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HIV and chemoprophylaxis, the importance of considering social structures alongside biomedical and behavioral intervention

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Abstract

This manuscript draws connections between chemoprophylaxis and the biomedical model of disease that emphasizes individual behavior. We argue that chemoprophylactic HIV interventions have limited utility at the population-level, and that structural interventions need to be prioritized. We use the recent CAPRISA 004 and iPrEx trials to (a) critique the utility of these trials from a public health perspective by highlighting the difference between efficacy and effectiveness, (b) apply an alternative theory of health behavior as a way to reorient the field toward the discussion of the need to employ structural interventions, and (c) examine two aspects of HIV prevention efforts – funding structures and iatrogenic effects of biomedical approaches – as a means of overcoming obstacles to more widespread adoption of structural interventions.

Keywords

HIV; Structural; Prophylaxis; Microbicide; Randomized control trial

Introduction

Articles regarding the CAPRISA 004 Trial and the iPrEx Trial, reporting the effectiveness and safety of a tenofovir based antiviral microbicide gel (the gel) and oral emtricitabine and tenofovir combination therapy (FTC-TDF), respectively, were published to much acclaim (Abdool Karim et al., 2010; Grant et al., 2010). CAP-RISA 004 found a 39% reduction in the incidence of HIV infection among women using the gel, and iPrEx found a 44% reduction in HIV incidence among men who have sex with men (MSM) using FTC-TDF. Both were double-blind, randomized, placebo controlled trials (RCT). These results were quite remarkable – none of the previous 11 microbicide trials had been able to demonstrate any effectiveness in preventing new HIV infection, and iPrEx was the first trial to provide evidence that oral pre-exposure prophylaxis can also reduce rates of HIV infection. Among many accolades, CAPRISA 004 results were featured in the keynote address at the International AIDS Conference, iPrEx was judged the top medical breakthrough of 2010 by

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TIME Magazine, and both were reported on the front page of the New York Times (Dugger, 2010; McNeil Jr., 2010; Park, 2010). While indeed path breaking work, we argue that these trials, heralded as watershed moments in the fight against HIV, are emblematic of the conflation of biomedicine and public health. We are over reliant on and place too much faith in the biomedical model of disease and the ability of biomedical technology to solve public health problems. Real progress in the fight against HIV requires reorganizing our thinking toward a more comprehensive approach that leverages both biological *and* social interventions as appropriate. We make our case by outlining three primary arguments.

First, we discuss the difference between efficacy and effectiveness by discussing aspects of the trials that limit the real world utility of the gel and FTC-TDF. We do this not because either were poorly conducted or bad science, but precisely because they are fitting examples of the problematic disconnect between a well conducted and analyzed RCT and real world public health application. Using specific details of the trials to anchor a general critique of biomedical and behavioral HIV interventions, we argue that common reasons underpin the failure of many individual-focused HIV interventions, indicative of an overreliance on the biomedical approach to prevention. Second, we apply an alternative theory of health behavior as a way to reorient the field toward the discussion of the need to employ structural interventions that prevent new HIV infections. However, we have long known HIV/AIDS is a socially patterned disease (Farmer, 1992; Shilts, 1987) and also recognize that structural interventions have previously been advocated (e.g., *AIDS* 2000:14(Suppl 1) is a special issue devoted to the topic). As such, our third argument presents a case for the importance of renewing efforts to facilitate these interventions. We discuss how our very funding structures reflect biomedical thinking while creating barriers to sustainable structural solutions and also discuss the iatrogenic effects of the biomedical approach to HIV interventions. This final argument is motivated by intransigence against implementing structural interventions. Given the announcement by the FDA to fast track approval of the gel (CONRAD, 2010), talk of a label change for Truvada (FTC-TDF's brand name; Gilead Sciences, Foster City, CA) (Cohen, 2010), and continued investment in chemoprophylaxis trials (Cohen, 2010) a discussion of the feasibility and merits of high-risk versus structural interventions (defined below) is both warranted and timely.

Biomedical and public health approaches to disease

Before we pursue our three arguments, however, we first provide a brief overview of biomedical and public health approaches as a historical lens through which to ground our critique, and define several terms we use throughout the discussion. In this paper we draw a distinction between biomedical and public health approaches to disease. The biomedical approach has its roots in allopathic (western) medicine and is concerned with the individual – what caused this instance of disease, what can treat this individual, and what could have prevented this case from occurring? Clarke, Shim, Mamo, Fosket, and Fishman (2003) provide a useful overview of the history of biomedicalization. Medicalization, which began in the late 19th and continued through the 20th century, refers to the process in which allopathic medicine was embedded into various social realms. Bio-medicalization is a more recent phenomenon and refers specifically to the reconstitution and extension of medicalization through emergent forms of technoscience (a term referring to the inextricable

nature of scientific research from its practical application). Central to our arguments here, biomedicalization entails a focus on the individual as the primary unit of analysis as well as an increasing reliance on and expectation that technology will solve an expanding array of conditions defined as medical problems.

A public health approach to disease, however, is oriented toward populations and aggregates of individual health states – what causes rates of disease and how do we prevent disease from occurring in populations? Public health originated as a critique of the relationship between political economic systems and the health of populations (Waitzkin, 2007). However, biomedical thinking has permeated public health, as embodied by the Black Box era of epidemiology in which focus is given to individual risk factors and individual outcomes within populations (Susser & Susser, 1996a). One example of this influence is the emergence of individual autonomy as a goal of public health (Munthe, 2008). Here autonomy refers to providing opportunities for individuals to improve their own health either through information or technology while respecting an individual's choice of whether or not to take advantage of said opportunity. In response to the Black Box era of epidemiology, equality has also emerged as a goal of public health (Munthe, 2008). This concern for how health is distributed among population subgroups can be seen in attempts to reinscribe public health with more sociologically oriented theories of disease causation (Diez-Roux, 1998; Krieger, 1994; McMichael, 1999; Pearce, 1996; Susser & Susser, 1996b). So while we have seen an explosion of research into the social determinants of health (Kaplan, 2004) the extent to which public health is indeed focused on population health is debated and far from complete (Bourgois, 2002).

