Published in final edited form as:

J Obstet Gynecol Neonatal Nurs. 2014 ; 43(5): 633–E50. doi:10.1111/1552-6909.12481.

A Multilevel Understanding of HIV/AIDS Disease Burden among African American Women

Bridgette M. Brawner, PhD, APRN [Assistant Professor of Nursing]

Center for Health Equity Research, Center for Global Women's Health, University of Pennsylvania School of Nursing, 418 Curie Blvd., 4th Floor, Room 419, Philadelphia, PA 19104-4217, 215-898-0715 (office), 215-746-3374 (fax), brawnerb@nursing.upenn.edu

Abstract

Disproportionate HIV/AIDS rates among African American women have been examined extensively—primarily from an individually-centered focus. Beyond individual behaviors, factors such as the hyper-incarceration of African American men and geographically concentrated disadvantage may better explain inequitable disease burden. This paper proposes a conceptual model of individual, social, and structural factors that influence HIV transmission among African American women. The model can be used to develop comprehensive assessments and guide prevention programs in African American communities.

Keywords

African Americans; conceptual model; disease prevention; health disparities; HIV/AIDS; risk factors; socioeconomic factors; underserved populations; vulnerable; women

Background

Racial and ethnic minorities, particularly African Americans, continue to experience disparate HIV/AIDS incidence and prevalence rates (Centers for Disease Control and Prevention [CDC], 2013a). These rates mirror and sometimes outpace reported estimates in sub-Saharan Africa and the Caribbean (Joint United Nations Programme on HIV/AIDS [UNAIDS] and World Health Organization [WHO], 2009). In the United States, women represent one-fourth of all Americans living with HIV/AIDS (CDC, 2013b). The rate of new HIV infections (per 100,000 population) among African American women is 20 times higher than that of White women (CDC, 2013a); heterosexual transmission is the primary mode of HIV infection (CDC, 2012). Alarming projections suggest that 1 in 32 African American women will be diagnosed with HIV at some point in their lifetime (CDC, 2014).

¹Callouts

Despite significant advances in biological and behavioral sciences, HIV/AIDS continues to cause significant burden among women around the globe.

²Comprehensive, multi-level HIV prevention programs are needed to adequately address the host of factors that contribute to HIV/AIDS disparities.

³Nurses in the sexual health field should be knowledgeable of multi-level factors that contribute to HIV risk, to enhance assessments and guide health promotion.

These epidemiological trends point to the critical need to comprehensively intervene with this population.

Despite longstanding biological and behavioral efforts to curb HIV/AIDS disease burden (Baeten et al., 2012; Eaton et al., 2012; Kennedy, Fonner, O'Reilly, & Sweat, 2013), the epidemic continues to have a devastating impact around the globe. Behavioral scientists have made significant strides in developing HIV prevention interventions to promote behavior change among African American women, however, maintenance of these health behaviors remains a challenge (Feldman, Silapaswan, Schaefer, & Schermele, 2014). Moreover, researchers have even demonstrated that compared to other racial and ethnic groups, African Americans may be more likely to engage in behaviors such as increased condom use and HIV testing which should decrease HIV risk (Pflieger, Cook, Niccolai, & Connell, 2013). Nevertheless, gross HIV/AIDS inequities are enduringly pervasive among African American women.

The question remains: *what factors increase risk for HIV among African American women, even with the use of protective behaviors and therapies?* This quandary requires simultaneous investigation of relevant contextual factors at the individual-, social- and structural-levels. Further, since African American women occupy multiple social categories that intersect with both privilege and oppression, the intersectionality of African American womanhood (e.g., race/ethnicity, gender and socioeconomic status) should also be taken into account (Bowleg, 2012). Gender roles and sexual socialization also warrant further exploration (Hall & Pichon, 2014). The author coined the term “geobehavioral vulnerability to HIV” to better understand HIV transmission among African American women.

The Concept of “Geobehavioral Vulnerability to HIV”

Geobehavioral vulnerability to HIV suggests that it is not just *what* you do, but also *where* you do it, and *with whom*, that increases your risk of HIV infection. Geosocial spaces—geographic areas where people interact, such as housing developments, census tracts or cities—with high HIV prevalence produce a greater probability of being exposed to HIV. Within these locations, higher individual viral loads facilitate HIV transmission (Blaser et al., 2014), as well as directly affect the total viral load within networks/communities (Das et al., 2010). Therefore, individual risk behavior is only one part of the equation when a person's geography and network/community associations influence HIV risk. For example, it is well established that African American communities are disproportionately affected by HIV/AIDS. If it is in fact true that African Americans tend to have sexual partners from their same racial and ethnic group (CDC, 2014), the increased HIV prevalence among potential sexual partners may mediate the relationship between behavior and subsequent HIV risk. Trends in HIV cases support this postulation; though it has not yet been analyzed in the published literature.

To illustrate the role of geography, consider HIV diagnosis rates in two states; Montana and Maine. In 2011, the HIV diagnosis case rate (per 100,000) for African Americans ranged from 0 in Montana to 170.5 in Maine (CDC, 2011); this rate is in contrast to rates of 2.7 to 3.4 respectively among Whites in both states. Compared to Montana, HIV is more heavily

concentrated among African Americans in Maine, with more than a 100-fold increase in the number of new HIV cases. Thus, African Americans in Maine would have greater geobehavioral vulnerability to HIV than those in Montana. Moreover, if specific geosocial spaces in Maine accounted for a disproportionate share of HIV cases in the state, as we tend to see with the clustering of the epidemic in certain areas, a person's risk for acquiring HIV would be amplified in those locations. According to the law of total probability, even if people in Montana engaged in significantly more HIV risk-related behaviors, their risk of acquiring HIV would be inherently lower. While individual risk-related behaviors do increase transmission risk, the probability of exposure is increased at the outset for those who have geobehavioral vulnerability to HIV. In understanding HIV transmission among African American women, they are not necessarily "riskier" than other groups. Instead, some African American women have minimal "room for error" because of the sheer concentration of HIV in their geographical and social environments.

As noted by Nunn et al. (2014), an individual's geography should not determine his or her destiny, yet gross geographic HIV/AIDS disparities exist across neighboring communities. Given our knowledge of factors associated with noncondom use such as fear of losing the relationship and/or waning condom use over time (Brawner, Gomes, Jemmott, Deatricks, & Coleman, 2012; Walsh, Fielder, Carey, & Carey, 2012), the notion of geobehavioral vulnerability to HIV has crucial implications for prevention messaging in regions where HIV is prevalent. Moreover, the concept may have implications for other health concerns where individual behaviors need to be put in context by the recognition that "place matters" (Cummins, Curtis, Diez-Roux, & Macintyre, 2007; Woolf & Braveman, 2011).

