majority of the patients described as severe.

Key words: Lipodystrophy, highly active anti-retroviral therapy (HAART), nutrition surveys, obesity, abdominal.

INTRODUCTION

Highly active anti-retroviral therapy (HAART) is the standard of care therapy for patients with human immunodeficiency virus (HIV)-1 infection and CD4 counts ≤ 350 cells/mm^3. In Kenya, there has been a dramatic increase in the number of patients accessing antiretroviral therapy from an estimated 3,000 in 2002 to 511,181 in 2011 (Kenya ART Guidelines, 2011). However, viral eradication is not possible with HAART, thus antiretroviral therapy use has to be indefinite for the clinical benefits to be preserved (Hoggs et al., 1998). Prolonged use of HAART has led to recognition of long term complications of these therapies such as lipodystrophy which was first described in HIV-1 infected individuals by Carr et al. (1998). It manifests with distressing morphologic changes in body habitus such as central fat accumulation (lipohypertrophy) evidenced by increased abdominal girth and increased waist to hip ratio, development of a dorsocervical fat pad (buffalo hump), breast enlargement, fat

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accumulation in the anterior neck and multiple lipomata. Lipodystrophy also manifests with loss of peripheral subcutaneous fat (lipoatrophy) in the face, arms, legs, abdomen and/or buttocks resulting in the appearance of sunken cheeks, exaggerated musculature, bones, arteries and veins occurring most frequently among patients who are responding to HAART. A mixed syndrome has also been reported in patients who exhibit simultaneous fat loss and accumulation at distinct locations of the body (Tien et al., 2003).

Studies have shown that patients with lipodystrophy report increased distress due to the cosmetic effects and think that the obvious facial and extremity wasting represents disease progression and a form of involuntary disclosure of HIV status. This has been associated with both short-term and long-term suboptimal adherence to antiretroviral regimens leading to treatment failure (Reynolds et al., 2006). The dysmorphic changes have also been associated with social stigmatization, reduced self esteem, a disruption of sex life and therefore reduced quality of life (Blanch et al., 2004). In addition, HAART-naive patients have been reported as reluctant to initiate treatment with healthcare providers being viewed as ignoring and discrediting patients' distress (Ammassari et al., 2002). The overall prevalence of at least one physical abnormality in various studies is about 50% after 12 to 18 months of therapy (Heath et al., 2002; Galli et al., 2002). In the HIV out-patient study (HOPS), a sub-analysis was performed on 1077 patients visiting out-patient clinics over three month duration. It was reported that 49% of the study population had one or more signs of lipodystrophy. Of the patients, 13.3% had only signs of peripheral fat atrophy, 13.2% had only signs of fat accumulation, and 22.7% had both (Lichtenstein et al., 2001).

In the LIPOCO study, a cross-sectional analysis of 154 men who were part of a French observational cohort, lipodystrophy was observed in 53.25% patients. Investigators classified 15.89% patients in the lipoatrophy group, 4.21% in the obesity group and 18.22% in the mixed group (Saint-Marc et al., 2000).

Diagnosis of HIV-associated lipodystrophy is typically made on clinical grounds. Patient self-reports may be an early and the best indicator of body shape changes, and correlates with physical examination. Case definitions for use as a research tool have been suggested (Carr et al., 2003). Other methods include anthropometric estimates of both visceral adipose tissue (VAT) and subcutaneous adipose tissue though more emphasis has been placed on the prediction of VAT (Zamboni et al., 1998), skin fold thickness to estimate subcutaneous fat, computed tomography (CT) and magnetic resonance imaging (MRI) scans which give objective quantification of fat (Seidel et al., 1990) but requires expert interpretation and are expensive, dual energy X-ray absorptiometry which is suitable for examining subcutaneous fat, but cannot be used to estimate visceral fat, dorsocervical fat and facial fat, and bioelectrical impedance analysis which estimates whole lean body tissue.

HAART is increasingly available and accessible to HIV infected patients in Kenya and has transformed HIV into a chronic manageable disease, but with chronic complications such as lipodystrophy, the cosmetic aspect complications such as lipodystrophy, the cosmetic aspect of which may compromise antiretroviral drug adherence and, ultimately, treatment success. However, there are few studies on lipodystrophy in Africans despite its high prevalence in other societies.

Data from this study will provide a foundation for on-going education to clinicians and patients on the risk factors for these complications and their relationship to antiretroviral therapies.

MATERIALS AND METHODS

Ethical considerations

The study was conducted after approval by the Department of Clinical Medicine and Therapeutics, University of Nairobi, and the Kenyatta National Hospital Scientific and Ethical Review Committee.

Study site

This study was conducted at the HIV out-patient clinic at Kenyatta National Hospital, a tertiary national referral and teaching hospital in Kenya.

Study population

The participants were HIV infected patients, ≥15 years old on HAART for six months or longer seen in the HIV clinic from August, 2007 to August, 2008.

Study design

This was a cross-sectional descriptive study. A study questionnaire was used to collect baseline and clinical data. The assessment of lipodystrophy was determined by self report and physician assessment using a modified version of the lipodystrophy case definition questionnaire (Carr et al., 2003). Anthropometric measurements (height, weight, mid upper arm circumference, waist circumference and hip circumference) were obtained using a standardized protocol based on the Third National Health and Nutrition Examination Survey (NHANES III).

An abdominal circumference of greater than 102 cm for men and 88 cm for women was considered as increase in abdominal girth (Miller et al., 1998). A body mass index more than 25 kg/m^2 was considered overweight. The minimum sample size (n) required to determine the prevalence of lipodystrophy was determined at 265 patients. The criteria for statistical significance was P value <0.05.

Inclusion criteria

HIV infected male and female patients aged 15 years or more and deemed compliant on HAART for six months or more were eligible for this study.

Exclusion criteria

Patients on anabolic steroids or immune-modulatory therapy, those with Cushing's disease or other endocrine disorders, pregnant patients, moribund patients, and patients with malignancy or features of HIV wasting syndrome were excluded.

Patient assessment

The Comprehensive Care Centre operates five days in a week. All patients undergo full evaluation at initial visit consisting of a comprehensive history, including current and prior anti-retroviral therapy, past and current history of opportunistic infections; physical examination and laboratory investigations including full blood count, liver and renal function tests, CD4 and CD8 counts.

Patients eligible for HAART commence treatment and thereafter return to the clinic monthly for review and supply of antiretroviral medication.

Recruitment was done among patients who had been on chronic treatment. The patients were informed about the study and their eligibility assessed. Those who met the inclusion criteria and gave signed informed consent were recruited and the history of their illness was taken. The study questionnaire and lipodystrophy case definition questionnaire were administered by the principal investigator followed by a targeted physical examination and performance of anthropometric measurements.

Sample size calculation

The minimum sample size (n) required to determine the prevalence of lipodystrophy was calculated using the formula:

$$n = \frac{Z2\ Л\ (1- Л)}{d^2}$$

whereby Z value is the upper $\alpha/2$ point of the normal distribution, 1.96; Л is the assumed prevalence. A prevalence of 22% was used from unpublished local data, d = precision, 0.05

Outcomes

Lipodystrophy was defined by at least one of the following features: fat wasting (lipoatrophy) in the face, neck, arms and legs and gluteal regions; fat accumulation (lipohypertrophy) was defined by central obesity (waist circumference of >88 cm in males and >102 cm in females), focal fatty deposits, cervical fat pad enlargement and gynaecomastia; mixed disease was defined as patients with features of both lipoatrophy and lipohypertrophy.

Lipodystrophy was rated using the HOPS scale first by the patient and then by physician examination, as "subtle" (noticeable only if specifically looked for, no change in clothing fit), "moderate" (easily noted by patient or physician, clothing has become loose/tight), or "severe" (obvious to the casual observer, has required a change in clothing size).

Statistical analysis

All data were entered into database using Microsoft excel. Statistical analysis was performed using Statistical Package for Social Sciences (SPSS), version 15.0 and described as means, medians, standard deviation and frequency distributions. The criteria for statistical significance was P value <0.05.

RESULTS

318 HIV-seropositive patients were screened on chronic HAART therapy and excluded 53 (16.6%) patients; 40 had been on HAART for less than 6 months, 5 had opportunistic infections, 3 were moribund, 2 had HIV wasting syndrome, 2 declined consent and 1 had a malignancy. 265 patients were thus enrolled at the Comprehensive Care Centre at the Kenyatta National Hospital.

Patients' baseline characteristics

The mean and median age of the study population was 40.69 and 40 years, respectively. Females constituted 59.6% of the study participants. The mean baseline CD4 count of the study participants was 119 mm^{-3} while CD4 count at the time of study was 335 mm^{-3}. Majority of the patients that is, 194 (73.3%) were in World Health Organization (WHO) stage III and IV at initiation of HAART. The mean duration of treatment of the study participants was 29.7 months with a median of 28 months. One hundred and seventy seven patients (66.8%) had been on HAART for longer than 18 months. Stavudine based regimens were the most commonly used with 188 (70.9%) patients being on this combination and 41 (15.5%) patients being on AZT-based regimen. Twenty six of these patients had switched from a stavudine (d4T) based regimen prior to enrolment into the study. It was also noted that of 36 (13.6%) patients who were on a tenofovir disoproxil fumarate (TDF) based regimen, 30 had switched from a d4T based regimen and 6 from a zidovudine (AZT) based regimen prior to the time of enrolment. Consequently, 244 (92%) of the study participants had used a d4T containing regimen during their follow-up in the clinic. The switches were mainly due to drug toxicity (lipodystrophy and peripheral neuropathy) and treatment failure.(Table 1)

The males weighed more than the females. The mean body mass index (BMI) of the study population was 22.1 kg/m^2. Both median waist circumference and waist to hip ratio (WHR) were within normal at a median of 83.5 cm and 0.89, respectively for males and 84 cm and 0.87, respectively for females. (Table 2)

Lipodystrophy

Among the study participants on chronic HAART therapy, 51.3% (confidence interval (CI) 45.6 to 57.6) had at least one sign of abnormal fat distribution. The concordance between patient self-assessment and physician examination was 96.9%. Lipoatrophy was described in 44%, lipohypertrophy in 15% and mixed syndrome in 41% of patients with lipodystrophy.

Facial fat loss was the commonest sign of lipoatrophy described in 75.7% of patients with fat distribution

Table 1. Demographic characteristics of the study population.

Variable	Category	No. of patients	Frequency (%)/ Mean
Age	-	265	40.7
Gender	-	158	59.6
WHO stage	I	24	8.9
	II	47	17.3
	III	99	37.3
	IV	95	36
CD4 counts	Nadir	256	119 mm^{-3}
	Most recent	265	335 mm^{-3}
Duration of HAART (Months)	6 -18	83	31.2
	19 - 36	123	46.4
	> 36	59	22.4
HAART combinations	d4T based	188	70.9
	AZT based	41	15.5
	TDF based	36	13.6

Table 2. Distribution of anthropometric variables of the 265 patients included in the study.

Variable	Median (IQR)	
	Male (n=107)	Female (n=158)
Weight (kg)	64.5 (45-97.5)	62.7 (40.5-96)
Height (cm)	172 (151-188))	166 (149-185)
Waist circumference (cm)	83.5 (61-117)	84 (60-130)
Waist to hip ratio	0.89 (0.72-1.18)	0.87 (0.63-1.30)

abnormalities, followed by fat loss in the arms (48.5%), legs (36.8%), gluteal area (36.8%) and breast (11.8%). Among patients with lipohypertrophy, increased abdominal girth was evident in 40.4% of the patients of whom, 24% had isolated abdominal fat accumulation. Breast enlargement was found in 30.9% of the patients and fat accumulation in the dorsocervical area in 5.1% of the patients (Table 3). There was a high degree of concordance (70 to 97%) between patients and their physicians on the presence of abnormal fat distribution at the different body sites. Most patients had severe lipoatrophy (Figure 1).whereas lipohypertrophy was described as mild to moderate (Figure 2).

DISCUSSION

Lipodystrophy is a well recognized problem in the Western world but with very little data in the African population. There is currently no published data on its prevalence in Kenya. This study was conducted between August 2007 and 2008 at Kenyatta National Hospital, a referral and teaching hospital in Kenya. It comprised 59.6% females (female to male ratio, 1.5:1). Most of the individuals in the study population were young individuals with a median age of 40 years and about 50% aged below 50 years. Females were younger than their male counterparts where 60.7% were below 40 years as compared to 44% of males. These findings reflect the National Acquired Immune Deficiency Syndrome (AIDS) and Sexually Transmitted Infection (STI) Control Programme (NASCOP, 2005) estimates that at least two-thirds of all HIV infected in-dividuals in Kenya are young women in the reproductive age. Therefore, the age and gender distribution of this study population is fairly representative of the sample of HIV-infected patients in Kenya.

The mean BMI was 23.1 kg/m^2; this was within the normal range of 18 to 25 kg/m^2. The median mid-upper arm circumference was 27 cm, the median waist circumference was 84 cm and the median WHR of this population was 0.96. These were similar in both male and

Table 3. Distribution of body sites affected by lipodystrophy.