Drawing upon various literatures we employ several related but distinct terms in this manuscript. We use agency when referring to an individual's freewill and decision making capacity. We refer to structures, on the other hand, to describe patterned social relationships (e.g., group affiliation), resources (e.g., capital accumulation), and institutions (e.g., government). Accordingly, we use the term structural intervention to refer to efforts that target the aforementioned entities in order to influence health, usually by means of facilitating health-promoting behavior or hindering health-harming behavior. Individual interventions, on the other hand, target agency; these interventions ask the individual to alter behavior without modifying structures that may promote or constrain behavior. We highlight two forms of individual interventions in the context of HIV: 1) interventions that target behavior and 2) interventions that target biological pathways of HIV infection. Structural interventions are more difficult to categorize, but have included targets ranging from income distribution to gender norms (e.g., Pronyk et al., 2006). We situate these intervention strategies within the framework offered by Geoffrey Rose (1985). He distinguishes between individual-level interventions aimed at high-risk groups that offer advice or medication to prevent individual instances of disease, and population-level interventions aimed at structures that serve as determinants of the distribution of disease to lower the mean level of disease within populations.

Efficacy versus effectiveness – limitations of chemoprophylaxis and individual intervention

Following others we define the efficacy of an intervention as the reduction in risk associated with full and complete implementation of an intervention, and the effectiveness of an intervention as the reduction in risk as implemented (Institute of Medicine, 2008; Steckler & McLeroy, 2008; Stein, 1990). Efficacy then is an intrinsic property of the particular intervention (e.g., yearly rate of pregnancy among women who use condoms perfectly is 2%). But effectiveness depends on the context into which an intervention is introduced (e.g., not all women use condoms correctly or consistently; yearly rates of pregnancy among women who exhibit “typical” condom use is 15%) (Trussell, 2007). Conceptually the upper limit of an intervention’s effectiveness is its efficacy, and quite often there is a considerable gap between the two. We argue there are two reasons underlying this gap. The most often acknowledged and debated reason concerns the conditions of the trials in which intervention efficacy is established. However, the second (underappreciated) reason concerns the nature of the interventions themselves.

Both trial protocols include interventions that address behavioral and biologic risk factors. These interventions have the potential to make the adherence estimates, and hence the reported efficacy of the gel and FTC-TDF, rest within their upper limits. To illustrate, both studies included frequent HIV counseling and testing during enrollment. In CAPRISA 004, a “comprehensive adherence support program assisted participants with the mechanics of applicator use, timing and dosing, avoidance of gel sharing and incorporation of gel use into their daily routines” (Abdool Karim et al., 2010; pg 1169). iPrEx diagnosed and treated symptomatic and asymptomatic sexually transmitted infections (STIs) in study subjects and their partners (Grant et al., 2010). Additionally, behavioral interventions (e.g., individualized motivational interviewing (MI), risk-reduction counseling) were used in both studies to assist participants in overcoming obstacles to gel/pill use.

As a matter of equipoise it was appropriate to include these behavioral components. As STIs increase the probability of HIV transmission (Fleming & Wasserheit, 1999), treating STIs may decrease HIV incidence in the social network of study participants (Though there is conflicting evidence regarding the effect of STI control interventions on HIV infection (Ng, Butler, Horvath, & Rutherford, 2011), ethical concerns would dictate their treatment regardless). The results (Table 2 (Abdool Karim et al., 2010), and Fig. 4 and Table S8 (Grant et al., 2010)) also show that the efficacy of the gel and FTC-TDF is a function of adherence. A review of MI interventions revealed MI can increase condom use and reduce risky sexual behaviors (Dunn, Deroo, & Rivara, 2001). And though evidence is not yet definitive, several studies suggest that MI might have both a direct and indirect effect on HIV medication adherence (Golin et al., 2006; Parsons, Rosof, Punzalan, & Di Maria, 2005). Furthermore, though RCTs are adept at building confidence in causal relationships, they often lack an ability to generalize these relationships to other populations because of self-selection into the RCTs. People that agree to participate in an RCT of HIV chemoprophylaxis may be less likely to engage in sexual risk behaviors and more likely to adhere to a prescribed regimen than individuals that do not agree to participate (e.g., Shoptaw et al., 2008). Though it is

difficult to quantify this bias it seems improbable that individuals most likely to engage in high-risk behavior are adequately represented in either (or any) study.

By virtue of their research design, these studies can isolate the unique effect of the gel/FTC-TDF but they cannot isolate the effect of the interaction between the gel/FTC-TDF and the previously mentioned components that presumably would not accompany real world dissemination. (Ultimately this is a technical issue inherent in social science research surrounding the ability of a study to claim causal inference and the construct validity of a manipulated intervention.) Most troubling, however, is the preoccupation with "imperfect" behavior as the reason underlying the failure of biomedical intervention, a view that trivializes and ignores the nature of the failure itself – if only people were compliant our "perfect" intervention would have worked. Ironically, it is this very perspective which continues to privilege incomplete biomedical solutions. Some advocate for scaling up of combined behavioral and biomedical interventions as a means to maximize prevention efforts (e.g., Buchbinder & Liu, 2011; Padian, Buvé, Balkus, Serwadda, & Cates, 2008; Piot, Bartos, Larson, Zewdie, & Mane, 2008). However, continuing to neglect fundamental questions of human behavior will produce disappointing results in both the short and long term.