Expanding Beyond Individual Behavior

In addition to individual behavior, a lack of socioeconomic and other environmental resources create risk environments that make certain communities vulnerable to HIV/sexually transmitted infection (STIs; Biello et al., 2012). In effect, certain social and structural contexts appear to facilitate more rapid and widespread transmission of HIV. Substantial strides have been made in advancing our understanding of social and structural aspects of this unrelenting epidemic (Blankenship & Smoyer, 2013; Gupta, Parkhurst, Ogden, Aggleton, & Mahal, 2008). Auerbach, Parkhurst and Cáceres (2011) strongly point to the need to move the focus away from the individual level to a multi-level approach that includes social and cultural contexts. They further posit that HIV transmission is best understood within a broader realm of social forces that have the potential to affect behaviors. Brawner, Teitelman, Webb, and Jemmott (2013) assert that for the future of HIV prevention among women, vulnerabilities at the biological, social and structural levels will have to be addressed in a comprehensive, personalized manner.

An integrated understanding of drivers of HIV transmission is vital to the design of evidence-based, multi-level, complex models of HIV prevention. The purpose of this paper is to propose a multifaceted conceptual model that aims to refocus social determinants of sexual health (CDC, 2010a) more intently on the social and structural contexts in which many African Americans live and engage in sexual relationships. This multi-level conceptualization of HIV risk among African Americans may shed light on disproportionate

HIV disease burden among African American women. The idea is also consistent with Williams' and Jacksons' (2005) assumption that health is a socially embedded process. Further, through Jones' (2000) framework for understanding levels of racism (i.e., institutionalized, personally mediated, and internalized), race-associated differences in HIV/AIDS rates are better contextualized. More specifically, historically entrenched inequitable processes in the United States have laid the foreground for the pervasive race-associated differences we see in health outcomes today. The psychological distress associated with racial discrimination and exposure to poverty have significant health effects (Krieger, Kosheleva, Waterman, Chen, & Koenen, 2011), and HIV/AIDS disparities may be one such consequence. The conceptual model is expounded below, followed by implications for research and practice.

A Conceptual Model for Understanding HIV/AIDS among African Americans

Based on formative research and a review of relevant literature, the author developed an ecological conceptual model (Bronfenbrenner, 1986) to explore HIV transmission in the general African American population (see Figure 1). For the purposes of this paper, the model is used to better understand HIV/AIDS inequities among African American women. HIV risk can be viewed as a manifestation of interactions among individual, social and structural factors which create and sustain the risk context. In the author's conceptualization, these multi-level factors interact to influence both behaviors that transmit HIV (e.g., sexual activity, multiple sexual partners, injection drug use and noncondom use) and indicators of HIV transmission (e.g., percentage of the population with undetectable viral loads, and HIV incidence and prevalence rates). The relationship between behaviors that transmit HIV and HIV risk is perceived to be mediated by variations in indicators of HIV transmission.

Individual-level Factors that Protect Against or Increase HIV Risk

Individual-level factors include past experiences, current situations and daily occurrences that intersect an individual's life at any given moment in time, thus shaping his/her behavior and outlook on life. It is through these factors that women interface with partners, communities and wider societies. Individual-level factors considered include: educational attainment, mental health and substance use, community engagement, racial and ethnic identity, gender socialization and sexual health.

Educational Attainment—Educational attainment is an indicator of both current socioeconomic status and future mobility. Studies have linked education levels to HIV transmission, demonstrating an inverse relationship between educational attainment and HIV risk (Hargreaves et al., 2008; Paasche-Orlow, Clarke, Hebert, Ray, & Stein, 2005). Among African American women, structural-level interventions that emphasize high school and college graduation may decrease vulnerability to HIV; Painter, Wingood, DiClemente, DePadilla, and Simpson-Robinson (2012) discovered that the odds of a STI diagnosis were 73% lower among participants with a college degree or greater.

Mental Health and Substance Use—Psychological symptoms linked to HIV risk-related behaviors include depression, anxiety, and post-traumatic stress; and are often the result of exposure to violence or secondary to learning difficulties, mood disorders,

Attention-Deficit/Hyperactivity Disorder, or psychoses (Brawner, Gomes, Jemmott, Deatrick & Coleman, 2012; Brown et al., 2010). Comorbidities like alcohol and substance abuse contribute to the psychopathology, and further increase the chance of HIV/STI risk-related sexual behaviors such as multiple lifetime partners, more frequent sexual intercourse, unprotected sex, and trading sex for money or drugs (Lorvick et al., 2012).

Community Engagement—Building on the collective power work of Blankenship, West, Kershaw and Biradavolu (2008), the degree of an individual's collective power, defined here as community engagement, can be viewed as his/her collective identity (sense of unity with others), efficacy (perception that others would work together to deal with shared problems) and agency (experience speaking out and advocating for a group's rights). Community engagement may have protective benefits against HIV risk, and some argue that community empowerment and mobilization may be the most effective means of HIV prevention (Beeker, Guenther-Grey, & Raj, 1998); although challenges to mobilization have been noted in the African American community (Quimby & Friedman, 1989). For example, among gay and bi-sexual men, a sense of community engagement may moderate the effects of poverty, homophobia, and racism on sexual risk behaviors (Ramirez-Valles, 2002). Similar research has not specifically targeted African American women; however, inferences may be drawn from other populations.

Racial and Ethnic Identity—We do not have sound evidence to substantiate inherent racial or ethnic vulnerability to HIV risk behaviors. To the contrary, researchers have documented that African Americans report engaging in fewer risk behaviors than other racial and ethnic groups (Chatterjee et al., 2006; Ojikutu et al., 2013; Pflieger et al., 2013). Further, a stronger sense of racial and ethnic identity is noted as a protective factor against HIV risk (Beadnell et al., 2003; Wyatt et al., 2013).