Change in body fat		Physician assessment (n=136)	
		Lipoatrophy (%)	Lipohypertrophy (%)
Facial fat	Yes	103 (75.7)	5 (3.7)
	No	33 (24.3)	131 (96.3)
Neck	Yes	13 (9.6)	6 (4.4)
	No	123 (90.4)	130 (95.6)
Dorsocervical	Yes	9(6.6)	7 (5.1)
	No	127 (93.4)	129 (94.9)
Breast	Yes	16 (11.8)	42 (30.9)
	No	120 (88.2)	94 (69.1)
Arm	Yes	66 (48.5)	5 (3.7)
	No	70 (51.5)	131 (96.3)
Abdomen	Yes	13 (9.6)	55 (40.4)
	No	123 (90.4)	81 (59.6)
Gluteal fat	Yes	50 (36.8)	6 (4.4)
	No	86 (63.2)	130 (95.6)
Leg fat	Yes	50 (36.8)	4 (2.9)
	No	86 (63.2)	132 (97.1)

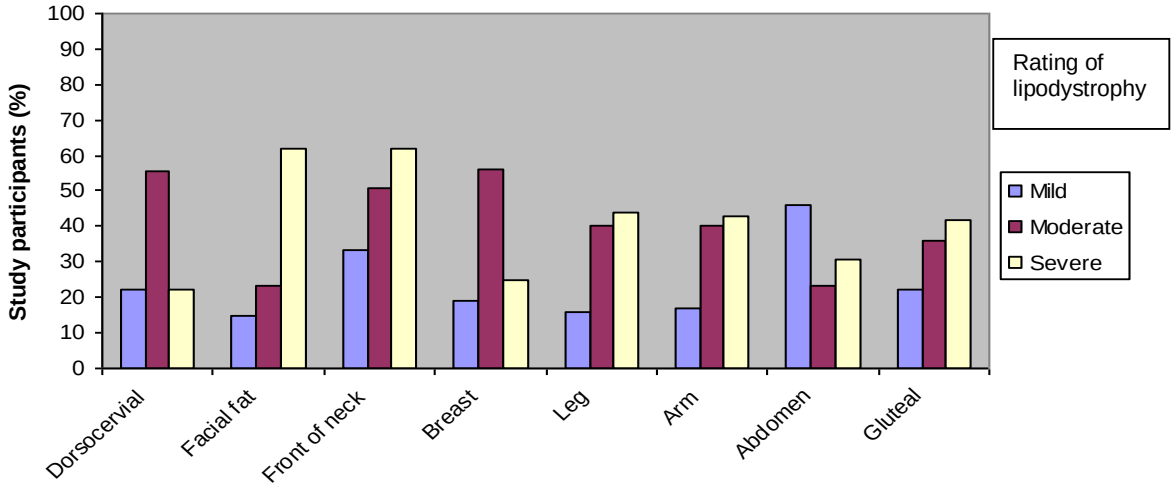

Figure 1. Severity of lipoatrophy by body site of this population.

female patients and within normal. The normal parameters could be a reflection of decreased morbidity as well as the gain of lean tissue mass conferred by the use of HAART and the continuous nutritional assessment and counseling conducted to patients attending our clinics regularly.

In comparison, in the multicenter AIDS cohort study (MACS) cohort, Palella et al. (2004) reported a mean BMI of 25 ± 3 and a mean WRH of 0.95 ± 0.07; the mid upper arm circumference (MUAC) reported 32 ± 4, waist

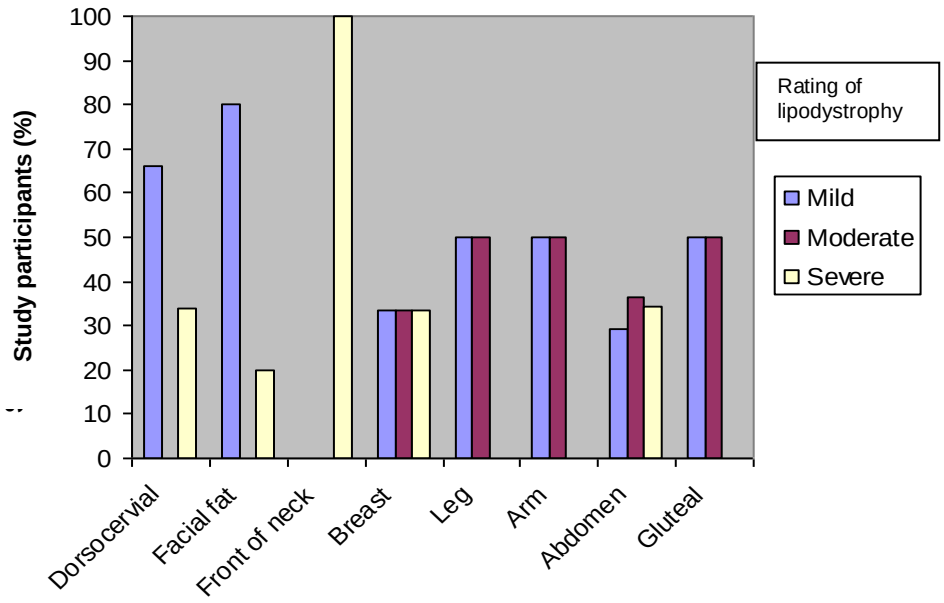

Figure 2. Severity of lipohypertrophy by body site of the population.

circumference of 90 ± 9 and mean weight of 69.6 ± 10.8 using standardized NHANES III protocol. These higher values could be explained by the fact that these measures were done in Caucasian patients who probably started HAART earlier. The lower values in our population may also be explained by the high prevalence of malnutrition in this set-up, genetic make-up and lifestyle influences on body fat composition. In addition, the reduced MUAC could have been lower due to high prevalence of lipoatrophy (44%) in our patients.

The overall prevalence of HIV associated lipodystrophy in HAART treated patients was 51.3% (CI 45.6 to 57.6) discerned on physical examination. This high prevalence was expected due to patient treatment with stavudine and zidovudine which are implicated in the etiology of lipodystrophy from majority of studies (Van der Valk et al., 2001; Fellay et al., 2001; Saint-Marc et al., 2000).

In Rwanda, a multicenter study in 571 patients reported a prevalence of 48.5% in urban population and 17.3% in rural groups (Mutimura et al., 2007). Our study was done in an urban set-up and the higher prevalence may have been due to influence of diet, lifestyle and behavioral choices on the development of lipodystrophy.

A cross-sectional analysis done on 1077 patients belonging to the HOPS cohort who had been on HAART for 3 years, Lichtenstein et al. (2001) found a prevalence of 49%. This study was similar to ours in using patient report and physician examination to diagnose lipodystrophy.

Peripheral lipoatrophy was the most common phenotype occurring in 44% of our patients. Facial atrophy was reported in 75.7%, arm atrophy in 48.5%, leg and buttock atrophy in 36.8% of patients with peripheral lipoatrophy. Most of the patients described the wasting as severe. This is a cause for concern, because it can impact on adherence due to effect of these body changes on cosmesis as well as increased stigmatization.

The Rwanda study (Mutimura et al., 2007) reported facial, arm, leg and gluteal atrophy in 67, 66, 70, and 46%, respectively. The differences in the prevalence may be due to other environmental and genetic factors.

The simultaneous presence of peripheral lipoatrophy and lipohypertrophy (mixed disease) was common in our study (41%). This is similar to the prevalence reported in the HOPS cohort of 46.2% but much lower than in the Rwanda study (Mutimura et al., 2007) in which mixed syndrome was the most common phenotype occurring in 72% of the study population. These findings of mixed disease suggest that lipoatrophy and lipohypertrophy should be assessed together when describing the prevalence or incidence of lipodystrophy syndrome.

Lipohypertrophy was found in 15% of our study population and was the least common phenotype diagnosed. Abdominal adiposity was the most often reported form of lipohypertrophy found in 40.4% of patients with lipohypertrophy followed by gynecomastia in 30.9% and buffalo hump in 5.1%. Fat accumulation in the neck was commonly reported as severe while the other areas of lipohypertrophy involvement were reported as mild to moderate. Thirteen patients had isolated increase in abdominal girth and were analyzed alongside those with several signs.

The high prevalence of central obesity in this study sounds the drum beat for the clinician to assess for other risk factors for cardiovascular disease and thereafter incorporate therapeutic lifestyle measures in the management

of these patients.

Our findings compare well with those reported by the MACS in USA (Palella et al., 2004) which used anthropometric assessment in a case control study of HIV infected and non-infected patients. Among those on HAART, MACS reported facial atrophy in 42%, increased abdominal girth in 42%; buttock, leg and arm atrophy in 36, 34 and 29%, respectively. 12% of the patients had a buffalo hump.

In the Rwanda study (Mutimura et al., 2007), abdominal obesity was found in 84% of the study participants and gynecomastia in 47%. The differences may be due to differences in the methodology of the two studies. Our study used waist circumference to define increase in abdominal girth, while the Rwanda study used WHR. Waist circumference is known to be a more sensitive and specific measure of visceral adiposity than WHR (Zamboni et al., 1998).

The limitation of this study is that we were unable to perform imaging techniques such as CT and MRI scans due to their high costs. These scans are better in quantifying the changes in body fat. HIV associated lipodystrophy was common in HIV infected patients on long term HAART at Kenyatta National Hospital with the main phenotype being lipoatrophy.

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Full Length Research Paper

Collecting whole network data for human immunodeficiency virus prevention: A review of current strategies

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The study of social networks is essential to understanding the spread of infectious diseases. This study reviews strategies for collecting whole (that is, sociometric) network data for human immunodeficiency virus (HIV) prevention. Using selected criteria, peer-reviewed journal articles published from 1980 to 2012 were searched in ISI Web of Knowledge and PsychInfo databases, and social network journals. Data from articles represent 12 whole network studies; the preponderance of the remaining articles was from personal (that is, egocentric) network studies. A common approach used to devise a whole network was recruiting and linking personal networks. Other approaches included venue-based linkages and use of a population roster. Ethnography and chain referral methods were key components of a multi-method approach to successfully acquiring a whole network. Few studies adequately explicate data collection and linking methodologies. Potential ways to augment and standardize reporting for similar studies are suggested.

Key words: Human immunodeficiency virus (HIV), social network, sociometric, egocentric, recruitment.

INTRODUCTION

The nature of human immunodeficiency virus (HIV) transmission will benefit from a clearer understanding of the role and dynamics of social networks in order to curb further spread of the disease. While social networks have been explored as a factor in the spread of HIV since the early years of the epidemic (Auerbach et al., 1984), growing evidence citing that individual risk behaviors alone do not explain racial disparities in HIV, other sexually transmitted infections (STIs) and blood-borne infections (BBIs) outcomes increases the need to understand network dynamics of infection (Adimora et al., 2009; Ellen et al., 1998; Hallfors et al., 2007). In a nationally representative study of young adults, racial disparities in the prevalence of STIs were not explained by substance use or risky sex practices (Hallfors et al., 2007). Racial/ethnic minority groups are much more likely to belong to social and sexual networks with higher background STI/HIV prevalence, and this has been hypothesized to be a key contributing factor to HIV and STI disparities. With a growing interest in network research, combined with pressing need to prevent further spread of HIV, a paper that summarizes strategies for recruiting whole networks for HIV prevention is useful for (1) cataloguing the ways in which whole networks can be collected for HIV studies, (2) orienting new and emerging HIV network researchers, and (3) informing future research in this area.

In general, the majority of social network studies use either whole network (that is, sociometric) or personal

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network (that is, egocentric) designs. Personal network studies involve focal individuals ("egos") and those they are tied to ("alters"), while whole network designs attempt to understand social structure through a (not always) complete inter-connected web of direct and indirect ties among individuals in a bounded network. The manner in which research questions is conceptualized dictates the type of network studies conducted. This, combined with the incontrovertible difficulty and resource-intensiveness of conducting whole network studies, may account for the greater number of personal network studies in the literature. Moreover, numerous ethical issues are likely to arise in all network research, especially in HIV research which reports on sexual and drug use relationships (Woodhouse et al., 1995).

Studies examining social networks and HIV varied in the ways networks are incorporated into the study. Most commonly, network characteristics have been incorporated as data collection items on social factors contributing to disease incidence, prevalence, or behavior. This is typically done by characterizing risk networks with regard to structural, compositional, relational and functional aspects that influence HIV risk. For example, factors such as network size and attributes of both network members and relationships have been shown to influence risk behavior (De et al., 2008; Latkin et al., 2003; Smith et al., 2004; Williams and Latkin, 2007). Social network approaches have also been employed in the design of intervention studies that seek to alter behavioral norms within networks; one common method has been to use peer opinion leaders to diffuse new norms throughout the network (Latkin et al., 2003; Kelly et al., 2006; Latkin, 1999). Finally, social network approaches, including respondent-driven sampling (RDS), are also regularly used in the recruitment of hidden and/or high-risk groups (Abramovitz et al., 2009; Heckathorn, 1997; Heckathorn et al., 2002; Kendall et al., 2008).

Numerous articles have been published examining the effects of personal network characteristics on risk behaviors and HIV-related outcomes; and the field has benefited significantly from these contributions. Personal network studies, which predominantly use self-report data by the index about their direct network members, have largely been employed to understand interpersonal influence and risk factors and diffusion of norms from a peer leader to network members. However, personal network data are not optimally designed to address questions of population transmission and spread, unless the multiple, smaller networks they yield can be connected to form larger network components. Components represent the number of persons who can be reached through direct and indirect linkages in a network. Whole networks, by definition, are complete networks depicting all connections within a defined social group or geographic space; therefore, they are designed to yield larger components than those sought in personal networks. For this reason, they may be more informative when considering population-level inter-relationships, risk connections and potential infection spread. Because they yield larger interconnected structures, whole networks offer multiple viewpoints for identifying prevention points, for example, through measures of centrality, position, exposure and influence.