Figure 2 of each manuscript show Kaplan–Meier estimates of time to HIV infection for both the intervention and placebo arms (Abdool Karim et al., 2010; Grant et al., 2010). In CAPRISA 004 the difference in HIV incidence between the microbicide arm and placebo arm was quickly apparent with a 50% lower incidence of HIV among the women using the gel 12 months into the trial. However, over the course of the study the benefit associated with the microbicide waned and by 30 months there was only a 39% difference in incidence between the two arms. While estimates over time are not presented for iPrEx, the figure does show a trend where the large gap between FTC-TDF and placebo in weeks 84–108 converges in weeks 120–132. Without additional data we can do little more than speculate as to what is responsible for these trends. However, a similar waning of intervention effects over time have been noted in large, controlled, HIV behavior change prevention trials (Coates, Richter, & Caceres, 2008). The reduction of effects over time across these studies leads us to be wary of how any meaningful population-level effect could be sustained. Though our ability to maintain intervention-facilitated behavior change has advanced greatly, these effects do diminish over time (Ory, Lee Smith, Mier, & Wernicke, 2010). Researchers who study behavior change also cite the importance of changing environments in order to maintain these effects (e.g., Toobert, Strycker, Glasgow, Barrera, & Angell, 2005).

Though often considered different classes of interventions, both behavioral and biomedical interventions are products of biomedical thinking as they rely on the individual to be successful. With the exception of certain strategies (e.g., vaccination and circumcision), the majority of these strategies require continual adherence. And though the gel and FTC-TDF might arguably be seen as refinements on condoms in that they circumvent aspects of behavior that impede proper use – the gel is female controlled and PrEP can provide a biological barrier in the absence of condoms – they are both still individual health behaviors in their own right. We contend that there are limits to what individually focused

interventions, including chemoprophylaxis and behavioral modification, can achieve precisely because of the difficulty of implanting individually based interventions. The history of HIV interventions, however, has overwhelmingly focused on the biomedical and behavioral (Coates et al., 2008; Merson, O'Malley, Serwadda, & Apisuk, 2008; Padian et al., 2008). There is, even if only implicit, a disconnect between individually focused interventions and the complexity of human behavior – even at the beginning of the epidemic, before scientists identified the virus that causes AIDS, we knew condoms could prevent new infections. Still, in that period of heightened fear and death among the MSM community in the United States, not everyone used condoms (Shilts, 1987). Rather than focus on refining biomedical interventions that are less efficacious than condoms, and potentially less effective, we should endeavor to understand the reasons underlying the gap between efficacy and effectiveness for both pragmatic public health and ethical reasons.

Having argued that the gap between the efficacy and effectiveness of an intervention is driven by not just the conditions of the trials but by the nature of the interventions themselves it becomes necessary to explore this disconnect in order to elucidate avenues for intervention. In the following section we utilize an alternative theory of health behavior through which to promote the importance of structural interventions.

An alternative theory of health behavior – implications for intervention strategies

An orientation primarily concerned with the autonomy of individuals might naturally focus on efficacy over effectiveness, as it lacks sufficient concern about aggregate levels of health. Arguably this orientation would also guide research efforts toward individual solutions to ameliorate individual risk factors. Because biomedical interventions are so well poised to address these individual risk factors, it may be largely why they are privileged in our research questions. This disconnect can be seen in the case of the gel. Twenty years ago an influential commentary called for the creation of a microbicide gel in order to empower women to protect themselves rather than rely on condom negotiations with their male partners (Stein, 1990). The logic being, though condoms are nearly 99% efficacious per use they cannot always be used since females negotiating condom use inverts the logic of male domination. Therefore, though less efficacious, a method that relies on a woman for implementation can be used more often and thus has the potential to prevent more transmissions at the population-level. This is the basis for infectious disease control – intervening on the components that make up the reproductive rate (R_0), here the risk of transmission per contact, ultimately decreases the population-level incidence (Zenilman, 2007). However, the article never questioned the logic of male domination or if the same paradigm might inhibit use of a gel. Male domination was taken for granted and by extension assumed to be immutable. This privileges biomedical intervention as *the* solution rather than interrogating the sociologic reasons underpinning the need to empower women and situating biomedical interventions as *part* of the solution.

This is not meant to demean the author of the commentary, discourage calls for innovation, or ignore interventions that have resulted in the empowerment of women in the last two

decades. Rather, we invoke this example because other interventions do not receive the same level of funding, attention or acclaim that chemoprophylaxis has. Furthermore this is a concrete example of the ways in which biomedical thinking myopically creates solutions to health problems. We find Cockerham's (2005) "health lifestyle theory" a particularly useful alternative theory of health behavior to think about these issues. Drawing on Weber and Bourdieu (among others) Cockerham constructs a paradigm to explain why individuals engage in various health behaviors. Structures (e.g., class, gender, race) probabilistically shape life chances (e.g., what schools you go to) but also influence one's socialization experiences (e.g., culture), which influence the choices one makes. The interplay of life chances and life choices create one's dispositions to engage in behavior. Critical to our arguments, this model demonstrates why it's difficult to change individual behavior with education or technology – one's disposition to act is deeply rooted in life history. Behaviors hold salience to individuals, particularly behaviors as intimate as sex or drug use. The theory also highlights the power that structures exert at various times and levels on the creation and maintenance of health behaviors. Therefore, while we recognize that health behavior is ultimately determined by individual choice (i.e., agency), those choices are a function of very real structural constraints. Structures that rest outside of individual control make it easier or harder to engage in particular health behaviors. It is easier to recognize the constraints certain structures produce (e.g., user fees on antiretroviral (ARV) medication adherence) and somewhat more difficult to enumerate others (e.g., norms and desires surrounding unprotected sex). Health lifestyle theory acknowledges the importance of behavior as a determinant of health, but likewise acknowledges that individual behavior is rarely wholly determined by individuals. This logic should serve to renew an impetus toward creating and disseminating structural interventions. In addition to modifying those structures that influence health outcomes, we also argue that structural intervention promotes the possibility for increased individual agency. Structural change is not at odds with individual autonomy, but it may facilitate it.