Gender Socialization—Researchers have noted that the engendered role of power in heterosexual intimate relationships contributes to HIV risk in women (Wingood et al., 2006). Particularly regarding condom use, it is important to consider attitudes toward condom use among men as these sometimes shape condom use and relationship scripts among women (McLellan-Lemal et al., 2013). For example, some African American men believe that condoms take away their masculinity, power, and attractiveness, and this belief can sway their female partners' attitudes toward condom use (Harvey & Bird, 2002; Senn, Carey, Vanable, & Seward, 2009). Additionally, negative media influences on gender socialization are particularly salient among African American women, where bombardment with images of women being promiscuous and submissive begins early in life (Robillard, 2012). Researchers have also noted that sexism is indirectly associated with unprotected sex through the mechanisms of psychological distress and difficult sexual situations (e.g., having been sexually coerced; Choi, Bowleg, & Neilands, 2011).

Sexual Health—Women are physiologically more susceptible to HIV infection than men, and the presence of a STI significantly increases HIV risk (Nusbaum, Wallace, Slatt, & Kondrad, 2004). Genital herpes, along with other STIs, alters the genital skin integrity, whereby increasing HIV risk up to 11 times (Minton, 2013). Further, HIV risk-related

sexual behaviors (e.g., noncondom use and multiple sexual partners) also place individuals at heightened risk for contracting other STIs. The prevalence of STIs is higher among African Americans than other racial and ethnic minority groups (CDC, 2010b) which may increase biological vulnerability to HIV among African American women.

Social-level Factors that Protect Against or Increase HIV Risk

Based on work by Auerbach, Parkhurst and Cáceres (2011), social-level factors are defined as the “core social processes and arrangements—reflective of social and cultural norms, values, networks, structures and institutions—that operate around and in concert with individuals’ behaviors and practices to influence HIV epidemics in particular settings” (pg. 3). Social-level factors in the model include: social capital, geographically and socially constrained sexual networks and neighborhood social order and safety.

Social Capital—Putnam (1995) defined social capital as “features of social life—networks, norms and trust—that enable participants to act together more effectively to pursue shared objectives” (pg. 664). In relation to health, social capital is a descriptor of existing social relationships (Kawachi & Berkman, 2000) which highlights the degree to which participants/residents trust each other, engage in civic action together and have reciprocity. Communities with higher levels of social capital therefore are presumed to have more effective civic organizations which result in increased prosperity, as well as enhanced law and order. Researchers have demonstrated that compared to poverty and income inequality, social capital is the strongest predictor of gonorrhea, syphilis, Chlamydia and HIV/AIDS (Holtgrave & Crosby, 2003).

Geographically and Socially Constrained Sexual Networks—Individuals who are geographically and socially isolated tend to choose sexual partners from within their own networks (Friedman & Aral, 2001; Youm & Laumann, 2002). When STIs, including HIV, are highly prevalent in these networks, transmission is more likely to occur among members (Millett, Peterson, Wolitski, & Stall, 2006; Youm & Laumann, 2002). The HIV crisis among African American men in the United States can no longer be ignored (Raj & Bowleg, 2012); especially as a better understanding of HIV transmission among African American women is sought. Concurrent sexual partnerships, as opposed to sequential partnerships, provide increased opportunity for rapid viral spread (Grieb, Davey-Rothwell, & Latkin, 2012). Contextual factors that fuel concurrent sexual partnerships in the African American community include low male-to-female sex ratio, economic oppression, racial discrimination, and high incarceration rates of Black men (Adimora et al., 2013; Sharpe et al., 2012). Specifically, researchers have documented that a greater shortage of males and higher incarcerations rates among Non-Hispanic African American men nearly double the odds of having two or more partners (Pouget, Kershaw, Niccolai, Ickovics, & Blankenship, 2010). African Americans may also be more likely to have sexual partners of unknown HIV status (Oster et al., 2011).

Neighborhood Social Order and Safety—Community stressors are also associated with HIV risk behaviors (Kalichman, Simbayi, Jooste, Cherry, & Cain, 2005). Police presence, crime rates, commercial sex work and drug use, which are all linked to

neighborhood social order and safety, shape part of the context in which sexual risk behaviors occur in communities (Blankenship & Koester, 2002). These effects are seen across the lifespan (Schensul, Levy, & Disch, 2003). Further, reduced neighborhood social order may represent the inability of community residents to regulate lawlessness and promote safety (Sampson, Raudenbush, & Earls, 1997), which may be a proxy for community-level involvement in health-related issues.

Structural-level Factors that Protect Against or Increase HIV Risk

Structural-level factors are the deeply embedded manifestations of historical inequities and injustices. For Wacquant (2010b), “the daily experience of material dilapidation, ethnoracial seclusion, and socioeconomic marginality translates into the corrosion of the self, the rasping of interpersonal ties, and the skewing of public policy through the mediation of sulfurous cognition fastened onto a defamed place” (pg. 2). This level includes: incarceration rates, service availability and accessibility, racial residential segregation and concentrated disadvantage.

Incarceration Rates—Incarceration has significant health effects, even after release from prison (Schnittker & John, 2007). Yet the social effects of the mass incarceration of African American men are not fully understood (Western & Wildeman, 2009). Most notably, HIV and incarceration can be considered dual epidemics (Wohl, Rosen, & Kaplan, 2006); HIV seroprevalence is nearly three times higher among incarcerated individuals than in the general population (Maruschak, 2012). Drug use and sexual risk behaviors fuel the epidemic among inmates (Hammett, 2006). The HIV seroprevalence of inmates has significant implications for the communities inmates return to when they are released. For example, HIV rates are documented to be higher in areas that are disproportionately impacted by incarceration, parole and probation (Blankenship & Smoyer, 2013). Given that African Americans are unjustly and disproportionately sentenced to and represented in the criminal justice system (Bales & Piquero, 2012; Wacquant, 2010a), African American communities bear a heavier burden of the effects of incarceration on HIV seroconversion than other racial and ethnic groups.

Service Availability and Accessibility—Service use can be understood through Andersen’s (1995) behavioral model of health services, where he purports that health service usage is a factor of an individual’s predisposition to use services (i.e., demographics, social structure and health beliefs), issues that enable or precede use (i.e., personal/family and community), and their need for care (i.e., perceived and evaluated). Factors that enable or precede use such as service availability (spatial distribution and office hours of services) and accessibility (i.e., cost, transportation and patient relations) are pivotal to HIV prevention and treatment.