Simulation studies, such as those conducted by Morris et al. (2009) have used population parameters from large representative studies to illustrate the dynamics of infection spread under conditions where concurrent partnerships exist. These types of studies are aptly suited for demonstrating concurrency and visual representation of where risk is located within a social network. Morris et al. (2009) showed that even modest levels of concurrency greatly impacts epidemic potential and also demonstrated how sexual mixing patterns by race could have produced present-day racial health disparities. Although simulation studies are informative in explaining observed patterns and to predict future patterns, they do not negate the need to understand networked relations only possible with empirical field studies. Being able to identify and prevent new HIV infections, when persons are most infectious, is critical to reducing prevalence.

Understanding network dynamics in empirical field studies is hindered by multiple challenges to collecting whole network data for HIV prevention. First, recruiting whole networks depends upon having clearly delineated boundaries for sample recruitment. For studies within organizations (e.g. schools), it is possible to identify all members from a roster or similar mechanism and proceed to determine ties among them. For population-based recruitment in high prevalence communities, social and geographic boundaries are not always clear. For example, persons living with or at risk for HIV may occupy multiple geographic spaces (e.g. living in an area distinct from the one where they engage in risky behaviors). Alternatively, the target population may be socio-demographically diverse and include members from both hidden and unhidden populations. Many HIV studies target individuals based on their risk behaviors or membership in a defined high-risk group. In contrast, whole network studies are comprised directly and indirectly linked individuals who may be at varying levels of risk for infection. Under a network perspective, persons generally considered "low risk" and who may not otherwise be targeted for prevention or intervention remain at risk of infection through indirect relationships. The combination of one's position within a network and the behaviors of direct and indirect ties may affect one's behaviors and health outcomes.

Enumeration and recruitment of network members represent two additional challenges to sampling whole networks. Enumeration can be hindered by multiple biases, including recall and misclassification biases, masking (that is, limiting disclosure as a means of protecting privacy) and inability to identify anonymous partners. Recruitment of alters can be potentially more challenging than enumeration, particularly among connected members

who are at risk of HIV through indirect ties. Finally, depending upon the recruitment design, identifying linkages among individuals will be necessary to complete the network, and this can be done through several methods, including direct observation and respondents reporting the ties among their network members. Achieving a complete network for HIV prevention is methodologically challenging and very rare. For most cases in HIV research, a whole network refers to a network that recruits beyond alters who are connected directly or through one intermediary person to include longer indirect linkages and the connections among them.

Multiple strategies have been used to recruit whole networks for HIV research with prevention implications, but no systematic approach currently exists. Often, a mixed method approach that combines quantitative and qualitative methods is required to recruit a whole HIV risk network. Specifically, we address the following questions: What are the strategies used to sample, recruit, and collect whole network data for HIV prevention? What are the strengths and limitations of the strategies used? Are there recommendations that can be made toward standardizing approaches for specific goals and/or populations?

METHODOLOGY

Inclusion criteria

Studies were selected for review if they were: quantitative STI or HIV research that collected whole network data and were published in a peer-reviewed journal between January 1, 1980 and March 30, 2012. Since achieving whole networks in the truest sense in HIV studies is very rare because of the methodological challenges indicated, we used a more encompassing criterion. Granovetter (1973) suggests that personal networks are made up of an ego, ego's contacts and their contacts. As such, in this study, we report on studies whose recruitment went beyond these two levels of ties. Our interest was specifically in social network studies, rather than studies employing primarily cluster analyses, contact-tracing, respondent-driven sampling methods, phylogenetic studies, and investigations of outbreaks; as such, studies focused on these latter methods of recruitment, analysis, or linking were excluded.

Our search was limited for two reasons. First, our focus is on understanding field-based whole network studies. While the aforementioned methods may share some properties of networks, they represent different approaches that may not be as applicable to field-based research. For example, investigators seeking to recruit whole networks within high-risk communities usually do not do contact-tracing or investigate outbreaks; these typically have been functions relegated to public health departments. Moreover, molecular phylogenetic studies seek to discover the source of infection, and depend on having a recruited sample to trace molecular data. Furthermore, cluster analysis assigns a set of individuals to a group or cluster based on some algorithm (e.g. distance). Finally, respondent-driven sampling is the method that yields dendritic (that is tree-like) structures upon which limited network analyses can be performed. Second, given the large number of studies of HIV, STI, and other blood-borne infections that now incorporate a network component, we necessarily had to create boundaries for this review, and we acknowledge that these boundaries exclude many network studies. Other eligibility criteria were: a focus on either drug or sexual networks and field-based empirical studies. Conceptual, simulation and internet-based studies were excluded. Internet-based studies were excluded because they are categorically different from field-based studies and have their own specific set of methodological issues. Studies conducted or published outside of the United States were included in the search; however, non-English language publications were not included in the research.

Search strategy

Two databases (ISI Web of Knowledge and PsychInfo), as well as 3 social network journals (Connections, Social Networks, and the Journal of Social Structure) were searched for relevant articles. ISI Web of Knowledge is the largest database of citations in the Arts and Humanities, Social Sciences and Sciences. Both the Social Science Index and Medline are indexed within this database. Subject searches were conducted using the terms "HIV" or "STI" and "network." Additional searches were conducted using the terms "network" and "gonorrhea" or 'Chlamydia" or "syphilis" or "sexually transmitted" and "network" and "hepatitis." The search terms were purposefully chosen to be broad in hopes to capture all indexed studies on HIV, STIs, blood-borne infections and networks.

Analysis

The Web of Knowledge searches yielded a total of 2,248 articles for the time period (including duplicates between the two searches), of which 65 were selected for more in-depth screening for inclusion. The PsychInfo search yielded 1,050 articles, of which 30 were selected for further review. The journals Social Networks, Journal of Social Structure, and Connections yielded 129 articles that were reviewed; of which 14 were selected for further review. Article titles, and/or abstracts were reviewed to generate list of articles for further review and final list of potential articles was retrieved, reviewed and agreed upon by both authors. Of note, our results are an attempt to report on distinct studies, not specific analyses or articles written within each study. Figure 1 summarizes the article search flow.

RESULTS

The final number of whole network studies meeting the inclusion criteria was 12 (Figure 1). The geographic variation, population studied, sampling, recruitment and data collection methods varied across the 12 studies (Table 1), as well as key features such as largest network component, number of contacts recruited, and linkage procedures (Table 2). This study describes some of these features in more detail subsequently.

Regional spread, risk groups and outcomes targeted among identified studies

Several studies were conducted in multiple regions. Of the 12 studies identified, 5 were conducted outside of the United States, 1 in Africa (Malawi), 1 in Asia (Hong Kong), 2 in Canada (British Columbia, Manitoba), 1 in Puerto Rico, and 1 in Europe (Russia, Bulgaria, Hungary). Of the studies conducted within the United States, 2 were conducted in South-eastern states (Atlanta,

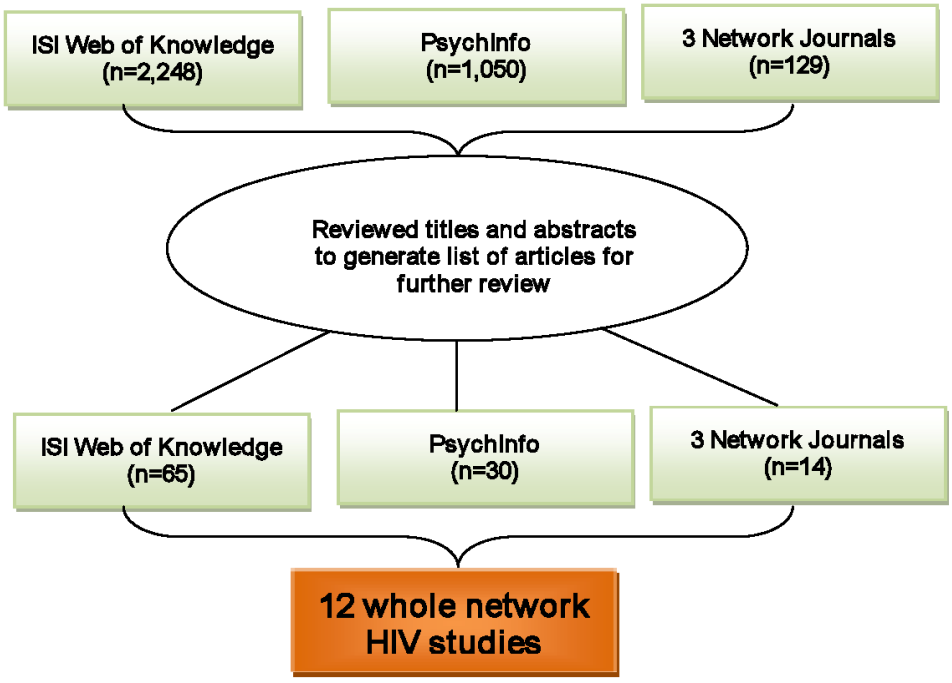

Figure 1. Literature search flow[a].

GA), 2 in southwestern states (Colorado Springs, CO, Flagstaff, AZ), 1 in the west (Los Angeles, CA), and 3 in the North-eastern region (Brooklyn, NY (2); Hartford, CT). Five studies targeted men who have sex with men (MSM), although perhaps not exclusively; 1 targeted female sex workers; and 6 targeted drug users. All of the studies examined both sex and drug risks regardless of primary target population. Additionally, all of the studies had HIV outcomes as the primary interest, though STIs were reported on. No whole network studies of hepatitis infection were found, but studies targeting injection drug users (IDUs) did report on hepatitis prevalence and risk.

Sampling and recruitment of whole HIV networks

Table 1 summarizes the key components of the 12 whole network studies identified along with the main references that were identified in our searches (Amirkhanian et al., 2009; Friedman et al., 1997, 1999, 2007a, b, 2008; Helleringer and Kohler, 2007; Helleringer et al., 2009; Klovdahl et al., 1994; Lee et al., 2009a, b; Liebow et al., 1995; McGrady et al., 1995; Remple et al., 2007; Rice et al., 2012; Rothenberg et al., 2001, 2000; Weeks et al., 2002; Wylie et al., 2007). Sampling and recruitment of whole networks was rarely achieved by a priori delineation of social or geographic boundaries. Although, there was variation among how the studies recruited and constructed whole networks, we identified 4 main strategies or designs: (1) personal networks (7 studies), (2) random walk (2 studies), (3) census (1 study) and (4) two-mode (2 studies). We review each strategy in more detail subsequently.

Recruiting personal networks via targeted sampling

Tables 1 and 2 list and provide details on the studies that used personal networks to build whole networks. Devising a whole network by recruiting and linking personal networks was by far the most common approach. In most cases, recruitment began with outreach in targeted locations where the population(s) of interest could be sampled. Three of the studies began recruitment in specific venues: the study of indoor female sex workers (FSW) in British Columbia began recruitment in sex establishments; the study of runaway homeless youth (RHY) recruited from a drop-in center for homeless youth using an event-based approach; and the Central European studies of MSM began recruitment in bars and clubs. Venues offer clear-cut boundaries for beginning recruitment, but may bias the sample toward individuals who frequent those venues. Outreach and recruitment in community areas with high rates of HIV risk behaviors is another common approach and may allow researchers to intercept potential participants in their “natural” environment. Venue-based sampling, on the other hand, is useful when there is no particular community location where members of a high-risk group congregate.

For many studies, outreach, ethnography and chain referral methods were key components of a multi-method approach to successfully acquiring a whole network sample.

Table 1. Description of whole network studies, by recruitment strategy.

Study, time frame, geographic location	Study population/risk group	Sampling, recruitment and data collection methods
Personal networks linked to form a whole network		
Colorado Springs Study (1988-1992; Colorado Springs, CO, USA)	High risk heterosexuals (that is, IDUs, prostitute women); 1st year: (n=255 index) and their sexual injection networks (n=1,296)	Participants were recruited via clinics, drug treatment centers, testing sites, and through outreach. Recruited participants (egos) were interviewed to nominate social, sexual, illicit drug and injecting drug partners for the prior 6 months. Personal networks linked using health department charts.
High Risk Settings Study (1998-1999; Hartford, CT, USA)	Adult drug users (n=293 index); mean age=37.3 years	Ethnography to document hidden drug use sites. Street outreach in high drug use neighborhoods-targeted sampling. Respondent-driven methods to ascertain personal networks. Personal networks linked using photos to ascertain cross-network memberships.
Indoor Female Sex Workers Study (June 2004- February 2006; Vancouver, British Columbia, Canada)	Female sex workers (n=49) and their recent sexual partners (n=504); mean age=37 years	Targeted sampling to select ethnically and geographically diverse sex establishments (n=7) from a list that was compiled using outreach methods. Female sex workers at each establishment were asked to identify and complete a proxy questionnaire for up to 10 recent sexual partners. Personal networks were linked to create a whole network through clients who patronized ≥ 1 commercial sex establishments (house regulars)
Social Factors and HIV Risk Study (July 1991-January 1993; Brooklyn, NY, USA)	IDUs and their drugs and sex partners (n=767 index)	Street outreach and ethnography in areas of heavy drug use in a defined area. Chain referral to ascertain personal networks. Personal networks were linked using names provided. Linkages confirmed between two individuals if 1) engaged in face-to face contact with research staff at the same time, 2) were observed together in public.
Young MSM Networks in Central Europe (2003-2004; St. Petersburg, Russia; Sofia, Bulgaria; and Budapest, Hungary)	Young MSM (n=156); age=varied by city/analytic sample	Ethnography used to select venues (bars, night clubs), index participants, and to observe social circles and leaders within circles. Initial “seed” recruited and interviewed to identify and recruit all members of immediate friendship group. Network leaders were identified for intervention.