Of course, structural interventions are hardly the magic bullet to public health problems, but they represent an important step forward. What is particularly attractive about structural interventions is that they can directly influence the likelihood of engaging in behavior by making it harder or easier. The promise of structural intervention on population health rests among those individuals who want to engage in healthy behaviors but who live in a context where their choices are constrained (e.g., I want to exercise but there's nowhere to run), and also among individuals whose behaviors is largely dictated by convenience (e.g., it is easier to bike to work than to drive and find parking). We also recognize that people engage in health-damaging behaviors all the time despite numerous structures in place to prevent their use. Tobacco use is a notable example where individuals have to actively overcome a variety of barriers to smoke. We would not argue that there is one structure that needs to be targeted to unleash healthy human behavior, rather research will need to unearth the complex of structures producing health behaviors (e.g., Bourgois & Schonberg, 2008). Furthermore, because structural interventions will almost always succumb to strong individual agency to do otherwise, achieving the greatest population effect rests in accommodating strategies that target individual behaviors as well. For this reason it is not uncommon for authors to call for layered approaches to HIV prevention strategies that include both behavioral and structural

interventions (e.g., Coates et al., 2008; Piot et al., 2008; Rotheram Borus, Swendeman, & Chovnick, 2009).

The lack of clarity surrounding structural interventions is also of consequence. Even when articles articulate how structural conditions influence HIV risk, or summarize the state of structural interventions, too often are scaled-up individual-level campaigns conflated with structural interventions (Parker, Easton, & Klein, 2000; Poundstone, Strathdee, & Celentano, 2004). Scaling up individually based interventions still fundamentally relies on changing individual actions to mitigate risk without altering the context in which decisions are made and therefore does not represent a structural intervention (McLaren, McIntyre, & Kirkpatrick, 2010). We acknowledge that one component of this problem rests with inconsistent characterizations of what constitutes structural intervention. Earlier in the paper we defined structural interventions as those efforts that target one of those entities we described, but understandably others have generated lists different from our own. While we cannot resolve this issue of definitions, we are less interested in deciding precisely where the line is drawn and more in putting forward a vital point: a behavioral intervention does not de facto become a structural intervention by virtue of being implemented on a large scale. And though several excellent extant typologies of structural interventions exist (Blankenship, Bray, & Merson, 2000; Blankenship, Friedman, Dworkin, & Mantell, 2006; Des Jarlais, 2000; Gupta, Parkhurst, Ogden, Aggleton, & Mahal, 2008; Sumartojo, 2000) inaction persists, which seems to indicate insufficient will rather than insufficient knowledge.

Many have studied the structural drivers of HIV infection among heterosexuals in South Africa and MSM in the United States. Though a comprehensive review of structural constraints that influence HIV transmission is beyond the scope of this manuscript, the following examples are indicative of behavioral constraints created by social structures, placing populations at risk of HIV infection. In South Africa high levels of HIV knowledge among high-risk populations fail to prevent infection because costs, wait times and stigmatizing behavior by service providers result in reluctance to access health services (Parry, Petersen, Carney, Dewing, & Needle, 2008). Reduced spending on public sector health care across the globe and imposed user fees as part of cost recovery plans led to dramatic decreases in preventive and primary care services, including STI treatment and distribution of ARVs, all of which have dramatic consequences for HIV transmission (Kalipeni, Craddock, Oppong, & Ghosh, 2004; Stein, 2008). Within the United States MSM face prejudice, discrimination, and stigma associated with same-sex behavior, the stress from which has been demonstrated to adversely influence mental health (Hatzenbuehler, McLaughlin, Keyes, & Hasin, 2010; Meyer, 1995) and sexual health behaviors (Diaz, Ayala, & Bein, 2004). Young MSM who experience rejection from family because of their sexual orientation are less likely to consistently use condoms during sex, more likely to abuse drugs (Ryan, Huebner, Diaz, & Sanchez, 2009), and may resort to commercial sex work to support themselves (i.e., “survi val sex “) (Gangamma, Slesnick, Toviessi, & Serovich, 2008).

Renewing efforts to facilitate structural interventions

One under-examined factor in our failure to sufficiently implement structural interventions lies in how we fund interventions in the United States. The National Institutes of Health

overwhelmingly focuses funding on biomedical approaches to the exclusion of structural (and even behavioral) research (Bertozzi, Laga, Bautista-Arredondo, & Coutinho, 2008; Kaplan, 1998). Approximately 95% of the trillion dollars the United States spends on health goes to direct medical services, with only 5% being allocated to population - approaches to prevention (McGinnis, Williams-Russo, & Knickman, 2002). Another aspect of funding lies in the organization of how monies are allocated. We overwhelmingly concentrate both intellectual and financial resources on individual outcomes rather than shared exposures or horizontal service integration (Rotheram-Borus et al., 2009). HIV is not the only health concern for South Africans or MSM. Identifying and influencing common causes of various health concerns would be a more efficient approach to public health in terms of allocating resources and promoting health.

Others have argued against criticisms (such as ours), which state that public health has an inappropriate pre-occupation with identifying mechanisms and solutions that exist at the individual-level (Rothman, Adami, & Trichopoulos, 1998). One of their arguments is that scientists should be able to pursue science for the sake of science and that a “downstream” focus has produced useful interventions. In general we agree with this sentiment, however in the case of HIV prevention there are iatrogenic effects of the individualistic research enterprise that weaken this particular critique.

As discussed above, there is a clear rationale behind the development of both the gel and FTC-TDF, though we highlight how a different theoretical orientation would alter the approach one might take to solving each issue. However, several externalities require consideration. Regarding FTC-TDF, we must be mindful that MSM at highest risk of HIV infection may also be least likely to adhere to a regular regimen. A study of HIV-positive MSM found that active substance use was negatively associated with ARV adherence (Malta, Strathdee, Magnanini, & Bastos, 2008). While we carefully interpret the gel’s effectiveness it does have the potential to fill an unmet need. Nevertheless, we caution that those women who are already most at risk of HIV infection by virtue of living in an environment which constrains their behavioral choices may be most vulnerable to misuse of the gel if they misunderstand how to use the microbicide, or believe that it is 100% efficacious. Worse yet is the possibility they are coerced into using it in lieu of condoms, or subversive use subjects them to retributive domestic violence. These specific situations have not been documented though others have documented the complex nexus of disadvantaged social status, drug use, gender based violence and sexual risk behaviors among South African women (e.g., Morojele, Brook, & Kachieng’a, 2006; Sawyer, Wechsberg, & Myers, 2006).