Residential Segregation and Concentrated Disadvantage—Spatial concentration of disadvantage is the result of longstanding inequalities that stem from the deindustrialization of cities and the out-migration of more affluent residents (Massey, 1990; Massey, 1996). The concept of concentrated disadvantage can be used to describe “the degree to which poverty and other disadvantages are confined to a limited number of

neighborhoods within a city in contrast to being spread throughout an urban area” (pg. 62) (Krivo, Peterson, Rizzo, & Reynolds, 1998). Substantial racial residential segregation has concentrated the majority of African American residents in disenfranchised communities, and racial prejudice limits upward mobility (Williams & Collins, 2001). Racial segregation has also been documented to modify the association between income inequality and mortality; increasing levels of Black racial segregation leads to an inverse association between income inequality and mortality (Nuru-Jeter & LaVeist, 2011). Residential segregation, reinforced by gentrification, may serve to maintain elevated rates of HIV/STI infections in social and sexual networks.

Behaviors that Transmit HIV

While all of the aforementioned multi-level factors are important, in most cases the probability of acquiring HIV is still mediated by behavior—albeit within the context of external influences. Sexual activity (Marks, Crepaz, Senterfitt, & Janssen, 2005), multiple sexual partners (Senn et al., 2010), injection drug use (Magnus et al., 2013), and noncondom use (McLellan-Lemal et al., 2012) are all well-documented behaviors associated with increased rates of HIV transmission among African American women. The previously mentioned multi-level factors are theorized to directly influence individual behavior. The relationship between these behaviors and subsequent HIV risk is then presumed to be mediated by community-level indicators of HIV transmission.

Community-level Indicators of HIV Transmission

Community-level indicators of HIV transmission include HIV incidence and prevalence, and the concentration of HIV (e.g., percentage of HIV-positive persons with undetectable viral loads) in a geosocial space. The level of semen or serum viral load is a known marker of infectivity at the individual level (Wawer et al., 2005), leading to a growing interest in community-level markers. Community viral load is a population-level marker of antiretroviral therapy-mediated (ART-mediated) virologic suppression and HIV transmission potential (Das et al., 2010). Researchers are in the process of determining whether percent undetectable or community viral load is a more accurate and methodologically sound population-level marker (Miller, Powers, Smith, & Cohen, 2013). By decreasing the rates of new infections, and controlling community viral load/concentrations of HIV in a given risk context, HIV risk may be mediated (Cohen et al., 2012; Terzian et al., 2012).

Summary and Implications for Research and Practice

The conceptual model presents four major pathways for both empirical testing and clinical practice (see Figure 1; pathways are represented as P_x). First (P_1), interactions among the multi-level factors are presumed to influence community-level indicators of HIV transmission. Studies with nested designs can be used to explore how indicators such as educational attainment, neighborhood social order and safety, and racial residential segregation correlate with and explain the variance in HIV/AIDS burden across communities. Second (P_2), interactions among the multi-level factors are purported to shape individual behavior. Cross-sectional or longitudinal surveys with large samples can be used

to test pathways between factors such as mental health, social capital, service availability, and multiple sexual partners. Third (P_3), with the notion of geobehavioral vulnerability, the relationship between individual behaviors and HIV risk is postulated to be mediated by HIV incidence and prevalence rates, as well as the actual amount of HIV virus present in a particular area. Comparative, advanced spatial analyses of behaviors in high and low HIV prevalence communities could be used to investigate this claim. Lastly (P_4), HIV risk is believed to be the manifestation of interactions among multi-level factors which create and sustain the risk context. Based on findings from the aforementioned analyses, Structural Equation Modeling and Bayesian Simulation could be used to estimate the probability of HIV risk in different communities, and inform service and resource allocation. Combining primary and secondary data sources could ensure adequate power to test the hypotheses, as well as provide up-to-date, targeted information for specific HIV epicenters.

With respect to practice, the conceptual model provides guidance to conduct targeted sexual health assessments and interventions with African American women in clinical settings, as well as broader community health assessments in African American communities. For example, it would be important to ask questions about incarceration history for both clients and their sexual partners, and to understand the nature and structure of their geosocial setting. The intent is not to encourage African Americans to disengage from each other and/or abandon high HIV prevalence areas. Instead, geobehavioral vulnerability to HIV should be explained in a culturally sensitive and meaningful way, stressing the importance of HIV risk reduction. For example, clinical encounters and public health campaigns in high prevalence geosocial spaces could emphasize that a particular group is not necessarily “riskier”, but that the higher rates of HIV in that area require people to take additional precautions to preserve their health. Deficits-based communications could be reframed to positive messages of social accountability.

The role of factors such as the media on gender socialization, as well as the availability and accessibility of HIV-related services are also important for HIV prevention messages. Programs that are gender and culturally relevant, and that take a social determinants of health approach to HIV prevention, may be most effective in African American communities. In this manner, the social and structural factors that drive and/or exacerbate individual behaviors can be taken into account and addressed.

Discussion

Individual-level determinants of HIV/STI risk occur within the context of social and structural driving forces; this author argues that social and structural inequities shape the HIV risk context beyond the influence of individual behaviors. HIV prevalence rates are noted to be higher in high poverty areas (Denning, DiNenno, & Wiegand, 2011), and historical injustices have concentrated African Americans and other racial/ethnic minorities to these regions (Massey, 2013). In the proposed conceptualization, multi-level inequities such as concentrated disadvantage, the hyper-incarceration of African American men, and geographically and socially constrained sexual networks interact to cluster HIV in certain geographical and interpersonal spaces. Geobehavioral vulnerability to HIV is thereby increased among African American women who have sexual relationships in these geosocial

spaces. As noted by Cummins et al. (2007), “there is a mutually reinforcing and reciprocal relationship between people and place” (pg. 1825).

Limited educational attainment, poverty, and imbalanced male-female sex ratios all fuel the HIV epidemic among African American populations (Dean & Fenton, 2010). Thus, structural interventions should continue to be incorporated in our HIV prevention dialogue, especially since they have proven to be efficacious (Adimora & Auerbach, 2010). Similar to others, this author argues that HIV is an individual, social and structural concern, requiring community engagement and mobilization toward its eradication. Although a universal “test-and-treat” model could potentially eliminate new HIV infections over time, social and structural barriers exist to widespread implementation and sustainability (Kulkarni, Shah, Sarma, & Mahajan, 2013). Neither a biomedical nor behavioral approach to HIV prevention can be sustained in the absence of considering the broader contexts. It is important to note, however, that there are substantial challenges associated with the implementation of structural interventions so as not to minimize the arduous nature in which they are executed (Auerbach et al., 2011). This becomes particularly difficult when opposing entrenched systems and interests that continue to marginalize and oppress certain groups (Miller, Reed, Francisco, & Ellen, 2012), such as African American women.

