Role of biomedical and behavioral interventions and their evidence in prevention of HIV infection: A literature review

INTRODUCTION

Around 2.5 million people become infected with HIV each year and after 30 years of the HIV epidemic more than 34 million persons are living with HIV infection. This extraordinary toll on human life and public health worldwide will only be reversed with effective prevention. There is a need for evidence-based interventions that can be implemented to treat the established infections and prevent the new ones from happening. This paper aims to discuss about different types of HIV prevention strategies that are effective and practiced in different countries with special emphasis on evidence for success. A review of the literature was done to get the information about the successful interventions for HIV prevention from different countries. The literature was accessed from health and medical sciences databases available on the internet. All the relevant peer-reviewed journals and reports were studied and were categorically discussed in detail with the evidence. For a successful reduction in HIV transmission, there is a need for an aggregate effect of radical and sustained behavioral changes in a sufficient number of individuals potentially at risk. Reductions in HIV transmission need widespread and sustained efforts, and a mix of communication channels to disseminate messages to motivate people to engage in range of options to reduce the risk. The effect of behavioral strategies could be increased by aiming for many goals that are achieved by use of multilevel approaches with populations both uninfected and infected with HIV. These prevention programs operate on different levels to address the specific, but diverse needs of the populations at risk of HIV infection. There is an urgent need for greater demand and greater support from communities and policymakers for rights-based, evidence-informed prevention strategies. And the prevention experts need to overcome the prejudices and political sensitivities that have impeded implementation of the HIV prevention programs.

Key words: Behavioral strategies, biomedical interventions, communication, HIV/AIDS, prevention
Rights-based, evidence-informed, and community-owned programs that use a mix of biomedical, behavioral, and structural interventions, prioritized to meet the current HIV prevention needs of particular individuals and communities, so as to have the greatest sustained impact on reducing new infections.

**BEHAVIOURAL STRATEGIES**

They are defined as “interventions to motivate behavioral change in individuals and social units by use of a range of educational, motivational, peer-led, skill-building approaches as well as community normative approaches” (Coates and Gable 2008).

They include the sexual debut delay, sexual partner reduction, Consistent condom usage, HIV counseling and testing, sexual abstinence, monogamy, biomedical intervention uptake and consistent usage, adherence to harm reduction strategies. Behavioral interventions fall into two broad categories.

**Interventions to minimize sexual risk behaviors/ increase protective behaviors**

**Evidence**

They include sexual behavior change communications (SBCC) that employ a variety of channels to communicate a range of messages. Studies have been undertaken to assess both channels of communication and the content of the messages.

**Channels of communication**

**Mass media**

Much of the research on mass media has focused on changes in intermediary indicators such as knowledge, risk perception, and self-efficacy. Reviews of this research have generally found small, but positive effects on each of these indicators. Studies have also linked mass media to reported positive behavioral outcomes such as delay of sexual debut,[2] decreases in a number of sexual partners,[3-5] increases in condom use[6-8] and utilization of high throughput computing (HTC) and prevention of mother-to-child transmission services.[9,10] Current research suggests that mass media is most effective when used to: Facilitate advocacy efforts[11] and complement other community-level and interpersonal activities. Mass media programming has been shown to produce a dose-response effect, in which higher exposure to messaging resulted in increased self-reported positive behavioral change.[12]

**Community-level interventions**

Community mobilization campaigns have been shown to increase uptake of HTC in discordant couples[13] and youth.[14] Specific activities such as community-based dramas have been shown to increase HTC utilization and condom use.[15] Locally-based media programs have been shown to impact social norms, including perceptions of HIV-positive individuals.[16] While their geographic reach is often limited, effective community-based activities generally provide good results at a low cost per beneficiary, although the duration of these effects is unknown.[17] Community-level activities are most effective when they: Focus explicitly on community norms; develop key opinion leaders with the abilities and desire to diffuse messages widely, and facilitate support systems and networks.[18]

**Interpersonal communication**

Interpersonal communication and counseling are defined as person-to-person or small group interaction and exchange.[19-20] A recent meta-analysis of research examining interpersonal communication found that the exposure was significantly associated with increased knowledge and condom use.[21] In addition to these outcomes, peer education has demonstrated some success in changing community attitudes and norms.[22] Cost-effectiveness studies have shown that interpersonal communication has the ability to reach hard-to-reach population groups in a cost-effective manner.[23]

