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Concurrency is more complex than it seems

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More than ten years ago the concept of “concurrency” entered the epidemiological stage in the attempt to explain the differences of spread of HIV in different populations [1-4]. In recent years, following several publications and commentaries based on review of previous studies the concurrency hypothesis has been put forward more strongly to explain the rapid or slow heterosexual spread of HIV in countries around the world [5, 6]. However, the empirical basis proving that concurrency actually is the driving force behind the continuing high prevalence of HIV in sub-Saharan Africa has been lacking. While some studies investigated the impact of concurrent partnerships on the prevalence of HIV in various sub-Saharan Africa populations [7-9], they were not able to identify concurrency as a strong explanatory factor. Also, epidemiological observations like the decrease of HIV prevalence in Uganda following the advocacy of the “zero grazing” strategy for HIV prevention [10, 11] is not conclusive evidence for the impact of concurrent partnerships on HIV transmission, because of the possibility of ecological inference fallacy. Now Reniers and Watkins demonstrate in an ecological study of HIV prevalence in 34 sub-Saharan Africa countries that concurrency in the traditional form of polygyny can even be negatively correlated with HIV prevalence [12]. The authors used data from Demographic and Health Surveys (DHS) and HIV/AIDS Indicator Surveys from 19 African countries to investigate the prevalence of polygyny and HIV on country and subnational level. They show that those countries with higher levels of polygynous unions have a lower prevalence of HIV. This is true when using both male based as well as female based data.

Reniers and Watkins discuss various reasons why their results seemingly contradict the concurrency hypothesis. Obviously, concurrency measured in terms of number of wives of married men is only one form of concurrency and other forms could be present simultaneously in those societies with a high HIV prevalence. Furthermore, polygyny produces a very specific type of network pattern, namely many unconnected ‘stars’

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(polygynous men connected to several monogamous women), which limits the size of connected network components to the size of these 'stars'. HIV infected women, who are in a polygynous marriage system do not directly transmit further than their husband, if at all. Finally, the authors put forward the hypothesis of the "coital dilution effect" meaning that a man with many wives may have less frequent sexual intercourse with an infected spouse the more wives he has, thereby reducing the probability of getting infected by his infected wife.

Although this study is ecological and more research is needed to elucidate any causal association between polygynous unions and the transmission of HIV, the study marks a turning point in the thinking about concurrency and HIV in sub-Saharan Africa. Firstly, it clearly shows the need to view concurrent partnerships in their social and cultural context. It matters what the motivation is for establishing concurrent partnerships, how they are distributed among men and women, and in how far they are anchored in the culture of a society. The persistence of polygyny is linked to more traditional societies with other mechanisms in place that limit the transmission of HIV. For example, in societies with polygyny, more social control tends to prevent sex before marriage and early female age at first marriage is common. Polygyny also tends to be associated with longer durations of postpartum sexual abstinence between spouses and thus might protect young women from getting infected [13, 14]. For concurrent partnerships in Western societies Gorbach et al. [15] have shown that the definition of what constitutes a concurrent partnership can be further discriminated, leading to many forms of concurrency with more or less overlapping partnerships. Depending on their type, these partnerships are likely to contribute more or less to the onward transmission of HIV. A similar differentiation of types of concurrent partnerships that takes into account the motivation for their formation is needed for the sub-Saharan Africa situation.

Secondly, the results of Reniers and Watkins highlight the fact that we should not interpret concurrency as an uncorrelated characteristic of a sexual network. Concurrency, as investigated in Morris & Kretzschmar [3] is a simple caricature of a complex network structure, namely the average level of concurrent partnerships in a population with a given number of partnerships. Concurrency defined in this way is shown to increase the rate of epidemic growth of HIV. However, if besides concurrency, other local or global network characteristics change when concurrency levels are reduced the effects of concurrency reduction might be modified [16]. It is known that the variance of number of partnerships within a population affects the basic reproduction number in models with only instantaneous partnerships that are stratified by sexual activity [17]. Factors, such as the variance in the number of partners or the assortativeness of partner selection with respect to number of partners therefore affect HIV transmission dynamics, and, if altered, effects on prevalence cannot be attributed solely to changing levels of concurrency. As yet it is far from well understood what the appropriate measures are to quantify non-local network structure in order to best capture HIV transmission.

Also the question of the appropriate time scale on which to measure network structure needs further thought. Even in the most sophisticated empirical network studies to date such as the Likoma network study [18] it was not possible to distinguish unequivocally between concurrent partnerships and multiple monogamous partnerships accumulated over a certain time period. In view of these difficulties, we conclude that to date the proportion of HIV transmission that is due to concurrency in contemporary sub-Saharan Africa is unknown.

What further research is necessary? Clearly there is a need to standardize definitions of concurrency and collect more data. Commendable efforts are already underway by UNAIDS and partners [19], but complementary studies measuring different aspects of the dynamics of concurrency and its association with STI/HIV risk are urgently needed. The continued use of

robustly parameterized and validated mathematical models will be required to help interpret these data, and to help elucidate what effects can be attributed to concurrency and which to other, closely correlated risk factors, and therefore what the likely intended and unintended consequences of interventions targeting concurrency may be. This will not be straight forward and the findings are not likely to be unequivocal as suggested by the study in this issue of AIDS.

What does this all mean for prevention messages that are needed for curbing the further transmission of HIV now? Based on the straight forward interpretation of the ‘concurrency hypothesis’, messages such as “not more than one partner at a time” have been suggested [20]. However, such a message might not make sense in societies with polygynous marriage systems or otherwise culturally embedded forms of concurrency that are linked with other protective behaviours. Clearly, prevention messages must take the cultural context into account, possibly even on the regional level [21]. Further, until it is better known what the unintended consequences might be of behavior change messages that seek to reduce concurrency, perhaps messages should be limited to generating awareness that the risk of becoming infected with HIV does not only depend on one’s own behavior, but also on the behavior of one’s partners and beyond. It should also be clear that this “beyond” is not visible for most individuals; nobody really knows what network location he or she occupies. But the awareness that behavior of a collective impacts on individual risk is the message that we have to bring across together with some concrete ideas about how to limit one’s risk in the face of that collective behavior.

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