The concept of geobehavioral vulnerability to HIV must be approached with caution when providing messaging for communities. The intent is not to vilify or stigmatize certain regions by highlighting the fact that HIV is a major concern for them (Friedman, Uhrig, Poehlman, Scales, & Hogben, 2014). However, it is important to convey that the geographical probability of HIV exposure is increased in certain geosocial spaces. Work can be done in partnership with communities to promote long-term, consistent condom use, routine HIV testing, and committed/monogamous relationships as social norms. This work has to occur, however, within the context of addressing other social and structural concerns the influence HIV risk. For example, provision of resources for homeless youth to decrease transactional sex, and reform of biased policies and laws that unjustly promote the hyper-incarceration of African American men.

Limitations of this conceptual model should be considered. The model presumes relational influences that have not been empirically examined. Future research is needed to test the suggested pathways. Some of the variables included in the model may not be relevant for other populations and geosocial settings, and the variable list is not exhaustive or mutually exclusive across individual, social and structural levels. Additional variables of significance, however, should be considered in adapted, population-specific models. Lastly, the nuances of culture and country of origin are not adequately captured in the conceptual model. Subsequent inquiries may benefit from disentangling these relationships in a culturally relevant manner. The proposed conceptual model can be used as a starting point to generate and test hypotheses for future research, and offers a basis for comprehensive, multi-level HIV prevention programs in African American communities.

The identification of specific, regional, multi-level factors that contribute toward excessive HIV/AIDS disease burden has the potential to (a) determine points of intervention to change social policies; (b) implement new HIV prevention and care strategies; (c) develop evidence

to inform the distribution of services and resources; and (d) curb the epidemic. The proposed gender-responsive model is a first step toward this goal, and will hopefully foster dialogue and urge a re-examination of HIV transmission from a social determinants of health perspective—through a geobehavioral lens. Lastly, although the model was devised based on the African American geosocial context, it may have implications for other health concerns, populations, and settings.

Supplementary Material

Refer to Web version on PubMed Central for supplementary material.

Biography

Bridgette M. Brawner, PhD, APRN, is an Assistant Professor of Nursing at the University of Pennsylvania School of Nursing. Through a health equity lens, her program of research focuses on multi-level, multi-method, biobehavioral approaches to sexual health promotion in disenfranchised populations.

References

- Adimora AA, Auerbach JD. Structural interventions for HIV prevention in the United States. *JAIDS Journal of Acquired Immune Deficiency Syndromes*. 2010; 55(suppl 2):S132–S135. [PubMed: 21406983]
- Adimora AA, Schoenbach VJ, Taylor EM, Khan MR, Schwartz RJ, Miller WC. Sex ratio, poverty, and concurrent partnerships among men and women in the United States: a multilevel analysis. *Annals of Epidemiology*. 2013; 23(11):716–719. doi: <http://dx.doi.org/10.1016/j.annepidem.2013.08.002>. [PubMed: 24099690]
- Andersen RM. Revisiting the behavioral model and access to medical care: Does it matter? *Journal of Health and Social Behavior*. 1995; 36(1):1–10. [PubMed: 7738325]
- Auerbach JD, Parkhurst JO, Cáceres CF. Addressing social drivers of HIV/AIDS for the long-term response: Conceptual and methodological considerations. *Global Public Health*. 2011; 6(suppl 3):S293–S309. [PubMed: 21745027]
- Baeten JM, Donnell D, Ndase P, Mugo NR, Campbell JD, Wangisi J, Katabira E. Antiretroviral prophylaxis for HIV prevention in heterosexual men and women. *New England Journal of Medicine*. 2012; 367(5):399–410. [PubMed: 22784037]
- Bales WD, Piquero AR. Racial/ethnic differentials in sentencing to incarceration. *Justice Quarterly*. 2012; 29(5):742–773.
- Beadnell B, Stielstra S, Baker S, Morrison D, Knox K, Gutierrez L, Doyle A. Ethnic identity and sexual risk-taking among African-American women enrolled in an HIV/STD prevention intervention. *Psychology, Health & Medicine*. 2003; 8(2):187–198.
- Becker C, Guenther-Grey C, Raj A. Community empowerment paradigm drift and the primary prevention of HIV/AIDS. *Social Science & Medicine*. 1998; 46(7):831–842. [PubMed: 9541069]
- Biello KB, Kershaw T, Nelson R, Hogben M, Ickovics J, Nicolai L. Racial residential segregation and rates of Gonorrhea in the United States, 2003–2007. *American Journal of Public Health*. 2012; 102(7):1370–1377. [PubMed: 22594733]
- Blankenship KM, Koester S. Criminal law, policing policy, and HIV risk in female street sex workers and injection drug users. *Journal of Law, Medicine & Ethics*. 2002; 30(4):548–559.
- Blankenship, KM.; Smoyer, AB. Between Spaces: Understanding Movement to and from Prison as an HIV Risk Factor. In: Sanders, B.; Thomas, YF.; Griffin Deeds, B., editors. *Crime, HIV and Health: Intersections of Criminal Justice and Public Health Concerns*. Netherlands: Springer; 2013. p. 207–221.