Another frequently cited concern regarding chemoprophylaxis is the potential for an increase in risky sexual behavior, or behavioral disinhibition (Eaton & Kalichman, 2007). We agree this possibility is troubling. Investigators should remain vigilant of this possibility though we highlight how an approach targeting structural constraints to engage in health behaviors may mitigate this concern.

The logic underpinning pre-exposure chemoprophylaxis as an HIV prevention tool, however, is less clear to us. One editorial went so far as to describe iPrEx as “proof of concept.”

(Michael, 2010) Considering only 36% of infected individuals in low and middle income countries are on ARV treatment (UNAIDS, 2010) it's hard to imagine covering entire populations with ARVs as a prevention tool. Given the known potential for antiviral resistance to develop (McGowan, 2010), the side effects of long term use of ARVs, the difficulty ensuring the effectiveness of condoms (which are far more efficacious), and that we have yet to even provide ARVs for all HIV-positive people, it's difficult not be skeptical of the underlying the exploration and continued funding of chemoprophylaxis (Cohen, 2010; Michael, 2010). If we are truly serious about using ARVs in any sort of preventive capacity, their greatest utility would be realized by ensuring that all individuals living with HIV receive appropriate medication. We can simultaneously promote the health of HIV-positive persons while reducing the likelihood for transmission through suppressing viral loads (Cohen et al., 2011; Donnell et al., 2010; Quinn et al., 2000). Given that this approach was lauded as the 2011 scientific breakthrough of the year by Science magazine (Cohen, 2011), we hope this is an area in which structural and biomedical intervention can work in concert to reduce new infections.

Biomedical interventions have a long history in the fight against HIV (Padian et al., 2008). That we have not had more success is frustrating, with some suggesting that we need to get drugs to phase 2B/3 trials sooner (McGowan, 2010). Unfortunately there is little reflection on how these clinical trials are conducted. For pragmatic reasons, researchers need to conduct all clinical trials in populations with high HIV incidence rates. Quite literally then we have been experimenting on vulnerable populations for 30 years. We acknowledge the existence of risk groups (by identifying populations that experience high HIV incidence) but ignore the reasons that underpin the high rates of disease the trials are designed to stop. This shifts responsibility for infection from the social conditions an individual is subject to, to the individual's behavior. The result, though unintentional, is to perpetuate methodological individualism reinforcing forms of symbolic violence that further stigmatize and subjugate already marginalized populations – symbolic violence, a concept developed by Bourdieu, refers to the imposition of categories of thought and perception by the dominant on the dominated. Analyzing the world through these categories, the dominated perceive the social order as just and attribute the source of individual failings to the individual. To illustrate, some have explicitly invoked the high-risk strategy in the case of FTC-TDF. MSM deemed to be at high-risk (as determined by a prediction model and clinical judgment) would be preferentially offered prescriptions (Myers & Mayer, 2011). This confessional approach to prescribing PrEP – whereby MSM are required to admit to engaging in "high-risk" behaviors to health professionals – serves to admonish while at the same time labels the individual and reinforces stigma, which serves to facilitate risk of infection in the first place (Bourgois, 1998). Moreover, there is little attention given to the omnipresence of HIV clinical trails in constructing hegemonic notions of MSM as promiscuous and plagued by HIV, or how this may contribute to senses of complacency (Rausch, Dieffenbach, Cheever, & Fenton, 2011) or fatalism (Grov & Parsons, 2006) among MSM populations. There are likely similar effects in African populations.

Reflections on biomedical and structural interventions in public health

Looking back twenty years provides an opportunity to ask ourselves some very important questions. We must remember that the potential virtue of the microbicide never rested solely in its efficacy, but rather was conceptualized to be a useful tool in the fight against HIV because of its potential for real world effectiveness; when did we lose sight of this? While an intervention with any efficacy is indicated in an acute outbreak, in South Africa the HIV prevalence among antenatal clinic attendees increased from less than 1% in 1990 to over 20% by 1998 (Department of Health, 2005) and in 2008 an estimated 17% of the adult population was living with HIV (UNAIDS, 2009). In the United States, young MSM represent the only group in which the number of new infections motives has increased since 2006; MSM accounted for 61% of all new infections in 2009 (Prejean et al., 2011). The sheer magnitude of the HIV epidemic and its perseverance dictates we consider alternatives.

Looking to the future, we should be cognizant that the funding priorities and acclaim awarded to biomedical research compared to population health approaches sets a precedent that requires scrutiny. The lack of population health approaches may largely be a result of the structures in place used to fund research, where resources are allocated by individual outcomes, rather than shared exposures. As a pragmatic science, it is public health's imperative to figure out the best ways to improve the health of the public rather than solely pursue what's being funded. The continued limited utility of individually based interventions requires a rethinking of our funding schemes as well as the incentive structure in academia (Katz, 2008; Levins, 2010), a reflexive monitoring of the favored lines of inquiry (Navarro, 2005) which requires advocacy by the public health enterprise for variety of the types of projects that get funded, and a personal commitment by researchers to interrogate their position of privilege and – to invoke Gutierrez – exercise the "preferential option for the poor" (Binford, 2004; Gutierrez, 1973).

Finally, we must realize that structural interventions are not inherently perfect. Behavioral interventions are not exclusively subject to the problems we've outlined. Structural interventions can also be implemented poorly, and as uncomfortable as the possibility may be, can also result in iatrogenic effects. For example, others have called for the decriminalization of HIV transmission as a way to improve public health by normalizing condom behavior, increasing testing rates and decreasing HIV-related stigma (Burris & Cameron, 2008).