**Focus of messages**

**Multiple partnerships**

Sexual activity with more than one partner plays a central role in all sexually-driven HIV epidemics. Ecological and associational evidence from generalized and concentrated epidemics points to a consistent pattern of significant decline in the proportion of men and women reporting multiple partners, followed by population-level declines in HIV infection.[24-26] Behavioral interventions utilizing various communication channels have had a demonstrable impact on reducing numbers of sexual partners in numerous populations including MSM, adult men and women, and young people.[27,28] While debate exists around the role of concurrent, as opposed to sequential, partnerships in HIV transmission,[29] efforts to evaluate concurrency reduction interventions are on-going.[30]

**Intergenerational and transactional sex**

In many settings, intergenerational sex and transactional sex are closely related.[31,32] Both practices are driven by economic needs or wants, as well as deeply-entrenched norms supporting age differences between partners and male dominance in relationships.[33] Women’s ability to refuse sex or negotiate condom use, which may already be limited, may be further compromised by age differences between partners or exchange of money or gifts. These factors, in combination with young women’s biological vulnerability to HIV infection, contribute to heightened risk for both young women and their male partners.[34]

**Age of sexual debut**

A number of national population-based surveys[35,36] have found a correlation between early initiation of sex and higher HIV prevalence among young people. Increased mean age of sexual debut is thought to be one contributing factor in declining HIV prevalence in some generalized epidemics in sub-Saharan Africa.[37] A multi-country study of youth in sub-Saharan Africa found that programs promoting abstinence, including those utilizing mass media, could produce increases of up to one year in mean age of sexual debut.[38]

**Alcohol use**

Alcohol use plays a critical role in sexual risk behavior that can lead to HIV transmission. Multiple studies have found that persons who
use alcohol in sexual situations are more likely to have unprotected sex, casual sex, and multiple partners, than persons who do not use alcohol in sexual situations. Alcohol consumption is linked with increased risk of sexually transmitted infection (STI) and HIV infection, gender-based violence and nonadherence to antiretroviral therapy (ART).

Supportive interventions to optimize biomedical interventions by creating demand for services and improve adherence and aftercare.

Creating demand for services

Evidence

Sexual behavior change communications has been widely used over the past decade to create demand for biomedical prevention approaches, including HTC and voluntary medical male circumcision (VMMC). HTC-focused mass media campaigns in Kenya and South Africa have been shown to increase uptake of testing services, with clear dose-response effects. Evidence from South Africa further indicates that exposure to SBCC programs is associated with discussing HIV and that discussion of HIV is associated with testing — suggesting a possible indirect effect of HTC promotion interventions.

Improving adherence and aftercare through client education

Evidence

Creating demand for services, while essential, is not sufficient in isolation to ensure positive outcomes. Helping clients identify side effects and adverse events, take medication correctly, and care for themselves following medical procedures can all contribute to optimal use of medical technologies. A randomized control trial in Kenya found that SMS reminders significantly improved ART adherence among patients. Similar approaches have been used to support attendance at VMMC follow-up visits.

Biomedical interventions

Defined as the “interventions are those that act directly on the biological systems through which the virus infects a new host.” Some of the biomedical interventions include:

1. Male condoms: When used consistently and correctly, male latex condoms are highly effective in preventing the sexual transmission and acquisition of HIV and other STIs at the individual level. Among most-at-risk populations, increasing condom availability, accessibility, acceptability, and use has had a demonstrable population-level effect in several epidemics. In heterosexual serodiscordant relationships in which condoms were consistently used, HIV-negative partners were 80% less likely to become infected compared with persons in similar relationships in which condoms were not used.

2. Female condoms: Laboratory studies indicate that the female condom (FC2) is an effective mechanical barrier to semen and viruses, including HIV. In 2006, WHO concluded that female condoms, when used consistently and correctly, have comparable effectiveness to male condoms. In 2009, the Food and Drug Administration approved the second generation of the FC2 for prevention of HIV, other STIs, and unintended pregnancy. A growing body of evidence shows that effective FC2 promotion to both women and men can increase the proportion of protected sex acts. Studies conducted in a variety of contexts show that the FC2is widely acceptable and realistic alternative to the male condom.

3. Voluntary medical male circumcision: Voluntary medical male circumcision is the surgical removal of the foreskin from the penis by trained medical personnel under aseptic conditions. Three randomized control trials indicated that VMMC reduces men’s risk of HIV acquisition by 50-60%. Extended follow-up of participants at up to 5 years posttrial indicated that the protective effect increased to 68%. WHO and UNAIDS have concluded that VMMC should be actively promoted as part of comprehensive HIV prevention efforts in settings where circumcision rates are low, and HIV prevalence is high. A prospective study enrolling HIV serodiscordant couples found a promising, although not statistically significant, 40% reduction in sero-conversions of women whose male partners were circumcised. A recent study suggests that VMMC, with the life-long protection it provides, is a cost-effective strategy to prevent HIV in high-prevalence areas.