- Blankenship KM, West BS, Kershaw TS, Biradavolu MR. Power, community mobilization, and condom use practices among female sex workers in Andhra Pradesh, India. *AIDS*. 2008; 22(suppl 5):S109–S116. [PubMed: 19098471]
- Blaser N, Wettstein C, Estill J, Vizcaya LS, Wandeler G, Egger M, Keiser O. Impact of viral load and the duration of primary infection on HIV transmission: Systematic review and meta-analysis. *AIDS*. 2014; 28(7):1021–1029. [PubMed: 24691205]
- Bowleg L. The problem with the phrase women and minorities: Intersectionality—an important theoretical framework for public health. *American Journal of Public Health*. 2012; 102(7):1267–1273. [PubMed: 22594719]
- Brawner BM, Gomes MM, Jemmott LS, Deatrick JA, Coleman CL. Clinical depression and HIV risk-related sexual behaviors among African-American adolescent females: Unmasking the numbers. *AIDS Care*. 2012; 24(5):618–625. [PubMed: 22292603]
- Brawner BM, Teitelman AM, Webb AL, Jemmott LS. Personalized biobehavioral HIV prevention for women and adolescent girls. *Global Advances in Health and Medicine (Special Issue: Women's Health Research: Roadmap to the Future)*. 2013; 2(5):100–108.
- Bronfenbrenner U. Ecology of the family as a context for human development: Research perspectives. *Developmental psychology*. 1986; 22(6):723–746.
- Brown LK, Hadley W, Stewart A, Lescano C, Whiteley L, Donenberg G, DiClemente R. Psychiatric disorders and sexual risk among adolescents in mental health treatment. *Journal of Consulting and Clinical Psychology*. 2010; 78(4):590–597. [PubMed: 20658815]
- Centers for Disease Control and Prevention. [Retrieved December 15, 2010] Establishing a Holistic Framework to Reduce Inequities in HIV, Viral Hepatitis, STDs, and Tuberculosis in the United States: An NCHHSTP White Paper on Social Determinants of Health. 2010a. from www.cdc.gov/socialdeterminants
- Centers for Disease Control and Prevention. Atlanta: U.S. Department of Health and Human Services; 2010b. Sexually Transmitted Disease Surveillance 2009.
- Centers for Disease Control and Prevention. [Retrieved April 16, 2014] HIV Surveillance by Race/Ethnicity. 2011. from http://www.cdc.gov/hiv/pdf/statistics_surveillance_raceEthnicity.pdf
- Centers for Disease Control and Prevention. [Retrieved April 17, 2014] Estimated HIV Incidence in the United States, 2007–2010. HIV Surveillance Supplemental Report 2012. 2012. from <http://www.cdc.gov/hiv/topics/surveillance/resources/reports/#supplemental>
- Centers for Disease Control and Prevention. [Retrieved April 11, 2014] HIV Among Women. 2013a. from <http://www.cdc.gov/hiv/risk/gender/women/facts/index.html>
- Centers for Disease Control and Prevention. [Retrieved August 10, 2013] HIV Surveillance Report, 2011. 2013b. from <http://www.cdc.gov/hiv/topics/surveillance/resources/reports/>
- Centers for Disease Control and Prevention. [Retrieved April 16, 2014] Fact Sheet: HIV among African Americans. 2014. from <http://www.cdc.gov/hiv/risk/raciaethnic/aa/facts/>
- Choi K, Bowleg L, Neilands T. The effects of sexism, psychological distress, and difficult sexual situations on US women's sexual risk behaviors. *AIDS Education and Prevention*. 2011; 23(5):397–411. [PubMed: 22010804]
- Cohen MS, Dye C, Fraser C, Miller WC, Powers KA, Williams BG. HIV treatment as prevention: Debate and commentary—will early infection compromise treatment-as-prevention strategies? *PLoS Medicine*. 2012; 9(7):e1001232. Retrieved from <http://www.plosmedicine.org/article/info%3Adoi%2F10.1371%2Fjournal.pmed.1001232#pmed-1001232-g001>. [PubMed: 22802728]
- Cummins S, Curtis S, Diez-Roux AV, Macintyre S. Understanding and representing 'place' in health research: A relational approach. *Social Science & Medicine*. 2007; 65(9):1825–1838. [PubMed: 17706331]
- Das M, Chu PL, Santos GM, Scheer S, Vittinghoff E, McFarland W, Colfax GN. Decreases in community viral load are accompanied by reductions in new HIV infections in San Francisco. *PLoS One*. 2010; 5(6):e11068. Retrieved from <http://www.plosone.org/article/info%3Adoi%2F10.1371%2Fjournal.pone.0011068#pone-0011068-g003>. [PubMed: 20548786]
- Dean HD, Fenton KA. Addressing social determinants of health in the prevention and control of HIV/AIDS, viral hepatitis, sexually transmitted infections, and tuberculosis. *Public Health Reports*. 2010; 125(Supplement 4):1–5. [PubMed: 20629250]

- Denning PH, DiNenno EA, Wiegand RE. Characteristics associated with HIV infection among heterosexuals in urban areas with high AIDS prevalence - 24 cities, United States, 2006–2007. *Morbidity and Mortality Weekly Report*. 2011; 60(31):1045–1049. [PubMed: 21832975]
- Eaton LA, Huedo-Medina TB, Kalichman SC, Pellowski JA, Popat AR, Sagherian MJ, Johnson BT. Systematic review and meta-analysis of single-session behavioral interventions to prevent sexually transmitted infections: Implications for bundling multiple STI/HIV prevention packages. *American Journal of Public Health*. 2012; 102(11):e34–e44. [PubMed: 22994247]
- Feldman MB, Silapaswan A, Schaefer N, Schermele D. Is there life after DEBI? Examining health behavior maintenance in the Diffusion of Effective Behavioral Interventions Initiative. *American Journal of Community Psychology*, online first. 2014:1–28. Retrieved from <http://dx.doi.org/10.1007/s10464-014-9629-3>.
- Friedman AL, Uhrig J, Poehlman J, Scales M, Hogben M. Promoting sexual health equity in the United States: Implications from exploratory research with African-American adults. *Health Education Research*, Online first. 2014 Retrieved from <http://her.oxfordjournals.org/content/early/2014/02/28/her.cyu003.abstract>.
- Friedman SR, Aral S. Social networks, risk-potential networks, health, and disease. *Journal of Urban Health*. 2001; 78(3):411–418. [PubMed: 11564845]
- Grieb SD, Davey-Rothwell M, Latkin C. Concurrent sexual partnerships among urban African American high-risk women with main sex partners. *AIDS and Behavior*. 2012; 16(2):323–333. [PubMed: 21538086]
- Gupta GR, Parkhurst JO, Ogden JA, Aggleton P, Mahal A. Structural approaches to HIV prevention. *The Lancet*. 2008; 372(9640):764–775.
- Hall NM, Pichon LC. Gender roles, sociosexuality, and sexual behavior among US Black women. *Health Psychology and Behavioral Medicine*. 2014; 2(1):171–182. [PubMed: 25614852]
- Hammett TM. HIV/AIDS and other infectious diseases among correctional inmates: transmission, burden, and an appropriate response. *American Journal of Public Health*. 2006; 96(6):974–978. [PubMed: 16449578]
- Hargreaves JR, Bonell CP, Boler T, Boccia D, Birdthistle I, Fletcher A, Glynn JR. Systematic review exploring time trends in the association between educational attainment and risk of HIV infection in sub-Saharan Africa. *AIDS*. 2008; 22(3):403–414. [PubMed: 18195567]
- Harvey SM, Bird ST. Power in relationships and influencing strategies for condom use: Exploring cultural beliefs among African American men. *International Quarterly of Community Health Education*. 2002; 21(2):147–162.
- Holtgrave DR, Crosby RA. Social capital, poverty, and income inequality as predictors of gonorrhoea, syphilis, chlamydia and AIDS case rates in the United States. *Sexually Transmitted Infections*. 2003; 79(1):62–64. [PubMed: 12576618]
- Joint United Nations Programme on HIV/AIDS (UNAIDS) and World Health Organization (WHO). AIDS epidemic update. 2009. Retrieved from http://www.unaids.org/en/media/unaids/contentassets/dataimport/pub/report/2009/jc1700_epi_update_2009_en.pdf
- Jones CP. Levels of racism: A theoretic framework and a gardener's tale. *American Journal of Public Health*. 2000; 90(8):1212–1215. [PubMed: 10936998]
- Kalichman SC, Simbayi LC, Jooste S, Cherry C, Cain D. Poverty-related stressors and HIV/AIDS transmission risks in two South African communities. *Journal of Urban Health*. 2005; 82(2):237–249. [PubMed: 15888636]
- Kawachi, I.; Berkman, LF. Social cohesion, social capital, and health. In: Berkman, LF.; Kawachi, I., editors. *Social epidemiology*. New York: Oxford University Press; 2000. p. 174–190.
- Kennedy CE, Fonner VA, O'Reilly KR, Sweat MD. A systematic review of income generation interventions, including microfinance and vocational skills training, for HIV prevention. *AIDS Care*. 2013; 26(6):659–673. [PubMed: 24107189]
- Krieger N, Kosheleva A, Waterman PD, Chen JT, Koenen K. Racial discrimination, psychological distress, and self-rated health among US-Born and Foreign-Born Black Americans. *American Journal of Public Health*. 2011; 101(9):1704–1713. [PubMed: 21778504]
- Krivo LJ, Peterson RD, Rizzo H, Reynolds JR. Race, segregation, and the concentration of disadvantage, 1980–1990. *Social Problems*. 1998; 45(1):61–80.