Winning the fight against the HIV epidemic will require intervention in a variety of areas. We laud any advancement that may reduce new infections, though we highlight the need for innovations that are just as concerned with the social environment as a determinant of the HIV epidemic as we are those innovations that target the biological mechanism of HIV infection. Remaining mindful of social contexts also highlights the importance of future studies that will need to examine the real world effectiveness of chemoprophylaxis alongside efforts to increase its efficacy, and reminds us to consider iatrogenic effects of these (and all) research approaches. There is much extant work on the structural drivers of HIV infection and a key challenge moving forward will be to translate this knowledge base into practice. Population-level interventions will need to target these structures in order to influence the

epidemiology of the HIV epidemic. Additional work needs to also be done on understanding emerging and changing trends in structural drivers. CAPRISA 004 and iPrEx represent important steps forward, but while we celebrate these milestones in the biomedical we need to remain vigilant in our recognition that HIV is also a socially patterned disease. As such, we need to act accordingly and also invest intellectual and material resources in those interventions that alter social structures as well.

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References

Abdool Karim Q, Abdool Karim SS, Frohlich JA, Grobler AC, Baxter C, Mansoor LE, et al. Effectiveness and safety of tenofovir gel, an anti-retroviral microbicide, for the prevention of HIV infection in women. Science. 2010; 329(5996):1168–1174. [PubMed: 20643915]

Bertozzi SM, Laga M, Bautista-Arredondo S, Coutinho A. Making HIV prevention programmes work. The Lancet. 2008; 372(9641):831–844.

Binford, L. An alternative anthropology: exercising the preferential option for the poor. In: Scheper-Hughes, N., Bourgois, P., editors. Violence in war and peace: An anthology. Oxford, UK: Blackwell Publishing Ltd; 2004.

Blankenship KM, Bray SJ, Merson MH. Structural interventions in public health. AIDS. 2000; 14:S11–S21.

Blankenship KM, Friedman S, Dworkin S, Mantell J. Structural interventions: concepts, challenges and opportunities for research. Journal of Urban Health. 2006; 83(1):59–72. [PubMed: 16736355]

Bourgois P. The moral economies of homeless heroin addicts: confronting ethnography, HIV risk, and everyday violence in San Francisco shooting encampments. Substance Use & Misuse. 1998; 33(11): 2323–2351. [PubMed: 9758016]

Bourgois P. Anthropology and epidemiology on drugs: the challenges of cross-methodological and theoretical dialogue. The International Journal of Drug Policy. 2002; 13(4):259–269.

Bourgois, P., Schonberg, J. Righteous dopefiend. Berkeley: University of California Press; 2008.

Buchbinder S, Liu A. Pre-exposure prophylaxis and the promise of combination prevention approaches. AIDS and Behavior. 2011; 15(0):72–79.

Burris S, Cameron E. The case against criminalization of HIV transmission. JAMA: The Journal of the American Medical Association. 2008; 300(5):578–581. [PubMed: 18677032]

Clarke AE, Shim JK, Mamo L, Fosket JR, Fishman JR. Bio-medicalization: technoscientific transformations of health, illness, and U.S. biomedicine. American Sociological Review. 2003; 68(2):161–194.

Coates TJ, Richter L, Caceres C. Behavioural strategies to reduce HIV transmission: how to make them work better. The Lancet. 2008; 372(9639):669–684.

Cockerham WC. Health lifestyle theory and the convergence of agency and structure. Journal of Health and Social Behavior. 2005; 46(1):51–67. [PubMed: 15869120]

Cohen J. A powerful and perplexing new HIV prevention tool. Science. 2010; 330(6009):1298–1299. [PubMed: 21127220]

Cohen J. HIV treatment as prevention. Science. 2011; 334(6063):1628. [PubMed: 22194547]

Cohen MS, Chen YQ, McCauley M, Gamble T, Hosseinipour MC, Kumarasamy N, et al. Prevention of HIV-1 infection with early anti-retroviral therapy. New England Journal of Medicine. 2011; 365(6):493–505. [PubMed: 21767103]

CONRAD. FDA and CONRAD chart U.S. regulatory path for 1% tenofovir gel for HIV prevention: Collaborative meeting with key stakeholders. Arlington, VA: 2010.

Department of Health. National HIV and syphilis antenatal seroprevalence survey in South Africa 2004. Pretoria, Gauteng; South Africa: 2005.

Des Jarlais DC. Structural interventions to reduce HIV transmission among injecting drug users. AIDS. 2000; 14:S41–S46. [PubMed: 10981473]

Diaz RM, Ayala G, Bein E. Sexual risk as an outcome of social oppression: data from a probability sample of Latino gay men in three U.S. cities. Cultural Diversity & Ethnic Minority Psychology. 2004; 10(3):255–267. [PubMed: 15311978]

Diez-Roux AV. Bringing context back into epidemiology: variables and fallacies in multilevel analysis. American Journal of Public Health. 1998; 88(2):216–222. [PubMed: 9491010]

Donnell D, Baeten JM, Kiarie J, Thomas KK, Stevens W, Cohen CR, et al. Heterosexual HIV-1 transmission after initiation of antiretroviral therapy: a prospective cohort analysis. The Lancet. 2010; 375(9731):2092–2098.

Dugger, CW. African studies give women hope in HIV fight. New York, NY: The New York Times; 2010.

Dunn C, Deroo L, Rivara FP. The use of brief interventions adapted from motivational interviewing across behavioral domains: a systematic review. Addiction. 2001; 96(12):1725–1742. [PubMed: 11784466]

Eaton L, Kalichman S. Risk compensation in HIV prevention: implications for vaccines, microbicides, and other biomedical HIV prevention technologies. Current HIV/AIDS Reports. 2007; 4(4):165–172. [PubMed: 18366947]

Farmer, P. AIDS and accusation: Haiti and the geography of blame. Berkeley: University of California Press; 1992.

