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Geographical targeting to improve progression through the sexually transmitted infection/HIV treatment continua in different populations

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Abstract

Purpose of review—The purpose of this study is to review and synthesize the recent literature on the use of geographical targeting to improve progression through HIV and sexually transmitted disease (STD) prevention and treatment continua in different populations.

Recent findings—Geographical targeting can help identify obstacles to progression through prevention and treatment continua for each stage and in specific geographic locations. Macro-level geographical targeting can help maximize allocative efficiency, while micro-level targeting of hot spots increases effectiveness of interventions. Migration into and out of geographical areas of interest constitutes a challenge to geographical targeting in that stage-specific monitoring strategies tend to yield inaccurate results when people leave the area. Despite these issues, it is possible to identify failures in each stage of the continuum by specific spatial location such as census tracts and focus improvement efforts accordingly.

Summary—Vulnerabilities, risk behaviours and infections all cluster across age, race-ethnicity, socioeconomic status, key populations, risk networks and geographic space. Spatial concentration may be the most important in this context, as it allows prevention programmes to identify and reach target populations more easily. Geographical targeting can be employed at both macro and micro levels and in combination with targeting of key populations and high-risk networks.

Keywords

allocative efficiency; HIV care continuum; risk networks; spatial targeting

INTRODUCTION

Optimum care for individuals and communities of people living with HIV and concurrent reduction in HIV transmission in populations involves identification of infected individuals, linkage to initial HIV care, long-term retention in care and treatment adherence, what is frequently referred to as the ‘continuum of care’ or ‘cascade of care’ [1]. The same

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Conflicts of interest

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framework is applicable to other sexually transmitted infections (STIs), particularly viral STI. The HIV treatment and care continuum as a concept evolved over time [2]. A similar model of 'person-time-of-infection', which focused not only on losses at each stage of the continuum but also incorporated time delays in each stage was introduced for STI treatment and prevention in 1999 [3,4]. Continuum models applied to other infectious diseases such as tuberculosis and malaria were published even earlier. Recently, the HIV care continuum is being used to measure longitudinal improvements and identify bottlenecks in HIV prevention [5,6]. Work to improve the HIV treatment and care continuum as a framework is accumulating [7,8■■,9–11]. One recent article incorporated the time dimension into the model, focusing on delays in each stage much like the STI, 'person-time-of-infection' model [12■].

Stage-specific measurement and monitoring strategies are needed in order to identify the most important obstacles and develop ways to overcome them [13]. Understanding how the continuum may vary across populations can help identify where interventions to overcome barriers may be most effective.

ROLE OF KEY POPULATIONS

Risk of acquiring and transmitting STI including HIV is unevenly distributed. Key populations such as MSM; female sex workers (FSWs); male sex workers (MSWs); male-to-female transgender women (transwomen); IDUs and adolescents and young adults with those risk behaviours mentioned previously are at a higher risk of acquiring and transmitting STI, including HIV, than other individuals in other age groups in the general population. Moreover, the societal context these key populations are embedded in tends to be different than that of the general population. Hence, parameters such as the accessibility, acceptability, effectiveness and efficiency of health services tend to differ across these population groups. Consequently, it is important to focus on these key populations and explore similarities and differences in STI/HIV treatment and care continua as they apply to different key populations. A number of investigators have studied the HIV treatment and care continuum in these key populations over the past couple of years.

In HIV epidemics wherein FSWs are key drivers of HIV transmission, the extent to which FSWs engage in the HIV care continuum could have a considerable impact on HIV transmission from FSWs to the wider population [14]. It is important to identify the impact that improving different stages of the FSW HIV care continuum could have on epidemic control. At this point in time, available routine programme data on HIV treatment among FSWs across settings may be inadequate [15■]. Data collected in the context of research studies may not be generalizable. Among transwomen in San Francisco, a high prevalence of HIV, coupled with modest antiretroviral therapy (ART) use and low virological suppression rates were observed, suggesting considerable room for improvement of the HIV treatment continuum in this key population [16].

In the USA, studies of the HIV treatment and care continuum among adolescents and young adults suggest that most interventions to address continuum drop offs have been developed for adults and may not be particularly generalizable to youth struggling with identity

formation, economic hardships and unstable housing [17]. This finding suggests that youth-focused interventions may be necessary to improve the HIV care continuum for adolescents and young adults. The need for the development of an interwoven prevention and treatment continuum approach for adolescents and young adults has been highlighted recently [18]. Such a prevention/treatment continuum would have HIV counselling and testing as its starting point; subsequent interventions for both HIV-negative and HIV-positive youth would be adolescent-centred, take advantage of technologies adolescents utilize in their daily lives and occur within the socioecological context of young people [18]. Young key populations such as young MSM require particular attention in this context.