- Kulkarni SP, Shah KR, Sarma KV, Mahajan AP. Clinical uncertainties, health service challenges, and ethical complexities of HIV “Test-and-Treat”: A systematic review. *American Journal of Public Health*. 2013; 103(6):e14–e23. [PubMed: 23597344]
- Lorvick J, Bourgois P, Wenger LD, Arreola SG, Lutnick A, Wechsberg WM, Kral AH. Sexual pleasure and sexual risk among women who use methamphetamine: A mixed methods study. *International Journal of Drug Policy*. 2012; 23(5):385–392. [PubMed: 22954501]
- Magnus M, Kuo I, Phillips G II, Rawls A, Peterson J, Montanez L, Greenberg A. Differing HIV risks and prevention needs among men and women injection drug users (IDU) in the District of Columbia. *Journal of Urban Health*. 2013; 90(1):157–166. [PubMed: 22692841]
- Marks G, Crepaz N, Senterfitt JW, Janssen RS. Meta-analysis of high-risk sexual behavior in persons aware and unaware they are infected with HIV in the United States: Implications for HIV prevention programs. *JAIDS Journal of Acquired Immune Deficiency Syndromes*. 2005; 39(4): 446–453. [PubMed: 16010168]
- Maruschak, L. HIV in Prisons, 2001–2010. Washington, D.C.: US Department of Justice, Bureau of Justice Statistics; 2012. (NCJ 238877) Retrieved from <http://bjs.ojp.usdoj.gov/content/pub/pdf/hivp10.pdf>
- Massey DS. American Apartheid - Segregation and the making of the underclass. *American Journal of Sociology*. 1990; 96(2):329–357.
- Massey DS. The age of extremes: Concentrated affluence and poverty in the twenty-first century. *Demography*. 1996; 33(4):395–412. [PubMed: 8939412]
- Massey DS. Inheritance of poverty or inheritance of place? The emerging consensus on neighborhoods and stratification. *Contemporary Sociology: A Journal of Reviews*. 2013; 42(5):690–695.
- McLellan-Lemal E, Toledo L, O’Daniels C, Villar-Loubet O, Simpson C, Adimora AA, Marks G. “A man’s gonna do what a man wants to do”: African American and Hispanic women’s perceptions about heterosexual relationships: A qualitative study. *BMC Women’s Health*. 2013; 13:1–14. Retrieved from <http://www.biomedcentral.com/content/pdf/1472-6874-13-27.pdf>. [PubMed: 23295104]
- Miller RL, Reed SJ, Francisco VT, Ellen JM. Conflict transformation, stigma, and HIV-preventive structural change. *American Journal of Community Psychology*. 2012; 49(3–4):378–392. [PubMed: 21805217]
- Miller WC, Powers KA, Smith MK, Cohen MS. Community viral load as a measure for assessment of HIV treatment as prevention. *The Lancet Infectious Diseases*. 2013; 13(5):459–464. doi: [http://dx.doi.org/10.1016/S1473-3099\(12\)70314-6](http://dx.doi.org/10.1016/S1473-3099(12)70314-6). [PubMed: 23537801]
- Millett GA, Peterson JL, Wolitski RJ, Stall R. Greater risk for HIV infection of Black men who have sex with men: A critical literature review. *American Journal of Public Health*. 2006; 96(6):1007–1019. [PubMed: 16670223]
- Minton K. HIV: From one STI to another ... with love. *Nature Reviews Immunology*. 2013; 13(3): 154–155.
- Nunn A, Yolken A, Cutler B, Trooskin S, Wilson P, Little S, Mayer K. Geography should not be destiny: Focusing HIV/AIDS implementation research and programs on microepidemics in US neighborhoods. *American Journal of Public Health*. 2014; 104(5):775–780. [PubMed: 24716570]
- Nuru-Jeter A, LaVeist T. Racial segregation, income inequality, and mortality in US metropolitan areas. *Journal of Urban Health*. 2011; 88(2):270–282. [PubMed: 21298485]
- Nusbaum MRH, Wallace RR, Slatt LM, Kondrad EC. Sexually transmitted infections and increased risk of co-infection with human immunodeficiency virus. *JAOA: Journal of the American Osteopathic Association*. 2004; 104(12):527–535. [PubMed: 15653780]
- Oster AM, Wiegand RE, Siomean C, Miles IJ, Thomas PE, Melendez-Morales L, Millett GA. Understanding disparities in HIV infection between black and white MSM in the United States. *AIDS*. 2011; 25(8):1103–1112. [PubMed: 21505305]
- Paasche-Orlow MK, Clarke JG, Hebert MR, Ray MK, Stein MD. Educational attainment but not literacy is associated with HIV risk behavior among incarcerated women. *Journal of Womens Health*. 2005; 14(9):852–859.