Fleming DT, Wasserheit JN. From epidemiological synergy to public health policy and practice: the contribution of other sexually transmitted diseases to sexual transmission of HIV infection. Sexually Transmitted Infections. 1999; 75(1):3. [PubMed: 10448335]

Gangamma R, Slesnick N, Toviessi P, Serovich J. Comparison of HIV risks among gay, lesbian, bisexual and heterosexual homeless youth. Journal of Youth and Adolescence. 2008; 37(4):456–464. [PubMed: 18607514]

Golin CE, Earp J, Tien HC, Stewart P, Porter C, Howie L. A 2-arm, randomized, controlled trial of a motivational interviewing-based intervention to improve adherence to antiretroviral therapy (ART) among patients failing or initiating ART. Journal of Acquired Immune Deficiency Syndromes. 2006; 42(1):42–51. [PubMed: 16763491]

Grant RM, Lama JR, Anderson PL, McMahan V, Liu AY, Vargas L, et al. Preexposure chemoprophylaxis for HIV prevention in men who have sex with men. New England Journal of Medicine. 2010; 363(27):2587–2599. [PubMed: 21091279]

Grov C, Parsons JT. Bug chasing and gift giving: the potential for HIV transmission among barebackers on the internet. AIDS Education and Prevention. 2006; 18(6):490–503. [PubMed: 17166076]

Gupta GR, Parkhurst JO, Ogden JA, Aggleton P, Mahal A. Structural approaches to HIV prevention. The Lancet. 2008; 372(9640):764–775.

Gutierrez, G. A theology of liberation: History, politics, and salvation. Maryknoll, NY: Orbis; 1973.

Hatzenbuehler ML, McLaughlin KA, Keyes KM, Hasin DS. The impact of institutional discrimination on psychiatric disorders in lesbian, gay, and bisexual populations: a prospective study. American Journal of Public Health. 2010; 100(3):452–459. [PubMed: 20075314]

Institute of Medicine. Methodological challenges in biomedical HIV prevention trials. Washington, D.C: The National Academies Press; 2008.

Kalipeni, E.Craddock, S.Oppong, JR., Ghosh, J., editors. HIV & AIDS in Africa: Beyond epidemiology. Oxford, UK: Blackwell Publishing; 2004.

Kaplan GA. The role of epidemiologists in eradicability of poverty. The Lancet. 1998; 352(9140): 1627–1628.

Kaplan GA. What's wrong with social epidemiology, and how can we make it better? Epidemiologic Reviews. 2004; 26:124–135. [PubMed: 15234953]

Katz MH. Interventions to increase interventions are needed. Journal of Public Health Management and Practice. 2008; 14(3):224–227. [PubMed: 18408546]

Krieger N. Epidemiology and the web of causation: has anyone seen the spider? Social Science & Medicine. 1994; 39(7):887–903. [PubMed: 7992123]

Levins R. Why programs fail. Monthly Review. 2010; 61(10)

Malta M, Strathdee SA, Magnanini MMF, Bastos FI. Adherence to antiretroviral therapy for human immunodeficiency virus/acquired immune deficiency syndrome among drug users: a systematic review. Addiction. 2008; 103(8):1242–1257. [PubMed: 18855813]

McGinnis JM, Williams-Russo P, Knickman JR. The case for more active policy attention to health promotion. Health Affairs. 2002; 21(2):78–93.

McGowan I. Microbicides for HIV prevention: reality or hope? Current Opinion in Infectious Diseases. 2010; 23(1):26–31. [PubMed: 19935418]

McLaren L, McIntyre L, Kirkpatrick S. Rose's population strategy of prevention need not increase social inequalities in health. International Journal of Epidemiology. 2010; 39(2):372–377. [PubMed: 19887510]

McMichael AJ. Prisoners of the proximate: loosening the constraints on epidemiology in an age of change. American Journal of Epidemiology. 1999; 149(10):887–897. [PubMed: 10342797]

McNeil, DG, Jr. Daily pill greatly lowers AIDS risk, study finds. New York, NY: The New York Times; 2010.

Merson MH, O'Malley J, Serwadda D, Apisuk C. The history and challenge of HIV prevention. The Lancet. 2008; 372(9637):475–488.

Meyer IH. Minority stress and mental health in gay men. Journal of Health and Social Behavior. 1995; 36(1):38–56. [PubMed: 7738327]

Michael NL. Oral preexposure prophylaxis for HIV – another arrow in the quiver? New England Journal of Medicine. 2010; 363(27):2663–2665. [PubMed: 21091280]

Morojele NK, Brook JS, Kachieng'a MA. Perceptions of sexual risk behaviours and substance abuse among adolescents in South Africa: a qualitative investigation. AIDS Care. 2006; 18(3):215–219. [PubMed: 16546781]

Munthe C. The goals of public health: an integrated, multidimensional model. Public Health Ethics. 2008; 1(1):39–52.

Myers GM, Mayer KH. Oral preexposure anti-HIV prophylaxis for high-risk U.S. populations: current considerations in light of new findings. AIDS Patient Care and STDs. 2011; 25(2):63–71. [PubMed: 21284497]

Navarro V. Social capital. Response. International Journal of Epidemiology. 2005; 34(2):480–481. [PubMed: 15737975]

Ng BE, Butler LM, Horvath T, Rutherford GW. Population-based biomedical sexually transmitted infection control interventions for reducing HIV infection. Cochrane Database of Systematic Reviews. 2011; (3):CD001220. [PubMed: 21412869]

Ory MG, Lee Smith M, Mier N, Wernicke MM. The science of sustaining health behavior change: the health maintenance consortium. American Journal of Health Behavior. 2010; 34(6):647–659. [PubMed: 20604691]

Padian NS, Buvé A, Balkus J, Serwadda D, Cates W Jr. Biomedical interventions to prevent HIV infection: evidence, challenges, and way forward. The Lancet. 2008; 372(9638):585–599.

Park, A. Top 10 medical breakthroughs: AIDS drugs lower the risk of HIV infection. TIME; 2010.