Table 1. Contd.

Networks, Norms, and HIV Risk Among Youth (2001-2004; Brooklyn, NY, USA)	Injection drug users and young adults were index cases (n=112) and network members (n= 353); age 18 to 24; of all participants, 71% Latino, 20% African-American; 15% MSM, 43% injected drugs	Ethnography, focus groups, and survey data used. Three waves of recruitment (index, partners of index, and network members of partners). IDUs and young adults recruited separately. Young adults recruited using a population-based representative sample from a previous study and targeting of specific households. IDUs (non-representative) targeted specific venues (e.g. shooting galleries, drug purchasing venues, needle exchange sites) as well as relied on walk ins. Participants were asked to bring in network members for interview, or given them a coupon to be redeemed , or were located by project staff.
Runaway Homeless Youth (2008; Los Angeles, CA, USA)	Young individuals age13 to 24 (n=136) seeking services at an agency serving homeless adolescents	Direct recruitment of 150 participants seeking services at a specific agency during the recruitment, of which 136 (90.7%) participated. Self-administered computerized interviews to collect individual-level data on index and a face-to-face interview to generate list of, and data on, network members.
Random walk		
Atlanta and Flagstaff Networks Study (1995-1999; Atlanta, GA and Flagstaff, AZ, USA)	Individuals at risk for HIV due to drug-using or sexual practices, with emphasis on interaction of risks (n=228 index); mean age=40.3	Ethnography used to ascertain community sites. Two seed participants from three geographically separated community sites selected to start chain. Chain-link referral and random walk methods to ascertain community chains of ~10 contacts.
Atlanta and Puerto Rico Ethnic Youth Network (Study period unreported; Atlanta, GA, USA and San Juan, Puerto Rico)	Adolescents 12-15 residing in defined geographic 1990 Census tract areas selected to define an ethnically homogenous, lower SES status region (n=43 index in Atlanta, n=52 index in San Juan). Atlanta: 129 respondents, 1141 total nodes, 12 components	Simple random sampling in defined areas using 1990 census data. In Atlanta, a roster of public of public housing project residents along with a two-stage method was used identify index. In San Juan, a random selection from a door-to-door canvas in a public housing project used to identify index. Respondents generated list of respondents (variable length) using 8 name generators. To continue a random walk, the next candidate for interview was randomly selected based on eligibility criteria (age 12-29 and resided in metropolitan area).
Census		
Likoma Network Study (October 2005-March 2006; Likoma, Malawi)	Likoma residents (n=923); age=18 to 35 years	Census of entire island to obtain roster of all households. Sexual network and health survey among study population. Biomarkers of HIV infection collected among network survey participants. Whole sexual network on island linked all individuals.

Table 1. Contd.

Two-mode networks		
Winnepeg Social Network Injection Drug Use Study (December 2003-August 2004; Winnepeg, Manitoba, Canada)	IDUs (node 1) (n=435 index); aged 15-64 (median=36 [male] and 35 [female]); 56% male; 47% First Nations or North American Indian, 34% White, 15% mixed race/ethnicity; Hotels (node 2): Up to 6 specific hotels where individuals inject drugs was identified by n=172 individuals	Advertisement and word-of-mouth in IDU neighborhoods. Individuals were interviewed using a structured questionnaire. Participants identified specific hotels (typically single-room occupancy or residential hotels) where they inject drugs. Two mode network linked up individuals through hotels identified.
Integrated Treatment Center Clinic (July 2007-March 2008; Hong Kong)	Chinese, MSM, recently HIV-infected (<1 year) clinic patients (n=114 recruited); mean age=33.5-37.5 years (based on papers published on sub-samples)	Two-mode affiliation networks converted to 1-mode networks. Self-administered questionnaire inquired about partners and locations where index clients frequented for seeking sex partnership (partner sourcing). Venue-based linking-individuals linked to partner sourcing venue, and then individuals linked to each other. HIV-1 pol gene phylogenetic analysis used to augment linkage.
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SES, socioeconomic status; IDU, injection drug user; MSM, men who have sex with men.

Table 2. Key features and characteristics of 12 whole network studies, by recruitment strategy.

Study, time frame, geographic location	Largest network component[a]	No. of contacts respondent could recruit or report on	Contacts recruited or proxy reports provided by respondent	Response rate for recruited contacts	Link identification
Personal networks linked to form a whole network					
Colorado Springs Study (1988-1992; Colorado Springs, CO, USA)	Over 600	All close personal sexual and injection contacts within past 6 months	Proxy reports and data pooling	75%	Names, demographic and locating information for each network member; matches were based on name, alias, ethnicity, gender, approximate age, and agency attendance; respondent asked about known relationships between each pair of associates using a matrix format
High Risk Settings Study (1998-1999; Hartford, CT, USA)	193 (66% of sample)	2 drug-using network members recruited	Contacts recruited	Not found	Full names and/or nicknames, pictures
Indoor Female Sex Workers Study (June 2004- February 2006; Vancouver, British Columbia, Canada)	553	Up to 10 most recent sex partners	Proxy reports	Not applicable	Mentions of same partners that match on race, residence, age, physical description
Social Factors and HIV Risk Study (July 1991-January 1993; Brooklyn, NY, USA)	277 (for sample of drug users); "large" (for group sex analysis)	Up to 10 risk network members	Mixed	Not found	First or street name, "questionnaire and other data"
Young MSM Networks (2003-2004; St. Petersburg, Russia; Sofia, Bulgaria; and Budapest, Hungary)	65	All friends identified and recruited	Contacts recruited	78.7% participation rate	Peer-driven recruitment
Networks, Norms, and HIV Risk Among Youth (2001-2004; Brooklyn, NY, USA)	206	Named network members up to a limit of 10 sex partners, 5 IDU partners, and two group sex event attendance partners	Contacts recuited	Recruited until sample goal reached (e.g. n=200 for IDUs)	Participants considered link if one named the other as someone whom, during the prior 3 months, they had a) injected drugs, b) had sex with and/or, c) attended a group sex event with.
Runaway Homeless Youth (2008; Los Angeles, CA, USA)	K-core range: 0-7 Large number of isolates or those with only 1-tie (56.6%)	All people interact with: at agency, hang out with, have sex with it, etc	Proxy reports	Not applicable	First and last initial, aliases, age, gender, race/ethnicity and attendance at agency where recruitment occurred for index Event-based approach (EBA): Regulars of a socio-physical space linked up

Table 1. Contd.

Random walk					
Atlanta and Flagstaff Networks Study (1995-1999; Atlanta, GA and Flagstaff, AZ, USA)	228 were members of 6 community chains; 17-94% of group members	All social, sexual, drug-using, and needle-sharing	Contacts recruited	40% of contacts interviewed	Linked via recruitment Names, general locations, descriptions used to locate associates. Respondent asked about relationships among pairs of contacts
Atlanta and Puerto Rico Ethnic Youth Network (Study period unreported; Atlanta, GA, USA and San Juan, Puerto Rico[b])	Atlanta: 763	Respondents generated variable list of network members interviewed	Contacts randomly selected for interview	Atlanta: Of 43 walks, 38 (89%) completed 3-step, 2 (5%) completed 2-step walks, and 1 (2%) completed a 1-step	Linked via recruitment Names, addresses, phone numbers used to locate associates
Census					
Likoma Network Study (October 2005-March 2006; Likoma, Malawi)	883	Up to 5 sex partners	Sex partners identified via roster and recruited	Not applicable (88% for respondent)	First names or initials, plus demographics; migration rosters
Two-mode networks					
Winnepeg Social Network Injection Drug Use Study (December 2003-August 2004; Winnepeg, Manitoba, Canada)	Component consisted of 154 IDUs and 39 hotels; K-core max size=3 (range 1-3)	Sample of 435 IDUs identified up to 6 specific hotels; 49 distinct Winnepeg hotels included in analysis (from 162 Winnepeg residents)	Individuals interviewed about specific hotels	Not reported	Individuals were linked to hotels; only indirectly to each other
Integrated Treatment Center Clinic (July 2007-March 2008; Hong Kong)	19 of 91 persons were not connected	All sex partners in 3 years prior to infection	Proxy data on locations where partners sought	Not applicable	2-mode matrix of MSM and locations converted to 1-mode matrix linking MSM

[a]Component size is the number of persons who are linked through direct and indirect linkages. [b]In two other locales, Seattle, Washington and Honolulu, Hawaii, a more limited scope of related research focused on adolescents' social relations. Data not reported here. HIV, human immunodeficiency virus; MSM, men who have sex with men.

sample. The Social Factors and HIV Risk study (SFHRS) and High Risk Settings study are good examples of this multi-method approach. Table 1 indicates which studies conducted ethnography as part of their recruitment approach. Outreach and ethnography in high-risk areas are labor-intensive, but elucidate the culture and context of the target groups and develop rapport, trust, and credibility. These high-risk areas become the source of initial recruits who become the "index" persons in the net-work study. Index persons are then asked to name their network members, who may or may not

all be recruited.

The Central European studies of MSM conducted targeted sampling and devised a method to identify the most central person in a small "social circle." Another approach has been to simply assign the initial recruits to "index" status. The former approach of determining the index via nominations from members of a social circle may be more important for interventions than for more descriptive epidemiologic studies of whole networks. The landmark Colorado Springs study and the Networks, Norms, and HIV Risk among Youth (NNAHRAY) recruited multiple risk groups and conducted detailed network inventories to ultimately reveal linkages across distinct subgroups.

Random walk approach

The Atlanta and Flagstaff Networks and the Atlanta and Puerto Rico (PR) Ethnic Youth studies targeting ethnic youth employed the random walk design (Tables 1 and 2). Random walk designs are link-tracing designs where each successive addition to the chain-link identified by randomly selecting an associate from the list of current recruits and locating them for study inclusion. In the Atlanta/PR study, a two-stage probability sampling of adolescents was conducted in census tracts, which was then followed by simple random sampling of named associates. With this design, members of the sample are linked via their recruitment. Therefore, unlike the personal network design, no linkages need to be made after subject recruitment. The Atlanta/PR study asked respondents to provide the name, address, and telephone number of associates, whereas the Atlanta and Flagstaff studies requested "general" location data. The Atlanta/PR study was conducted in the early 1990s; requesting name, address, and telephone number might present challenges with institutional review boards for investigators seeking to use this approach today. A limitation with the random walk design is the difficulty in locating associates with the locator information obtained from respondents.

Census approach

The Likoma Network study (Malawi) represents the rare opportunity to capture a complete whole network with the availability of a roster of the entire island's population as well as the use of biomarkers of HIV infection to validate linkages (Tables 1 and 2). The Likoma study produced the largest component among the studies; but it represents an exception since it used a census approach in a bounded geographic area (Likoma Island) (Helleringer and Kohler, 2007; Helleringer et al., 2009). Most HIV prevention studies looking to recruit whole networks are conducted under less optimal circumstances, where geographic boundaries are ambiguous and a population census is difficult to acquire.

Two-mode network approach

Another approach represented in the studies identified was venue-based linking (also known as two-mode networks), whereby individuals were linked through attendance at common venues. The Winnipeg Social Network Injection Drug Use study (SNS II) and Integrated Treatment Center Clinic study (Hong Kong) employed this strategy. The SNS II collected personal network data and did not create linkages among the IDUs in the study. Instead, a whole network was constructed by linking each IDU to a hotel where they injected. IDUs were only indirectly linked via their joint "membership" at the same hotel. The Integrated Treatment Center Clinic study conducted a similar analysis, but created "direct" linkages among the MSM in the study by assuming linkages among men who reported attending the same venue. The SNS II study has the analytic capability to do this as well. A limitation of these studies is that direct connections among individuals are assumed based on joint attendance at a venue or event. This approach might be useful when person-to-person linkages cannot be collected.

Data collection and link identification

Table 2 summarizes details on several key features of the 12 network studies, including how network contacts were recruited, the largest component size and link identification. Component size is the number of persons who are linked through direct and indirect linkages and is important in determining the degree to which infection can spread throughout a population. Many of the studies allowed reporting of all contacts, but may have recruited only a subset. Recruiting all contacts is very resource-intensive; and therefore, many studies may limit the number of recruits while simultaneously collecting proxy data on all contacts. Proxy data allows a way to collect information on associates from index persons and pool data on the attributes of associates to determine links. Large components can result from this method, as evidenced by the Colorado Springs study and the FSW study. Names (first, street, or initials) and other identifying attributes were consistently used as a key descriptor for pooling and making linkages. Response rates for studies varied somewhat. Having to locate associates may severely affect the ability to recruit associates into the study. Using peer-driven recruitment approaches can increase enrollment of network associates into studies.

DISCUSSION

Since the mid 1980s, social network concepts have been applied to HIV research and social network methodologies

are increasingly being utilized to understand the HIV/AIDS epidemic. The justification for using a network approach in HIV research and in developing interventions resides in the social context in which individuals engage in HIV risk behaviors and in which they become exposed to HIV (Rothenberg et al., 1996).