- Painter JE, Wingood GM, DiClemente RJ, DePadilla LM, Simpson-Robinson L. College graduation reduces vulnerability to STIs/HIV among African-American young adult women. *Women's Health Issues*. 2012; 22(3):e303–e310. [PubMed: 22555218]
- Pflieger JC, Cook EC, Niccolai LM, Connell CM. Racial/ethnic differences in patterns of sexual risk behavior and rates of sexually transmitted infections among female young adults. *American Journal of Public Health*. 2013; 103(5):903–909. [PubMed: 23488501]
- Pouget ER, Kershaw TS, Niccolai LM, Ickovics JR, Blankenship KM. Associations of sex ratios and male incarceration rates with multiple opposite-sex partners: Potential social determinants of HIV/STI transmission. *Public Health Reports*. 2010; 125(Suppl 4):70–80. [PubMed: 20626195]
- Putnam RD. Tuning in, tuning out: The strange disappearance of social capital in America. *PS: Political Science and Politics*. 1995; 28(4):664–683.
- Quimby E, Friedman SR. Dynamics of black mobilization against AIDS in New York City. *Social Problems*. 1989; 36(4):403–415.
- Raj A, Bowleg L. Heterosexual risk for HIV among Black men in the United States: A call to action against a neglected crisis in Black communities. *American Journal of Men's Health*. 2012; 6(3): 178–181.
- Ramirez-Valles J. The protective effects of community involvement for HIV risk behavior: A conceptual framework. *Health Education Research*. 2002; 17(4):389–403. [PubMed: 12197585]
- Robillard A. Music videos and sexual risk in African American adolescent girls. *American Journal of Health Education*. 2012; 43(2):93–103.
- Sampson RJ, Raudenbush SW, Earls F. Neighborhoods and violent crime: A multilevel study of collective efficacy. *Science*. 1997; 277(5328):918–924. [PubMed: 9252316]
- Schensul JJ, Levy JA, Disch WB. Individual, contextual, and social network factors affecting exposure to HIV/AIDS risk among older residents living in low-income senior housing Complexes. *JAIDS Journal of Acquired Immune Deficiency Syndromes*. 2003; 33(suppl 2):S138–S152. [PubMed: 12853863]
- Schnittker J, John A. Enduring stigma: The long-term effects of incarceration on health. *Journal of Health and Social Behavior*. 2007; 48(2):115–130. [PubMed: 17583269]
- Senn TE, Carey MP, Venable PA, Seward DX. African American men's perceptions of power in intimate relationships. *American Journal of Men's Health*. 2009; 3(4):310–318.
- Senn TE, Carey MP, Venable PA, Urban M, Sliwinski M. The male-to-female ratio and multiple sexual partners: Multilevel analysis with patients from an STD clinic. *AIDS and Behavior*. 2010; 14(4):942–948. [PubMed: 18483848]
- Sharpe TT, Voûte C, Rose MA, Cleveland J, Dean HD, Fenton K. Social determinants of HIV/AIDS and sexually transmitted diseases among black women: Implications for health equity. *Journal of Women's Health*. 2012; 21(3):249–254.
- Terzian AS, Bodach SD, Wiewel EW, Sepkowitz K, Bernard M-A, Braunstein SL, Shepard CW. Novel use of surveillance data to detect HIV-infected persons with sustained high viral load and durable virologic suppression in New York city. *PLoS One*. 2012; 7(1):e29679. [PubMed: 22291892]
- Wacquant L. Class, race & hyperincarceration in revanchist America. *Daedalus*. 2010a; 139(3):74–90.
- Wacquant L. Urban desolation and symbolic denigration in the hyperghetto. *Social Psychology Quarterly*. 2010b; 73(3):215–219.
- Walsh JL, Fielder RL, Carey KB, Carey MP. Changes in women's condom use over the first year of college. *Journal of Sex Research*. 2012; 50(2):128–138. [PubMed: 22235757]
- Wawer MJ, Gray RH, Sewankambo NK, Serwadda D, Li XB, Laeyendecker O, Kiwanuka N, Quinn TC. Rates of HIV-1 transmission per coital act, by stage of HIV-1 infection, in Rakai, Uganda. *Journal of Infectious Diseases*. 2005; 191(9):1403–1409. [PubMed: 15809897]
- Western B, Wildeman C. The Black family and mass incarceration. *The ANNALS of the American Academy of Political and Social Science*. 2009; 621(1):221–242.
- Williams DR, Collins C. Racial residential segregation: A fundamental cause of racial disparities in health. *Public Health Reports*. 2001; 116(5):404–416. [PubMed: 12042604]
- Williams DR, Jackson PB. Social sources of racial disparities in health. *Health Affairs*. 2005; 24(2): 325–334. [PubMed: 15757915]

- Wingood GM, DiClemente RJ, Harrington KF, Oh MK, Lang DL, Davies SL, Hardin JW. Efficacy of an HIV prevention program among female adolescents experiencing gender-based violence. *American Journal of Public Health*. 2006; 96(6):1085–1090. [PubMed: 16670238]
- Wohl D, Rosen D, Kaplan A. HIV and incarceration: Dual epidemics. *The AIDS Reader*. 2006; 16(5): 247–250. [PubMed: 16764066]
- Woolf SH, Braveman P. Where health disparities begin: The role of social and economic determinants—and why current policies may make matters worse. *Health Affairs*. 2011; 30(10):1852–1859. [PubMed: 21976326]
- Wyatt GE, Gómez CA, Hamilton AB, Valencia-Garcia D, Gant LM, Graham CE. The intersection of gender and ethnicity in HIV risk, interventions, and prevention: New frontiers for psychology. *American Psychologist*. 2013; 68(4):247–260. [PubMed: 23688092]
- Youm Y, Laumann EO. Social network effects on the transmission of sexually transmitted diseases. *Sexually Transmitted Diseases*. 2002; 29(11):689–697. [PubMed: 12438906]

Figure 1.

A Conceptual Model (with Presumed Pathways [P_x]) for Understanding Geobehavioral Vulnerability to HIV among African Americans