CLUSTERING OF INFECTIONS AND RISK BEHAVIOURS: IMPLICATIONS FOR TARGETING

Risk behaviours for STI, including HIV, and STI/HIV themselves are unevenly distributed in populations, beyond the existence of key populations. Behaviours and infections tend to cluster by age, socioeconomic status, race-ethnicity, sexual preference, region and census tract [19–21]. Given the concentration of vulnerability, behavioural risk and infections in particular subpopulations, in the context of limited and declining resources allocated for HIV/STI prevention, it is important to target prevention efforts to individuals most likely to transmit infection to others [22].

Although risk behaviours, vulnerability and infections are clustered across parameters such as age, socioeconomic status, race–ethnicity and sexual preference, their geographic or spatial concentration may be the most important, as it provides a practical approach for targeting subpopulations most affected by HIV and other STI. Moreover, spatial approaches may facilitate an additional focus on gaps in the availability and accessibility of healthcare and prevention services. Prevention efforts may target areas wherein vulnerability, risk behaviours and infection concentrate and prevention and healthcare services are unavailable [23].

Recent work consistently supports the programme efficiency of spatially targeted prevention strategies in order to maximize the impact of prevention programmes on HIV/STI epidemics [24■■]. It has been known for many years that in sub-Saharan Africa, HIV infections cluster significantly in space, even within relatively small geographic communities [25]. A recent analysis illustrated extensive local variation in HIV disease burden in sub-Saharan Africa with 15% of the population being located in areas of intense HIV epidemics. There are stark spatial disparities in the epidemic within countries and local areas where both the burden and drivers of the HIV epidemic are concentrated [24■■]. Other work suggests that the epidemic impact and programme efficiency of an intervention such as voluntary medical male circumcision (VMMC) can be improved by prioritizing a subset of the male population for demand creation and service availability [26]. According to this model, maximum programme efficiency can be attained by targeting young sexually active men; geographic areas with higher HIV prevalence than the national average and groups whose sexual behaviour puts them at a higher risk for acquiring HIV [26].

Spatial targeting can be implemented within smaller geographic areas. In high-incidence populations such as MSM targeting clusters of venues wherein MSM meet sex partners (sex partner meeting places or SPMPs), particularly high viral load venues, may be important for HIV/STI prevention [27■■]. It may be possible to employ spatial targeting at both the macro- and micro levels focusing prevention efforts in geographic areas where infections and risk behaviours cluster, and within those areas targeting venues where the highest-risk individuals such as sex workers, MSM or individuals with high viral loads meet sex partners.

One software package for modelling HIV epidemics and interventions has been applied to epidemics in a variety of economic settings with different epidemic types and disease burdens [28]. These applications suggest that in concentrated epidemics, targeting key populations lead to major efficiency gains, while in generalized epidemics, geographical targeting may be associated with opportunities for efficiency improvement.

The differentiation between targeting key populations and spatial targeting is complicated. The most practical approach to targeting key populations may often be geographic targeting, and conversely, geographic targeting may be a reflection of focusing on spaces wherein key populations concentrate. The differentiation between concentrated and generalized epidemics with respect to their implications for most effective targeting approaches may need to be explored further in future work. Some of the most interesting recent findings regarding spatial patterning of infections highlight the importance of concentrated sub-epidemics in generalized epidemic settings and the spatial concentration of key populations, as discussed below.

Recent studies of high-risk populations defined on the basis of geography show very high levels of both new and existing infections in the slums of Kenya; peri-urban communities of South Africa; and fishing villages in Uganda [29]. These findings were supported by phylogenetic analyses. The difficulty in targeting high-risk individuals is their identification. Moreover, membership in risk groups or key populations is highly dynamic; turnover in these groups is rather high with individuals moving in and out of them frequently. High-risk tends to be a ‘stage’ in individuals’ lifetimes rather than a ‘state’. Consequently, one of the most stable aspects of high-risk groups may be their spatial location or geography. It is interesting to note that most pro-grammatic work with key populations involves mapping, in-space as its first step [30]. The ‘core group’ concept is central to the predominant theoretical framework of transmission dynamics of STI, and it has evolved from studies showing geographic concentration of infections [30]. Moreover, the pattern of geographic concentration of high-risk groups (key populations; high-risk networks) is observed in both concentrated and generalized epidemics [29].

Geographic targeting has been explored for prevention studies as well [31]. A comparison of two rollout plans for antiretroviral-based microbicides in South Africa; a utilitarian plan that minimizes incidence by geographic targeting, and an egalitarian plan that maximizes geographic equity in access to interventions found that the utilitarian plan could prevent approximately 40% more infections than the egalitarian plan; and that geographic resource allocation decisions made at the beginning of a rollout, and the location where the rollout is initiated would be crucial to the success of the intervention.