More detail needed in HIV network studies

Our review suggests a need for more detail and specificity in titles and descriptions for social network studies, particularly given the growth in the number of network studies over the past two decades. Social network methods are particularly complex and a wide range of questions and analytic techniques can be generally classified as network-oriented. One of the primary challenges in classifying studies for this review was the lack of specific information on the type of network study being conducted. Specifically, explicit classification as to whether studies, and particular analyses, focused on personal networks or whole networks or both was rare. In some cases, the combined information provided by multiple articles on the same study was necessary to make this determination. While the term social networks or social network analysis is the umbrella term within which all network-oriented investigations fall, there are important distinctions between the goals and types of studies. In our review, the preponderance of studies identified evaluated solely personal networks, including studies of social support and social influence.

Perhaps more important than making an explicit statement regarding the type of study was providing specific details on sampling and recruitment, particularly for community-based whole network HIV studies where boundaries and sampling frames are often ambiguous. Significant variation existed in the explication of the sample recruitment method employed. How were boundaries determined, if at all? For example, a common practice was to use a personal network sampling design and link members to create a whole network. In this case, geographic boundaries may not need to be determined a priori. The question then becomes: how was the network initiated, with whom, and why?

Details on data collection and linkage construction, which is the process of determining the connections among network members and thus, creating the whole network, were also rarely comprehensive. What types of name generators were used and were there limits and a rationale for the number of alters individuals could report? What data were collected in order to determine linkages? Where did the network end and why? Academic journals limit the extent to which details of network studies, which tend to be complex and jargony, can be presented; and this may account for the consistent lack of detail. In some cases, articles were also published in books where considerably more detail was provided. Growing interest in the use of network analysis could benefit from a clearer understanding of the design and methods of network studies. Investigators of network studies might consider publishing a methods paper that describes the study and which can be used as a reference for researchers wishing to duplicate or build on such methods. This will be especially useful for new network investigators seeking to replicate and advance network-oriented HIV studies.

Toward developing standards

Results of the search strategy suggest some ways that whole network studies might be approached based on the population of interest. Whether the target population represents a hidden or accessible group may offer a natural delineation in methodological approach. For example, risk groups such as MSM and IDUs are hidden populations, because of their stigmatized and illegal behavior, respectively. Their marginal status tends to make their networks more cohesive, either geographically or socially. Targeted sampling appears to be standard practice as a first step in locating hidden populations. Because IDUs tend to be low-income, they may live in poorer areas, while MSM may congregate at gay venues or gay-friendly spaces. Ethnography is then conducted within target areas to understand social dynamics among members. Ethnography is time-consuming, but builds trust and rapport that is important in garnering full participation of the target group and in validating linkages (Friedman et al., 2008, 1997; Weeks et al., 2002). From targeted areas, individuals can be recruited and their network members named and then linked. Additionally, it seems important to begin networks with individuals with high degree (that is, relatively large number of direct ties) to increase the chance of constructing sizeable whole networks. Proxy reports also appear to yield networks with large components. The Colorado Springs study demonstrated the possibilities of recruiting a large connected component from distinct but overlapping risk groups such as IDUs and commercial sex workers (Klovdahl et al., 1994).

Determining network ties among diverse and dispersed populations, such as high-risk heterosexuals, will likely require a different approach. High-risk heterosexuals constitute a large population of different genders and ages. They are defined by Centers for Disease Control (CDC) as anyone with a known risk (e.g. HIV infection, drug injection, male-to-male sex) in a heterosexual partner. Other studies focused on high-risk heterosexuals may define the category according to specific individual-level behavioral risk. For example, research on age mixing indicates elevated risk of transmission between young women and older men (Kraut-Becher and Aral, 2006). High-risk heterosexuals (e.g. women) may engage in relatively lower levels of risk, but be networked through sex

partners to groups with higher prevalent or greater risk of HIV infection than themselves. Therefore, a viable approach may be targeting groups that link with high-risk heterosexuals, such as behaviorally bisexual men and persons with a history of incarceration or drug use, and identifying their sex and drug partners and any linkages among them. The Social Factors and HIV Risk study, Colorado Springs study, Atlanta and Flagstaff Network studies exemplify this strategy with their attempts to recruit diverse samples.

On using chain-link, contact tracing for network purposes

Recruitment methods that generate chain links, e.g. RDS, are often easier to implement, but do not represent "true" whole network data. While chain-link samples are networked data in the sense that all individuals are connected to at least one other person in the sample, they are primarily recruiting designs with imposed structures. Further, they typically do not include triads or cross-links (that is, respondents linked through a commonly reported associate). Instead, these methods result in long, linked chains of individuals in a dendritic structure. Because the structure of the network is imposed by the recruitment design, certain network analytic techniques cannot be performed. An overview of the types of social network questions that can be addressed and analyses performed with RDS data has been recently reviewed (Wejnert, 2009). However, a possible, but currently underutilized option is to incorporate network inventories into data collection for RDS studies. This would augment the data by capturing information on networks that might not be captured in the linked sample.

Contact-tracing studies are another type of network-oriented design identified in the search. Typically, these studies fall within the purview of local health departments and employ network methods for investigating sources and spread of disease in an outbreak. While these studies use network methods, they are a form of post-hoc analysis attempting to link incident cases to the sources of spread. While many investigators planning network studies do not begin with contact-tracing data, such data have been used to understand HIV risk networks and to inform prevention strategies.

STUDY LIMITATIONS

This review has several limitations. First, our inclusion criteria were very specific and primarily limited to field-based empirical whole network studies originating in community settings. Second, our search terms may not have retrieved all whole network studies fitting the criteria due to variable keyword indexing. Furthermore, difficulties encountered in classifying papers due to lack of sufficient details may have led to the omission of relevant research studies.

CONCLUSIONS

Whole network studies can provide unique opportunities to understand and interrupt the flow of infectious diseases in communities. This review suggests that no single recruitment strategy is sufficient for recruitment of a complete network. Each of the 12 studies reviewed had notable strengths as well as weakness. To optimize success of a near complete whole network, multiple methods are needed and these methods should be clearly delineated. More studies that include control or comparison networks are also needed to increase our understanding in differences in networks between different sub-populations. Understanding the structure and dynamics of social and risk networks remains critical for developing effective intervention to prevent and interrupt spread of infectious diseases.

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ABBREVIATIONS

HIV, human immunodeficiency virus; **IDUs,** injection drug users; **MSM,** men who have sex with men; **STI,** sexually-transmitted infections; **BBI,** blood-borne infections.

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Re-marriage decisions among people living with HIV in rural Southern Malawi

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This study explores re-marriage decisions of people living with human immunodeficiency virus (HIV) in matrilineal Chiradzulu and patrilineal Chikhwawa communities in Malawi. Specifically, it analyzes reasons and circumstances that come into play as they re-consider marriage relationships. Data were collected from July to December, 2010 using in-depth interviews from eighteen informants purposively sampled and was analyzed using content analysis method. Findings show four main issues; irrespective of kinship organization and despite resistance from kin, women decide to re-marry for financial support while men for physical care and emotional support. In the absence of widow inheritance, widows from patrilineal communities are not receiving the expected support from the deceased husband's relatives leading them to seek support through re-marriage. New marriages in patrilineal communities are supported through traditional marriage formalities. Suggesting that decisions to re-marry are influenced by socio-economic factors. Therefore, we recommend cultural sensitive health programmes embedded in these local realities that accept people living with HIV to re-marry and continue to access prevention of mother to child transmission of HIV and antiretroviral therapy services without reprisal.

Key words: Malawi, decisions, human immunodeficiency virus (HIV), reproductive health, kinship, marriage.

INTRODUCTION

In the early years of the human immunodeficiency virus (HIV) epidemic, little attention was given to the reproductive decisions among people living with HIV (PLWH), because of the risk of mortality and a few options to reduce mother to child transmission. Recently, however, HIV-related morbidity, mortality, and mother to child transmission of HIV during pregnancy, delivery and in the newborn are declining, because of antiretroviral therapy (ARV/ART) (Chasela et al., 2010; Kredo et al., 2009). HIV infection may now be considered a chronic illness because the ARVs suppress HIV replication resulting in resulting in increased CD4 cell count, delayed clinical progression of acquired immune deficiency syndrome (AIDS) and prolonged survival (Volberding and Deeks, 2010). Consequently, evidence emerging from research in developing countries indicates that ART may encourage PLWH receiving treatment to reconsider their reproductive decisions including getting married and having children (Nattabi et al., 2009).

Earlier studies in Malawi (Chirwa and Chizimba, 2009) and Uganda (Mukiza-Gapere and Ntozi, 1995) indicate that marriage practices have changed due to factors not

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not limited to HIV and AIDS only. Social-economic changes such high cost of living, high unemployment rates, intermarriages, education and modern religion have also affected marriage practices. Similarly, studies on the impact of the AIDS epidemic on marriages (Boerma et al., 2002; Caldwell, 1997; Floyd et al., 2008; Mukiza-Gapere and Ntozi, 1995; Kaler, 2004; Reniers, 2008; Schatz, 2005; Oleke et al., 2005) indicate that the epidemic has exerted a downward pressure on probabilities of re-marriages after either widowhood or divorce. In addition, HIV-infection has created fear of marriage as such some people refuse to marry for fear of finding 'death in marriage', possibility of spreading HIV to new spouses, re-infecting each other or transmitting HIV to a child in case they decide to have children. Stigmatization due to AIDS or suspicion of infidelity in case of widowhood, separation and divorce is high because the primary means of HIV transmission in sub-Sahara Africa remains heterosexual intercourse. Finally, HIV and AIDS reduce the attractability of widows of all ages (Oleke et al., 2005).

However, recently, de Walque and Kline (2012), indicate that re-married PLWH are likely to engage in behaviour typically associated with married couples, such as regular intercourse and infrequent condom use. Furthermore, since there is increased likelihood of one or both partners being HIV-positive, the re-married are a significant conduit for spreading HIV. Therefore, with the wide access of ART in developing countries and recent change of behaviour among PLWH, there is need for current information on the impact of HIV on re-marriages.

Nevertheless, there is a surprising paucity of literature on the reasons and circumstances for re-marriage (refers to couples that were married at some point in the past and decide to marry again) of PLWH. Existing studies focus mainly on: women (Agot et al., 2010; Boileau et al., 2009; Edwards et al., 2011); HIV-risk and separation, divorced or widowed (Lopman et al., 2009; Mermin et al., 2008; Boileau et al., 2009; Reniers, 2008); and re-marriage relating to religion and traditions (Muula, 2010; Trinitapoli and Regnerus, 2006). However, they did not consider the influence that the variation in kinship organisation (patrilineal and matrilineal) and gender might have on re-marriage decisions.

This paper therefore explores re-marriage decisions among PLWH who decided to marry when they were HIV positive in matrilineal and patrilineal communities. Specifically, it analyses reasons and circumstances that come into play as they re-consider marriage relationships. This paper extends research on impact of HIV and AIDS on reproductive decisions. However, it is limited to people who are living in rural Malawi where marital roles are distinct and limited to homemaking and subsistence farming.

METHODOLOGY

A qualitative approach was opted because the focus area has little existing research based knowledge. In addition, the area has sensitive, emotive and personal topics that could be captured fully through careful probing which lies at the core of the qualitative in-depth interview (Morse and Richards, 2007). The research questions required a greater depth of response capturing the meaning attached to re-marriage decisions in rural matrilineal and patrilineal communities.

Study setting

Informants were recruited from antiretroviral therapy clinics involved in the treatment and care of PLWH at two health centres in Southern Malawi. In Chikhwawa, informants were recruited from the Ngabu Rural Hospital and in Chiradzulu, from the Ndunde Health Centre. The two centres offer inpatient and outpatient HIV and AIDS treatment using multidisciplinary teams, and serve primarily low-income individuals from diverse backgrounds (National Statistical Office [NSO], 2010).

In Chikhwawa, kinship, marriage is organised according to patrilineal descent and virilocal residence, so that the transfer of traditionally cattle, but nowadays money (*lobola*) from the husband to the bride's family legitimizes marriage leading to the move of the woman from her natal household to her husband's compound after marriage. In these compounds, men are related by patrilineal descent and the children become members of the father's descent group. This practice places a married woman in a position of dependence on her affinal kin, especially her mother in-law. In Chiradzulu, on the other hand, the pattern is matrilineal descent and uxorilocal residence, that is, men leave their natal household to live in their wives' compound after marriage (Chimbiri, 2007), hence creating compounds where children become members of the mother's descent group. The man depends on his wife's kin for land and residence (Peters, 1997).

The interviews were conducted in the clinics from July to December, 2010. The sites were opted for because they receive patients from more remote villages, and are located away from trading centres and main roads that attract people whose origins are elsewhere. The informants came from areas surrounding these health facilities and the average time to and from their villages to the hospital ranged from one hour to three hours on foot.