Parker RG, Easton D, Klein CH. Structural barriers and facilitators in HIV prevention: a review of international research. AIDS. 2000; 14:S22–S32. [PubMed: 10981471]

Parry C, Petersen P, Carney T, Dewing S, Needle R. Rapid assessment of drug use and sexual HIV risk patterns among vulnerable drug-using populations in Cape Town, Durban and Pretoria, South Africa. Journal of Social Aspects of HIV/AIDS Research Alliance. 2008; 5(3):113–119. [PubMed: 18979044]

Parsons JT, Rosof E, Punzalan JC, Di Maria L. Integration of motivational interviewing and cognitive behavioral therapy to improve HIV medication adherence and reduce substance use among HIV-

positive men and women: results of a pilot project. AIDS Patient Care and STDs. 2005; 19(1):31–39. [PubMed: 15665633]

Pearce N. Traditional epidemiology, modern epidemiology, and public health. American Journal of Public Health. 1996; 86(5):678–683. [PubMed: 8629719]

Piot P, Bartos M, Larson H, Zewdie D, Mane P. Coming to terms with complexity: a call to action for HIV prevention. The Lancet. 2008; 372(9641):845–859.

Poundstone KE, Strathdee SA, Celentano DD. The social epidemiology of human immunodeficiency virus/acquired immunodeficiency syndrome. Epidemiologic Reviews. 2004; 26(1):22–35. [PubMed: 15234945]

Prejean J, Song R, Hernandez A, Ziebell R, Green T, Walker F, et al. Estimated HIV incidence in the United States, 2006–2009. PLoS ONE. 2011; 6(8):e17502. [PubMed: 21826193]

Pronyk PM, Hargreaves JR, Kim JC, Morison LA, Phetla G, Watts C, et al. Effect of a structural intervention for the prevention of intimate-partner violence and HIV in rural South Africa: a cluster randomised trial. The Lancet. 2006; 368(9551):1973–1983.

Quinn TC, Wawer MJ, Sewankambo N, Serwadda D, Li C, Wabwire-Mangen F, et al. Viral load and heterosexual transmission of human immunodeficiency virus type 1. Rakai Project Study Group. New England Journal of Medicine. 2000; 342(13):921–929. [PubMed: 10738050]

Rausch D, Dieffenbach C, Cheever L, Fenton K. Towards a more coordinated federal response to improving HIV prevention and sexual health among men who have sex with men. AIDS and Behavior. 2011; 15(0):107–111.

Rose G. Sick individuals and sick populations. International Journal of Epidemiology. 1985; 14(1):32–38. [PubMed: 3872850]

Rotheram-Borus MJ, Swendeman D, Chovnick G. The past, present, and future of HIV prevention: integrating behavioral, biomedical, and structural intervention strategies for the next generation of HIV prevention. Annual Review of Clinical Psychology. 2009; 5(1):143–167.

Rothman KJ, Adami HO, Trichopoulos D. Should the mission of epidemiology include the eradication of poverty? The Lancet. 1998; 352(9130):810–813.

Ryan C, Huebner D, Diaz RM, Sanchez J. Family rejection as a predictor of negative health outcomes in white and Latino lesbian, gay, and bisexual young adults. Pediatrics. 2009; 123(1):346–352. [PubMed: 19117902]

Sawyer KM, Wechsberg WM, Myers BJ. Cultural similarities and differences between a sample of Black/African and colored women in South Africa: convergence of risk related to substance use, sexual behavior, and violence. Women & Health. 2006; 43(2):73–92. [PubMed: 17000612]

Shilts, R. And the band played on: Politics, people, and the AIDS epidemic. New York: St. Martin's Press; 1987.

Shoptaw S, Rotheram-Fuller E, Landovitz RJ, Wang J, Moe A, Kanouse DE, et al. Non-occupational post exposure prophylaxis as a biobehavioral HIV-prevention intervention. AIDS Care. 2008; 20(3):376–381. [PubMed: 17963091]

Steckler A, McLeroy KR. The importance of external validity. American Journal of Public Health. 2008; 98(1):9–10. [PubMed: 18048772]

Stein ZA. HIV prevention: the need for methods women can use. American Journal of Public Health. 1990; 80(4):460–462. [PubMed: 2316768]

Stein, H. Beyond the world bank agenda: An institutional approach to development. Chicago, IL: The University of Chicago Press; 2008.

Sumartojo E. Structural factors in HIV prevention: concepts, examples, and implications for research. AIDS. 2000; 14:S3–S10.

Susser M, Susser E. Choosing a future for epidemiology: I. Eras and paradigms. American Journal of Public Health. 1996a; 86(5):668–673. [PubMed: 8629717]

Susser M, Susser E. Choosing a future for epidemiology: II. From black box to Chinese boxes and eco-epidemiology. American Journal of Public Health. 1996b; 86(5):674–677. [PubMed: 8629718]

Toobert D, Strycker L, Glasgow R, Barrera M, Angell K. Effects of the Mediterranean lifestyle program on multiple risk behaviors and psychosocial outcomes among women at risk for heart disease. Annals of Behavioral Medicine. 2005; 29(2):128–137. [PubMed: 15823786]

Trussell, J. Contraceptive efficacy. In: Hatcher, R.Trussell, J.Nelson, A.Cates, W.Stewart, F., Kowal, D., editors. Contraceptive technology: Nineteenth revised edition. New York, NY: Ardent Media; 2007.

UNAIDS. World Health Organization. AIDS epidemic update: November 2009. 2009.

UNAIDS. Chapter 4-HIV treatment. Global report: UNAIDS report on the global AIDS epidemic. 2010.

Waitzkin, H. Political economic systems and the health of populations: historical thought and current directions. In: Galea, S., editor. Macrosocial determinants of population health. New York: Springer; 2007.

Zenilman, JM. Sexually transmitted diseases. In: Nelson, KE., Masters Williams, CF., editors. Infectious disease epidemiology: Theory and practice. Sudbury, MA: Jones and Bartlett Publishers; 2007.