SPATIAL CLUSTERING OF KEY POPULATIONS

Although in much discourse targeting of key populations and spatial targeting are posed as alternative approaches, evidence suggests that key populations are themselves spatially clustered [32–34]. Spatial analyses of factors associated with HIV infection among young people; geographic clustering of high-risk behaviours in hot spots for sexually transmitted infections; and appraisals of female sex workers, all highlight clustering of behaviours and key populations in geographic space. Moreover, HIV knowledge itself, which may be critical for HIV prevention and treatment, may also be spatially clustered [35].

PREVENTION AND TREATMENT CONTINUA AND GEOGRAPHICAL TARGETING

The continuum framework is now being applied to improve prevention and treatment of HIV and other STI within specific geographic locations. In light of the great spatial heterogeneity in prevention and care continua, application of stage-specific monitoring strategies within defined geographic areas, followed by efforts to improve each stage may have significant impact on HIV and STI prevention. Moreover, attention can be focused on spatial differences in the continuum within geographic areas. The Minnesota Department of Health has calculated an HIV treatment continuum using HIV surveillance data to better understand the HIV epidemic and the disparities that exist in the delivery of care among HIV-positive people in Minnesota [36■■]. The HIV treatment continuum differs for people who live in the 11 county metropolitan areas compared with those who live in Greater Minnesota. Although there were no differences in viral suppression by geography, this analysis will facilitate geographic targeting of stage-specific improvement efforts in HIV prevention and monitoring of changes in the trends over time. Similar approaches targeting resources and prevention may be fruitful in other geographic areas.

Spatial patterns were identified as a strong independent predictor of linkage to care, retention in care and viral suppression [37■■]. Data from a retrospective cohort of people newly diagnosed with HIV, identified from Philadelphia's Enhanced HIV/AIDS Reporting System, were analysed to identify geographic areas with poor outcomes [37■■]. Outcomes of interest included 'not linked to care', 'not linked to care within 90 days' (thereby incorporating the time dimension and the concept of delays), 'retained in care' and 'not virally suppressed'.

This approach to geographic targeting with high granularity, within administrative spatial units, may be effective in improving HIV and STI prevention and treatment continua. The analysis also exemplifies the relevance of the Program Science approach with its 'embedded scientists' studying routinely collected programme data towards improving programme outcomes [38].

LAYERED TARGETING: KEY POPULATIONS, NETWORKS AND GEOGRAPHY

Limited and declining resources allocated for STI prevention including HIV necessitate that prevention efforts be targeted to those most likely to transmit infection [22]. The well established observation that vulnerability, risk behaviours and infections are all clustered in populations facilitates targeting efforts. Moreover, availability, affordability and accessibility of services are also clustered and need to be considered in juxtaposition to the concentration of risk [23]. Targeting may be achieved through a focus on key populations, networks or geography; however, simultaneous application of all three lenses may yield the best results.

Current work in the field includes examples of targeting through multiple lenses. Effectiveness of outreach to key populations such as MSM and FSW for testing and linkage to care can be maximized through the use of social networks in ‘hot spots’ wherein these populations congregate [39]. Similarly, use of social networking sex seeking apps can facilitate creation of geospatial density maps of MSM [40].

Spatial targeting may be utilized at both the macro and micro levels sequentially. Efforts may be concentrated in areas of high HIV and STI incidence or prevalence and in those areas venues (‘hot-spots’) where key populations and their high-risk networks congregate may be targeted.

One challenge for geographic targeting is population movement in space. As out-migration removes individuals already reached for prevention and care from the area, in-migration brings new individuals into the area. Turnover in the population of interest renders monitoring the stages of the continuum difficult and the results may be inaccurate [41■■]. Interestingly, migration plays a critical role in the spatial clustering of high-risk networks and key populations, the creation of hot spots and the dissemination of infection [42]. Development of systematic approaches for prevention programmes to reach migrant populations may increase the impact of geographic targeting on limiting the spread of STI, including HIV.

CONCLUSION

Geographical targeting may maximize the effect of the HIV and STI prevention and care continua in improving prevention. Macro-level geographical targeting may maximize allocative efficiency, while micro-level geographical targeting may improve effectiveness of interventions. Geographical targeting automatically ensures that key populations and risk networks are targeted to the extent that they are reflected in space. However, key population and risk network targeting can be employed simultaneously with geographical targeting to maximize impact.

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KEY POINTS

- Geographical targeting may maximize effectiveness of the STI/HIV prevention and care continuum.
- Key population and risk network targeting can be employed simultaneously with geographical targeting to maximize impact.
- Spatial targeting may be utilized at both the macro and micro levels sequentially.
- Macro-level spatial targeting may maximize allocative efficiency, while micro-level spatial targeting may improve intervention effectiveness.