Data collection

Data for this study was from a larger qualitative study that explored reproductive decisions of twenty couples living with HIV in two rural settings of matrilineal Chiradzulu and patrilineal Chikhwawa in Southern Malawi. Informants were recruited upon receipt of permission to conduct the study following ethical approval in Malawi (Kamuzu College of Nursing College Research Publications Committee and University of Malawi College of Medicine Research Ethics Committee (COMREC)) and Norway (Regional Committees for Medical Research Ethics (REK)). From the twenty couples in the main study, nine concordant couples living with HIV (CLWH) were recruited using purposive sampling, which implies a selection of participants due to their characteristics and knowledge of the research topic (Morse and Richards, 2007). The strategy used for purposefully selecting the informants was 'Maximum variation sampling', which implies conscious selection of informants with emphasis on variation of characteristics within the agreed upon inclusion criteria. Patton (2002) indicates that 'maximum variation sampling' aims at capturing and describing the central themes that cut across a great deal of participants. In the main study, variation was achieved through age, level of education, occupation, years living with HIV, number of children and length in a marriage union. This sampling technique enabled the researcher to select informants with diversity regarding socioeconomic status, education,

length of marriage and number of years living with HIV. In this study, the selection criteria was HIV-positive (concordant couples) in monogamous marriage relationship, had re-married when they were living with HIV, aware of their own HIV status and their current spouses' before they got married, had information about each other's HIV status as a couple and were in the reproductive age group of 18 to 49 years (NSO, 2010).

Three months were spent in each of the two study settings. This prolonged engagement, in addition to the researcher's fluency in Chichewa, enabled an in-depth understanding of expressed beliefs, fears, expectations, dominant ideas, and values of the informants related to re-marriage (Emerson et al., 1995). Practical access to the antiretroviral therapy clinics was gained through collaboration with the clinic co-ordinators. In both sites, the antiretroviral therapy clinic co-ordinators identified a contact person with whom the researcher discussed the study thoroughly.

A pilot study to test the data collection tool was done at Chiradzulu and Chikhwawa district hospitals during the researcher's orientation period to the study sites. Through piloting, we discovered that when the informants were being interviewed as a couple, one spouse did most of the talking. In Chiradzulu the men were dominating discussions about general issues, that is, support in the family, decisions to seek help while the women were dominating on issues of cultural practices pertaining to reproductive health. In Chikhwawa, the males were dominating the entire discussion, and assumed an heir of authority. In both study sites, the only areas that the women were discussing freely were issues that dealt with hospital antenatal care. As a result, the selection of informants was couples as units but the empirical analysis was at an individual-level.

People living with HIV were approached while waiting for their monthly check-up at the two study sites. Information about the research was given to the patients at the antiretroviral therapy clinic in two phases. First as part of the general briefing (health talk) that all clients received in an open area before the check-up begins and secondly as a private conversation with the contact person. Couples living with HIV, who indicated willingness to take part in the study, met the researcher who then asked them a few questions to determine eligibility. Those eligible were accorded an appointment for an interview. Informants gave an oral consent, which was tape-recorded. The informants that consented were assured of confidentiality, and were informed that they were free to quit if they wished. During the research activity, all the informants were given transport reimbursements of $2 and snacks were provided.

In-depths interviews were conducted in vernacular language. In-depth interviews were opted for because they allowed room to explore issues deeper, and are interactive in nature thereby enabling clarification of issues during the interview. In addition, they allowed further probing and modification of interview guides in the course of the study (Morse and Richards, 2007). The guide comprised a section on demographic characteristics. It also had an outline of topics with open-ended questions covering reasons, challenges and sources of information for their decisions among other areas.

The guide was carefully translated from English to Chichewa. An independent translator verified the quality of translation: who translated it back into the original language. Original and back-translated documents were then compared for consistency by the interviewer. Informants were interviewed independently from their partners, but on the same day to enable free expression of feelings and views. After one spouse was interviewed, he/she had to wait until the other spouse was interviewed in order to correct discrepant information. Most of the discrepancies were on the areas of number of pregnancies and children and use of family planning method. The in-depth interviews were carried out within the area of the ART clinic in offices or outside under trees where comfort and confidentiality was guaranteed. The interviews lasted between 50 minutes to 2½ hours.

Data analysis

The general principles and procedures for qualitative data content analysis as summarized by Graneheim and Lundman (2004), were used. The content of the interview text was from a larger study that was exploring reproductive decisions of CLWH. The interviews were read through several times to obtain a sense of the whole. Then the texts about re-marriages were extracted which constituted the unit of analysis. The texts were then divided into condensed meaning units, which were later labelled with a code. In this study, we consider a meaning unit as words, sentences or paragraphs containing aspects related to each other through their content and context. In order to ensure inter-rater consistency, once the coding team independently analysed each transcript, tentative categories of the codes were discussed between the researchers who initially did the coding independently. When the coding was compared, a few differences were observed. These were discussed and the transcripts were re-analysed resulting into fine-tuning of the coding and interpretations. Once the codes were agreed upon, the underlying meaning of the different categories of the codes was formulated into sub themes and the main theme. All the data from digitally- recorded in-depths interviews that was transcribed verbatim were typed. NVIVO version 9 was used to analyze and organize the data.

The interviews revealed several themes, which were highly inter-related, thus could naturally be located under any of the themes. Subsequently, the presentation was nonetheless chosen as the best way to guide the reader through the informants' elicitation. The results that follow present the most common themes expressed by the informants.

RESULTS

Characteristics of the informants

The participants for the study comprised 18 informants who re-married after death of their spouse or divorce and their ages ranged from 29 to 46 years with a mean age of 36 years. Ten informants (three from the matrilineal and eight from the patrilineal communities) had been living with HIV for less than five years. Five informants from matrilineal and two from patrilineal communities had been living with HIV for more than five years. All informants reported that they were in a monogamous relationship. They were living in either the wives or husbands' natal compounds depending on kinship organisation. Two female informants (one from each community) had no formal education at all. Sixteen informants had some schooling; 12 (four from the matrilineal and eight from the patrilineal community) had completed primary education while the other four (three from the matrilineal and one from the patrilineal community) had completed secondary school education (Form 4). Fourteen informants were subsistence farmers with small gardens and were without any other source of income. Only four male informants had formal jobs. All of the informants reported that they were Christians.

Further attributes on marriage status of the informants are summarised in Table 1. The results show that most of the informants' earlier marriage(s) ended because of either divorce or widowhood.

Table 1. Information on marriage.

Characteristic	Matrilineal	Patrilineal
Number of informants in		
2nd marriage	8	9
3rd marriage	0	1
Marital status before current marriage		
Divorced women	3	3
Divorced men	3	2
Widow	1	2
Widower	1	3
Mean time (year) lapse for re-marriage following		
Divorce	1	2
Death of spouse	2	1

Reasons for re-marrying and challenges

The purpose of the study was to explore re-marriage decisions among PLWH who re-married when they were HIV-positive in matrilineal and patrilineal communities. Despite negative reactions, on their re-marriage decisions after divorce or death of spouse, from their kin and health workers, they ended up re-marrying. Reasons for re-marriages varied according to gender and kinship organisation.

Financial/material support

Irrespective of kinship organisations, female informants reported that they re-married because they could not support their children from their previous marriages as single mothers following divorce or the death of their spouses. They were all unemployed and relied on their local gardens for produce. One female informant from the matrilineal community eloquently captured this theme by stating the following:

"My former husband had a chain of girlfriends. It reached a point that he never would give me money for household necessities. We discussed over it with our counsellors and I made my mind that I was ready for divorce, which I did against his wishes. Following the divorce, I continued staying here with my four children and took the responsibility of caring for all my four siblings because by then our parents had passed away and I was the oldest child. I kept on farming and I started a business, selling samosas in order to buy soap, and other necessities. It was tough and was determined to re-marry to ease the burden off me."

Confirming the wife's narrations, the husband in his separate interview indicated:

"We used to stay close to each other and I was staying by myself following divorce. I could see that she was struggling and was leading a very miserable life. She was shouldering all the responsibility on her own; none of her late husband's relatives was helping her. Furthermore, she lost both parents and she was married to a certain man who was mistreating her. They divorced and still struggled although she was doing some small scale business."

Another couple from the patrilineal community in their separate interviews shared this view regarding a similar experience:

"To be honest I needed financial assistance with my children and my late sister's children who passed away and left behind 4 children, 1 of the children stays with my parents and I stay with 3 because their father also passed away. Unfortunately, my late sister's husband only has an old mother and her husband died some time back. My husband and I provide all the support to them. At least my husband has animals that are a source of income from the family."

The husband had this to say:

"She used to suffer with the children before I re-married her. Her children [from a previous marriage] stay with her at my home village including her sisters' children. I do not think she can let them go because of some hardships (poverty) at her home village. I have goats, cattle and chickens which are my main source of income."

In addition, the female informants from the patrilineal community explained that following the death of their spouse or divorce, they were unable to stay at their marital home and were forced to go back to live with their parents and brothers. They explained that despite the

expected norm for the children to remain at their late husband's home compound, the residence depend on availability of resources [human, financial and material] from the parents-in-law. Some women stated that they were asked to take their children along, thus placing them in a difficult economic situation. A 35 year-old woman from a patrilineal community who was now in her second marriage with no child, but currently staying with her three children from her previous marriage narrated:

"When my husband died, they [her late husband's parents] told me that they could not afford to take care of neither me nor my children. Knowing that I could not stay alone like that with the children, I decided to accept their marriage proposal."

Another woman from the same community echoed similar experience:

"My late husband passed away after suffering for a long time with leg sores and I had 2 children with him who currently stay with me because when my husband passed away, I was informed by his [late husband] relatives that I should go back to my home village but I left the children behind. However, after some months my in-laws complained that they could not take care of the children because they were very young and one of them used to be ill frequently. Therefore, I have been staying with the children with no support [financial / material] from their fathers relatives."

The socio-economic situation comes over as crucial. Regardless of the women living in a patrilineal or matrilineal community, their families were unable to support them due to poverty. This necessitated for a male partner who could offer financial and material support and they re-married outside of the family and not a relative of their deceased spouse.

Physical care

The male informants said that although their current health status was fine they dreaded their future needs for care from a spouse once they develop AIDS. Informants who had once been sick after divorce or death of their spouse expressed how their female relatives had to take care of them. They further explained that even though cultural norms indicate that female relatives are responsible for the bulk of the caring responsibility, in situations where a man is sick, the wife is supposed to take up this responsibility. A man from a matrilineal community said:

"But I told her [his mother] that I know the consequences of the problem [HIV] that I have but I needed someone to be taking care of me."

A man from a patrilineal community also expressed similar sentiments:

"Since the death of my first wife, I never re-married so throughout the time that I was sick, it was my mother and sisters who were taking care of me. When I recovered I decided to get married to avoid a similar situation."

Independent of kinship organisation, the burden of care is expressed to be too heavy to be placed on female relatives. Hence, re-marriage is found to be the best solution.

Emotional support

The male informants explained further that they established new marriage relationships following death of a spouse or divorce in order to have a bond with someone. They narrated that when they were alone they felt that the absence of a spouse was the worst experience they ever had. Men in the matrilineal communities expressed how they were lacking emotional support after both their children and wife left.

Man from matrilineal community:

"I went to explain to my uncle and told him that; 'Since my first wife died I am lonely. Although I stay with my parents, I still need a wife. Moreover, all my children are at my late wife's relatives. I stay alone in my house. I have found a woman in Chiradzulu whom I feel I can be staying with."

While the men in the patrilineal communities indicated that although they had their children and relatives around, they needed someone to intimately share their life. They indicated in their separate interviews that their wives were their confidantes in issues related to HIV and AIDS.

Man from patrilineal community:

"Yes all my children from my previous marriage were still with me but I needed someone to be taking care of me. Apart from that, it will be easy for us to follow the counseling advice that they give us and we can live longer. It is only your wife that you can share intimately your concerns about our situation [HIV-positive status]."

Childbearing

In addition to financial and economic reasons for re-marrying, a matrilineal couple and two patrilineal informants explained that they had re-married in order to have children after divorce due to inability to conceive.

Woman from patrilineal community:

"I am not his first wife, they divorced and afterwards we

married. He told me that he divorced because they could not have a gift [child].' I was also divorced in my first marriage because I never had a child. When I came to him, luck was with me and I finally had a child. At least I have one child."

Man from patrilineal community:

"We were not able to have a child with my first wife so my relatives insisted that; 'May be both of you have been bewitched.' I Divorce her and re-marry another woman.' I used to say to myself, 'If only I had a chance to have just one child, my heart would have been at peace. I divorced her and re-married and I have 4 children."

Societal expectation

The male informants, regardless of their kinship backgrounds, indicated societal expectation as a reason for re-marrying. They explained that independent of HIV status, an adult but unmarried man is viewed as irresponsible and selfish in their societies as the following narratives demonstrate (Men from a matrilineal community):

"It is because of our traditions. ….it is a big problem to the extent that others will not look at me as a person. They will be pointing fingers at me. I did not want to be living as a bachelor, as a young boy, no I had to re-marry …."

"I was demeaned by some people that I was not a man; others said I was a selfish man who does not want to share his resources with others. As such, I decided that I should not be staying alone, yes I had relatives but they could not look after my day to day needs because they were all married."

Nevertheless, some informants from the matrilineal community, who decided to re-marry, never had a formal engagement. This group's views can be summed up by a male informant who said:

"The problem is that they just leave us on our own and they say, 'Just leave them, they will know what to do themselves this is not their first marriage."

Unlike their counterparts from the matrilineal community, PLWH who decided to remarry in patrilineal community were accorded all the marriage formalities. *Luphato*, a gift, a wrapper and money, given to a girl/woman from her boyfriend as a sign of marriage proposal, which is shown to parents. *Chifunukura mulomo* which is money given to girl by her boyfriend to initiate discussion of marriage proposal. *Maonano* also money, but given to a girl's parents from the boy's parent but for initiating the first marriage discussions and *lobola*, bride price. It was during these marriage ceremonies that parents and kin from both sides discussed issues of HIV-positive status. However, all the informants from the patrilineal community indicated that they married outside of the family and not a relative of their deceased spouse.

When asked about their experiences with the community and hospital pertaining to their re-marriage decisions, majority of informants reported negative experiences. Several informants explained how re-marriage in PLWH would induce talk in the community. For example, one female informant said,

"They [community] talk behind your back and ridicule you. They say we are just fast tracking AIDS by re-marrying."

The hospital was not even a safe net as they were cited as their harshest critics especially during health talks. Many informants spoke about the common jokes that health workers would make about re-marrying: 'bomb', *'kuika nankafumbwe mu chimanga'* [placing weevils in dry shelled maize]. They explained that the jokes are hurtful and prevent them from asking for guidance and seeking information about re-marrying.

DISCUSSION

Floyd et al. (2008) and Schatz (2005), argue that the presence of high HIV prevalence was creating a general fear of marriage, often expressed as a fear of finding 'death in marriage' (Desgrées and Coleman, 2005). Similarly, Reneirs (2008), in Malawi, and Oleke et al. (2005), in Uganda, show that HIV has reduced the re-marriage of widows because of the suspicion that their former husbands might have died from AIDS. However, with wide access of ARV's in developing countries PLWH continue to establish new marriage relationships (Kredo et al., 2009; Nattabi et al., 2009). Consequently, there is need for current information on the impact of HIV on re-marriages. The purpose of the paper is therefore to explore re-marriage decisions among PLWH in matrilineal and patrilineal communities focusing on those who re-married when they were HIV positive. This study extends research on impacts of HIV on reproduction decisions by exploring factors that drive PLWH to re-marry after divorce or deaths of their spouse. It is also an individual-level analysis of the decision of re-marrying, reflecting gender differences.

Firstly, the findings revealed that informants decide to re-marry mainly for economic, physical and emotional support. Specifically, women irrespective of kinship organisation, re-married for economic support. Consistent with results of previous studies that showed that women, whose main gender role in a marriage is house making have a greater economic incentive to re-marry than men because they have lower earnings power in the labour

market and their economic status often deteriorates following marital dissolution (Holden and Smock, 1991). Consequently, the findings suggest that women understand the effects of their financial constraints and lack of access to resources on them and their children and decide to re-marry consistent with findings reported in Kenya (Sarna et al., 2009) and Uganda (Seeley et al., 2009).

On the other hand, men re-marry for physical and emotional support irrespective of kinship organisation. This finding supports earlier work by Bernard (1972), who argued that men and women experience marriage in different ways. “His” marriage is thought to provide men with practical and emotional support, whereas “Her” marriage has been described as burdening women with homemaking and care giving responsibilities. This suggests that care remains a burden placed on women. Furthermore, the findings suggest that that even though ARV’s are available, men are still concerned about the potential risks for deteriorating health and the possibility of not living long enough to raise the children.

The foregoing means that men depend on their spouses for care and homemaking tasks consistent with observations made by Carr (2004) and Hirsh et al. (2009), and that they tend to rely exclusively on their wives for emotional intimacy and have few other sources of emotional support consistent with findings reported by Dykstra and de Jong Gierveld (2001). The main reason is that men tend to have few confidantes other than their spouses, whereas women tend to have larger and more emotionally intimate friendship networks than men (Antonucci and Akiyama, 2004).

Secondly, the findings revealed that the widows were not welcome to remain in their deceased husband’s compound due to economic reasons. This comes despite expectations that widows in patrilineal kinship communities would remain in their deceased husband’s compound, where one of the relatives, either a brother or a cousin, is expected to inherit the widow and take care of her and the children. In addition, the in-laws were unable to take care of the children and the widow. This may suggest that interventions against widow inheritance in the presence of HIV and AIDS are modifying society behaviour consistent with Agot et al. (2010), Ambasa-Shisanya (2007), in Kenya and Ntozi (1997), in Uganda.
On the other hand, widows in matrilineal kinship communities stay with their children, kin, and access farmland belonging to their natal compound. However, they still face economic hardships without a husband, because his contribution with work on the farm and income generating is essential to the proper upbringing of the children and other household activities (Peters, 1997). Irrespective of kinship organisation, widows were unable to provide basic necessities for their children leading them to re-marry with a view to surviving now rather than leaving their children to die of hunger (Ambasa-Shisanya, 2007).

Thirdly, the findings suggest that informants from patrilineal communities received social support through traditional marriage formalities that the community organized probably driven by the fact that a bride price had to be paid even in a second marriage. On the other hand, there were no formal marriage formalities arranged for informants re-marrying in matrilineal communities. Although, social support from friends and kin demonstrated in this paper among the patrilineal community may influence the establishment of the re-marriage relationship, the close relationships may obstruct the formation of a romantic relationship. Older children may disapprove or try to monitor the behaviour of a bereaved parent who is starting to date (Moore and Stratton, 2001). However, such a comprehensive discussion is beyond the remit of the present discussion since all the informants that re-married had children below 18 years of age.

Finally, the findings suggest that expectations from the society influenced informant’s decisions to re-marry. Some decided to re-marry because they were unable to conceive children in their previous marriage. Since childless is stigmatized in most societies (Runganga et al., 2001), some decided to re-marry in search for a child. Additionally, it was perceived to be socially unacceptable, economically unviable and emotionally constraining for an adult male to remain unmarried irrespective of kinship organization. The reason is that marriage is a normative social status in sub-Sahara Africa and that the societies are what could be called ‘totally a married society’ (Rhine, 2009) with the unmarried adults, being ridiculed as barren, prostitutes, or selfish. Hence, following separation or death of a spouse, people are likely to re-marry regardless of their HIV status (Gregory et al., 2007; Reneirs, 2008).

The analysis of the four reasons governing re-marrying decisions among PLWH might be framed in the Sallis and Owen (2002) socio-ecological model, which emphasizes the dynamic interaction between an individual and the environment. The model recognizes that, where individuals are responsible for instituting and maintaining life style changes necessary to reduce risk and improve health, individual behaviour is influenced by factors at different levels (Elder et al., 2007). In this paper, we have shown that informants gave various reasons for re-marrying which could fall under three levels: individual for support (economic, physical and emotional), community because of established norms values and societal.

This empirical work has a limitation because informants were not interviewed when they were considering to get married but some time after they re-married. As a result, they might have rationalized the reasons for their behaviour. However, despite the limitation, this study highlights important public health issues pertaining to re-marriage decisions of PLWH that warrant attention. In addition, it gives rich in depth insights into the lives and experiences of a growing segment of the population of

Malawi PLWH.

Conclusion

This study explored re-marriage decisions among CLWH in matrilineal and patrilineal communities focusing on CLWH who re-married when they were HIV positive. Specifically, it analyzed reasons and circumstances that come into play as CLWH re-consider marriage relationships. Stories of hardship after divorce or death of a spouse were common in the narratives of the informants. However, the problems and hardships differed, reflecting the different values and benefits brought to a relationship by men and women. The findings suggest that women decide to re-marry for financial support while men re-marry for physical care and emotional support irrespective of kinship organization. Furthermore, in the absence of widow inheritance, the findings suggest that widows from patrilineal communities are not receiving the expected support from the deceased husband relatives leading them to seek support from elsewhere through re-marriage. Nevertheless, the new marriages of PLWH in patrilineal communities were supported through traditional marriage formalities. Finally, the results suggest that decisions to re-marry were influenced by social expectations: individuals failing to conceive re-married in search of children while men re-married because it was expected that an adult male should be in a marriage. This study extends research on impacts of HIV/AIDS on reproductive decisions by exploring factors that drive PLWH to re-marry after divorce or deaths of their spouse. However, this study was limited to individuals who re-married while HIV-positive and living in rural areas where marital roles are distinct and limited to homemaking and subsistence farming.

RECOMMENDATIONS

The study shows that the informants re-marry after divorce or death of a spouse for financial, physical and emotional support. The reasons depend on gender, economical status and kinship organisation. Furthermore, we are aware that re-married individuals may be faithful, but they are certainly not going to abstain, and they are unlikely to use condoms (de Walque and Kline, 2012), thereby raising biomedical concerns about the risk of HIV super-infection, viral recombination and transmission of drug-resistant virus in cases where unprotected sex is practised. If no intervention is put in place, Malawi's maternal and infant mortality due to HIV will continue to be high; at the same time derailing the current achievements in HIV and AIDS. Therefore, in addition to HIV prevention information, we recommend a cultural sensitive health programme embedded in these local realities that accept PLWH to re-marry and continue to access prevention of mother to child transmission of HIV (PMTCT) and ART services without reprisal.

In order to improve the quality of life and the health of PLWH, we cannot solely focus on the individual, but must also focus on the local community and society as a whole. Therefore, policy makers, programme designers and implementers should not just focus on the individual but take into account the family and community in which the individual exist and do everything possible to help PLWH achieve their sexual and reproductive aspirations. Such interventions can only be done through collaborative partnerships that involve community leaders, health providers, and PLWH.

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Full Length Research Paper

Association between ethnicity and human leukocyte antigen (HLA) alleles on late presentation to care and high rates of opportunistic infections in patients with HIV

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Within Manitoba, Aboriginal people make up 15% of the province's population, but accounted for 53% of new human immunodeficiency virus (HIV) diagnoses in 2011. For over a decade, research has linked the human leukocyte antigen (HLA) class I alleles as having both protective and harmful effects in HIV disease progression. The abundance of HLA alleles that predispose to rapid disease progression, together with the rarity of protective HLA allele types, may be a contributing factor to a more rapid disease progression amongst individuals of Aboriginal ethnicity. We completed an epidemiological study on all HIV patients new to care in the Manitoba HIV Program in 2010, looking at markers of disease severity, such as CD4 cell count, rates of opportunistic infections (OI), and HLA type. In this cohort, the Aboriginal population was overrepresented, and presented with significantly more advanced HIV infection (lower CD4 counts, higher rates of OI), compared to patients from a Caucasian background. Our data supports previously identified associations between HLA type and disease progression, and demonstrates a difference in distribution of HLA type by ethnicity.

Key words: Aboriginal, disease progression, ethnicity, HLA B27, HLA B35, HLA B51, HLA B5701, human immunodeficiency virus, human leukocyte antigen, opportunistic infection.

INTRODUCTION

The human immunodeficiency virus (HIV) is a clinically important disease, contributing to tremendous morbidity and mortality. The prevalence of HIV infection in Canada is on the rise (Public Health Agency of Canada, 2008). In 2008, an estimated total of 65,000 people in Canada were living with HIV infection, which represents an increase of about 14% from the 2005 estimate of 57,000 cases (Public Health Agency of Canada, 2008).

A trend of higher proportion of HIV diagnosis among indigenous peoples was identified in the recent International

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Policy Dialogue on HIV/AIDS and Indigenous Peoples (International Affairs Directorate, 2010). Within Canada, Aboriginal people make up 4% of the Canadian population, but 8% of the Canadian population living with HIV, and this proportion is likely even higher with the increase in new HIV cases in the Prairies over the last 5 years (Public Health Agency of Canada, 2008). This over-representation is even more striking within Manitoba, as Aboriginal people make up 15% of the province's population, but 43% of new HIV diagnoses in 2009, and 53% of new HIV diagnoses in 2011 (Statistics Canada, 2006; Manitoba HIV Program, 2011). The province with the highest rates is Saskatchewan, with 172 new diagnoses in 2010, representing a rate of 16.1/100,000, almost double the average Canadian rate of 8.2/100,000 (Public Health Agency of Canada, 2010; Saskatchewan Ministry of Health, 2010). While the factors influencing these trends are undoubtedly complex and multi-factorial, they may not be entirely attributable to social and structural factors.

For over a decade, research has linked the human leukocyte antigen (HLA) class I alleles as having both protective (HLA B27, B51, B5701) and harmful (HLA B35) effects in HIV disease progression (Brumme et al., 2007; Carrington and O'Brien, 2003; International HIV Controllers Study, 2010; Kaslow et al., 1996; Pelak et al., 2010, Smeraldi et al., 1986). The enrichment of HLA alleles predisposing to rapid disease progression, together with the rarity of the protective HLA alleles among individuals of Aboriginal descent may be a contributing factor to a more rapid disease progression, as evidenced by the degree of immune suppression seen at presentation among the persons in care within the HIV clinics in Manitoba.

We completed an epidemiological study of all patients with HIV new to care in the Manitoba HIV Program in 2010. Factors analyzed included basic epidemiologic data such as age, gender, ethnic background, and major risk factors in acquiring HIV. We also looked at markers of disease severity, such as CD4 cell count on presentation, and opportunistic infections (OI). Finally, as HLA typing has been routinely performed in Canada since 2006 (in order to predict Abacavir hypersensitivity), each patient's HLA type was recorded. The aim of this study was to look for the presence of significant associations between markers of disease severity at presentation to care in the Manitoba HIV Program and HLA type.

METHODOLOGY

Medical chart reviews were completed at the Nine Circles Community Health Centre, a community-based HIV clinic and a hospital-based HIV clinic at the Health Sciences Centre in Winnipeg, Manitoba. These clinics are the two sites of the Manitoba HIV Program, which provides specialized care for over 1100 people living with HIV in Manitoba or about 90% of people with HIV in care in the province. Data from both centers were pooled for all analyses. Ethics approval was obtained from Health Research Ethics Board at the University of Manitoba.

Charts reviewed were of all 102 patients in the Manitoba HIV Program presenting new to HIV care in 2010. A set list of epidemiological categories were identified and defined prior to the onset of the chart review and used for data extraction. These included year of birth, gender, HIV transmission risk including emigrating from an area known to have a high prevalence of HIV infection (such as Africa, Eastern Europe, and Asia), ethnic background (this was self-reported), CD4 count, CD4 percentage (percentage of total lymphocytes that are CD4 cells); HLA type, presence (and if applicable, type) of OI. Patients self-reporting as Aboriginal ethnicity included people of First Nations, Métis, and Inuit descent. Two people were lost to follow-up prior to completing their initial assessment, and therefore limited epidemiologic data was available for them.

Analyses were carried out in Stata v10.0 (College Station, Texas) and Microsoft Excel. We described our population with means and medians for continuous variables and percentages for categorical variables. We compared groups using Mann-Whitney tests for continuous variables and Fisher exact tests for categorical variables.

RESULTS

Sociodemographic

The majority of the patients in our cohort were male (75%). The most common risk factor identified in acquiring HIV was heterosexual contact (63%), followed by men who have sex with men (MSM) (22%), originating from an HIV endemic area (20%), and intravenous drug use (16%) (Table 1).

Patients of Aboriginal ethnicity made up 37.6% of our patient cohort. The average age of Aboriginal patients was 34.4 for females and 39.2 for males, compared to the average age of 35.1 for non-Aboriginal females and 39.7 for non-Aboriginal males.

Clinical characteristics

The majority of patients (53%) presented with a CD4 count of less than 350 cells per microliter (µl) (Table 1). Over 1/3 of the patients had a presenting CD4 count less than 200 cells/µl, and of this group, 54% were Aboriginal (Table 2).

The majority of Aboriginal cases presented with a CD4 count <200 cells/µl, while the majority of people from Caucasian, African, and other ethnic backgrounds presented with CD4 counts >350 cells/µl (Table 2). The median CD4 count at presentation amongst Aboriginal patients (201 cells/µl, p=0.010, Mann-Whitney) and African patients (311 cells/µl, p=0.039, Mann-Whitney) was significantly lower than that of Caucasian patients (421 cells/µl) (Table 2). Aboriginal patients also presented with a lower median CD4 cell count percentage (17%) compared to non-Aboriginal patients (21%) (p=0.029, Mann-Whitney) (Table 2).

Opportunistic infections were diagnosed at presentation in 30% of our cohort, most commonly esophageal/

Table 1. Socio-demographic and clinical characteristics of patients presenting with a new diagnosis of HIV in Manitoba in 2010. Several people presented with more than one opportunistic infection (OI) at presentation.

Characteristic	N (%)
Age (n=102)	
10-17	1
18-24	14
25-29	14
30-39	28
40-49	28
50+	17
Mean (IQR)	38.4 (29.0 – 46.8)
Gender (n=102)	
Male	76
Female	26
Risk factors for acquisition of HIV (n=101)	
Heterosexual	64
Endemic	22
IVDU	16
MSM	20
CD4 count (cells/ul, n=101)	
<200	35
200-350	19
>350	47
Median (IQR)	319 (145 – 485)
Median CD4 % (IQR)	19.0 (13.5 – 27.0)
OI (n=30)	
Candidiasis	14 (47)
Pneumocystis jirovecii pneumonia	9 (30)
Herpes simplex	4 (13)
Tuberculosis	4 (13)
Cryptococcal meningitis	1 (3)
Burkett's lymphoma	1 (3)
Other	3 (10)
HLA type (n=100)	
HLA B27	2
HLA B35	14
HLA B51	25
HLA B5701	4

oropharyngeal candidiasis (47%) and *Pneumocystis jirovecii pneumonia* (PJP) (30%) (Table 1). In the 30 patients presenting with opportunistic infections, 14 were Aboriginal, while 10 were Caucasian (Table 2). Individuals who were Aboriginal were significantly more likely to present with an OI (P=0.0027, Fisher Exact test, OR 4.4, 95% CI 1.7-11.9) (Table 2).

Of the 54 patients who presented to care with CD4 counts less than 350 cells/µl, 31% were either heterozygous or homozygous for the HLA B51 allele (Table 3). This allele was only present in 17% of those people presenting with CD4 counts over 350 cells/µl (Table 3). HLA B35 and HLA B27 were equally distributed between patients presenting with CD4 counts greater than and less

Table 2. Comparison of selected socio-demographic, clinical characteristics, and human leukocyte antigen (HLA) type with self-reported ethnicity, in people presenting to care with a new diagnosis of HIV in Manitoba in 2010.

Characteristic	Ethnicity [N (%)]				p-value
	Aboriginal (n=38)	African (n=22)	Caucasian (n=36)	Other (n=5)	
Age at presentation (n=101)					
10-17	0	1 (5)	0	0	-
18-24	6 (16)	3 (14)	5 (14)	0	-
25-29	6 (16)	3 (14)	4 (11)	1 (20)	-
30-39	11 (29)	7 (32)	9 (25)	1 (20)	-
40-49	9 (24)	6 (27)	10 (28)	2 (40)	-
50+	6 (16)	2 (9)	8 (22)	1 (20)	-
Mean	37.7	36.0	39.9	42.8	-
CD 4 count (cells/ul, n=101)					
<200 (n=35)	19 (50)	9 (41)	6 (17)	1 (20)	-
200-350 (n=19)	7 (18)	2 (9)	9 (25)	1 (20)	-
>350 (n=47)	12 (32)	11 (50)	21 (58)	3 (60)	-
Median	201* (p=0.010, Mann-Whitney)	311* (p=0.039, Mann-Whitney)	420	369	-
Median CD4 %	17.0**	17.5	23.0	21.0	(p=0.029, Mann-Whitney)
Presence of any OI (n = 30)	14 (37)**	4 (18)	10 (28)	2 (40)	(p=0.0027, Fisher Exact)
HLA type					-
HLA B27 (n=2)	1 (3)	0	1 (3)	0	-
HLA B35 (n=15)	8 (21)	1 (5)	5 (14)	0	-
HLA B51 (n=25)	17 (45)	3 (14)	5 (14)	0	(p=0.005, Fisher's exact)
HLA B5701 (n=4)	0	0	4 (11)	0	(p=0.071, Fisher's exact)
Homozygous HLA of any type (n=15)	9 (24)	3 (14)	3 (8)	0	-

*Compared to the Caucasian cohort. **Compared to non-Aboriginal cohort.

than 350 cells/µl (Table 3). All patients with HLA B5701 presented with CD4 counts >350 cell/µl Interestingly, 19% of patients with a CD4 count <350 cells/µl were homozygous for their HLA alleles, compared to only 11% of those presenting with CD4 counts >350 cells/µl (Table 3).

HLA type

HLA type varied amongst ethnic groups. Of 15 patients with a homozygous HLA type, 60% were Aboriginal; one quarter of the Aboriginal cohort had homozygous HLA alleles (Table 2). Nearly one quarter of the Aboriginal cohort possessed an allele for HLA B35, compared to only 14% of Caucasian patients (Table 2). Almost half of Aboriginal patients had an allele for HLA B51, while only 14% of the Caucasian cohort did (Table 2). Amongst patients with at least one allele for

Table 3. Comparison of the CD4 count (cells/ul) and presence of opportunistic infection (OI) in people presenting to care with a new diagnosis of HIV arranged by human leukocyte antigen (HLA) type.

HLA type	CD4 count N (%)		OI N (%)	
	< or =350, n=54	>350, n=46	Present, n=30	Absent, n=70
HLA B35	7 (13)	7 (15)	5 (17)	9 (13)
HLA B27	1 (2)	1 (2)	1 (3)	1 (1)
HLA B51	17 (31)	8 (17)	8 (27)	18 (26)
HLA B5701	0	4 (9)	0	4 (6)
Homozygous HLA of any type	10 (19)	5 (11)	4 (13)	11 (16)

either HLA B35 or HLA B51, 63% were Aboriginal (Table 2). HLA B27 was uncommon, with only one Aboriginal and one Caucasian person possessing it (Table 2). Alleles for HLA B5701 were only found in Caucasian patients (Table 2).

In persons presenting with an OI, 17% had an allele for HLA B35, which was only found in 13% of those without an OI at presentation (Table 3). HLA B51 was fairly evenly divided, present in 27% of people with an OI at presentation to care and 26% of those without an OI (Table 3). However, of those people presenting with an OI, it was the most prevalent HLA type (Table 3). Only 1 individual with an OI had the HLA B27 allele (Table 3). Notably, no patients carrying the HLAB5701 presented with an OI (Table 3).

DISCUSSION

Our 2010 cohort demonstrated an association between HLA type and the severity of HIV disease at presentation to care, as represented by CD4 count and rates of opportunistic infection. It also emphasized several unique socio-demographic characteristics amongst the Manitoba HIV population, as compared to the HIV population in the rest of Canada.

Our cohort had a higher incidence of acquiring HIV through a heterosexual mode of transmission (63%) compared to the rest of Canada (36%) (Public Health Agency of Canada, 2008). While MSM is the most common mode of transmission in developed countries, it was reported in only 22% of the cases in our cohort (International Affairs Directorate, 2010). Similar to the 2009 Manitoba data, Aboriginal individuals were overrepresented among patients new to care in 2010, making up 37% of new patients with a diagnosis of HIV, but only 15% of the province's population.

Not only is the Aboriginal population numerically overrepresented, but they are also presenting with a significantly higher burden of HIV infection compared to patients from a Caucasian background, as measured by CD4 count and CD4 cell percentages. Individuals of an Aboriginal background were more likely to present late in the course of their infection, with half of new diagnoses of HIV presenting with CD4 counts less than 200, an AIDS defining criteria. These late presentations will not only negatively affect health outcomes of the individual, but also result in high disease transmission rates and are associated with higher costs to the health-care system (Krentz and Gill, 2012). A recent retrospective cost-analysis out of Calgary demonstrated that mean monthly healthcare costs for patients with HIV were inversely proportional to their CD4 count (Krentz and Gill, 2008).

Rates of OI at presentation in the 2010 cohort were quite high, with 1/3 of new patients in 2010 presenting with an OI. The majority of these infections were candidiasis or PJP. Perhaps reflecting their significantly lower CD4 count at presentation, there were significantly more Aboriginal patients who presented with an opportunistic infection (47%) compared to patients from a Caucasian background (33%).

Our data show high rates of HLA alleles previously shown to be associated with fast CD4 T cell count decline, while at the same time a paucity of the protective HLA B5701 allele, as 17% of patients presenting with an OI had an allele for HLA B35 and none had HLA B5701. Interestingly, 27% of patients presenting with an OI had an allele for HLA B51, which has previously been shown to have protective effects on HIV disease progression in a Chinese cohort (Zhang et al., 2011). In addition, 31% of patients presenting to care with CD4 counts less than 350 cells/µl had at least one allele for HLAB51. Research in Japan has suggested that some HLA alleles that have been shown to have protective effects on HIV progression in Caucasians, particularly, HLA B51 may lose their protective effect in other ethnic populations over time (Koga et al., 2010). This could explain the high incidence of the HLA B51 allele in patients presenting with advanced HIV disease, in particular, the high incidence of this allele in the Aboriginal population of our cohort (45%).

Indeed, our data did demonstrate a difference in distribution of HLA type by ethnicity. The majority of patients with HLA B35 were Aboriginal, while the protective HLA B5701 type was found only in Caucasian patients. In addition to HLA type, homozygosity of HLA type has been shown to contribute to rapid progression of HIV (Brumme et al., 2007; Carrington et al., 1999). In our cohort,

the majority of patients with a homozygous HLA type were Aboriginal (60%).

STRENGTHS AND LIMITATIONS

Our study had a number of strengths, including the population-based nature of the dataset; the Manitoba HIV program is the single point of HIV care in Manitoba, and thus theoretically all HIV positive individuals will receive their care through the program. Other strengths include the availability of HLA type, as well as additional clinical features of the case at presentation. There were a number of limitations to the study, including data being cross-sectional, and therefore it is impossible to determine causality in some of our analyses, such as the effect of HLA alleles on disease progression. The retrospective nature of these data may introduce some confounders and prospective confirmation of these associations is required. In addition, factors influencing disease progression in HIV are multiple, and include a diverse array of viral and host characteristics, as well as socioeconomic issues. Risk factors such as socio-economic disadvantage, culture and language diversity; and dispersion and remote location of communities are difficult to measure, but are also important contributors to the increased vulnerability of the Aboriginal population to HIV (International Affairs Directorate, 2010).

Nonetheless, the data from our cohort reflects an unequal distribution of HLA types and homozygosity amongst ethnic groups as well as in those patients presenting with advanced HIV infection. Our observations indicate that new strategies in healthcare may need to be developed to expand testing and linkage to care among this population to allow for earlier identification and to prevent advanced disease and its complications, particularly amongst the Aboriginal population.

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UPCOMING CONFERENCES

7th IAS Conference on HIV Pathogenesis, Treatment and Prevention, Kuala Lumpur, Malaysia, 30 Jun 2013

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