4. HIV testing and counseling (high throughput computing): The evidence for the direct impact of HIV testing and counseling on HIV incidence is mixed. However, HTC, knowledge of HIV sero-status, and successful linkages to other services are critical for access to effective prevention interventions for those who test negative, and to treatment and other HIV-specific services for people living with HIV/AIDS (PLWH). In particular, HTC process allows for identification of PLWH, which in turn supports programs like treatment that can protect their HIV-negative partners from infection. Recent Demographic and Health Surveys from 13 sub-Saharan African and five non-African countries show a median of 12% of women and 7% of men having been tested in the 12 months preceding the survey, and a median of 34% of women and 17% of men reporting having ever been tested. Diagnosis and treatment of sexually transmitted infections.

6. Studies have shown that STIs, including those that are asymptomatic, increase susceptibility to HIV infection two- to five-fold for several reasons, including direct damage to the mucosa through ulceration that facilitates infection, and through inflammatory processes that increase the proliferation of immune cells that are also targets for HIV. STIs also lead to higher HIV loads in the genital secretions of HIV-positive individuals, thereby increasing the chance of infecting their sexual partners. STIs are biological markers for risky sexual behaviors, increase susceptibility to HIV acquisition through genital ulcers, and increase onward transmission of HIV associated with HIV viral spikes.
7. Antiretroviral drug-based prevention: There are four opportunities for HIV prevention: Before exposure, at the moment of exposure, immediately after exposure, and as prevention focused on infected persons. Until recently, most prevention resources have been directed toward strategies aimed at preventing exposure. There is growing evidence that ART of infected individuals has an added prevention benefit. Treatment of HIV and prevention of HIV must be considered as elements of a single continuum and deployed together.

**Postexposure prophylaxis for HIV**

Postexposure prophylaxis (PEP) refers to the set of services that are provided to manage specific aspects of exposure to HIV and to help prevent HIV infection in a person exposed to the risk of infection. These services might include first aid, counseling including assessing the risk of HIV exposure, HTC, and depending on the outcome of exposure assessment, a limited course of antiretroviral drugs (ARVs), with appropriate support and follow-up.

**Evidence**

Strong evidence suggests that a short course of ARVs started within 72 h after exposure effectively reduces HIV transmission rates following needlestick exposure to HIV-infected blood. This comes largely from a single-case control study involving health care workers from France, UK and USA that revealed strong inverse associations between the likelihood of HIV infection following a needlestick injury and the postexposure use of zidovudine. However, data available from animal transmission models, perinatal clinical trials, studies of health-care workers receiving prophylaxis after occupational exposures, and observational studies indicate that PEP may reduce the risk of HIV infection after nonoccupational exposures as well.

**Treatment as prevention**

**Evidence**

An important determinant of risk of HIV transmission from an HIV-positive person to an HIV-negative person is the concentration of HIV in plasma. ART for the HIV-positive partner is associated with both reduced viral load and reduced risk of HIV transmission to sex partners within discordant partnerships, potentially by over 90%. These observational data were recently confirmed by HPTN 052, a randomized trial among 1,763 HIV sero-discordant couples in which the HIV-positive partner had a CD4 count between 350 and 550 cells/μL. The trial evaluated the effect of immediate versus delayed ART (initiated at CD4 of 250 cells/μL) in an HIV-positive individual.

**Pre-exposure prophylaxis for HIV**

**Evidence**

In the CAPRISA 004 study in South Africa, 889 high-risk women used 1% tenofovir gel vaginally up to 12 h before intercourse and within 12 h after intercourse. This study reported a 39% reduction in HIV acquisition overall, and maximal reduction of 54% in women who were the most adherent. HIV acquisition was inversely correlated with detection of tenofovir in the vaginal secretions, an indication of the strong association between product adherence and efficacy.

In the iPrEx study completed in 2010, HIV-negative MSM were provided daily emtricitabine and tenofovir disoproxil fumarate (TDF + FTC) for up to 2.8 years. The study found 44% reduction in HIV acquisition, and as with the CAPRISA trial, efficacy was strongly associated with ARV drug concentrations.

Another study, conducted by CDC in partnership with Botswana Ministry of Health, found that a once-daily tablet containing TDF+FTC reduced the risk of acquiring HIV infection by roughly 63% overall in the study population of uninfected heterosexual men and women.

**CONCLUSIONS**

All the different strategies and interventions were discussed in detail in the respective paragraphs above with evidence from various research project sites/trials thereby providing a strong support for decision making for public health professionals & clinicians. As public health professionals we must agree with the evidence-based medicine and have to find the lacunae in our implementing programs and correct the gaps for effective prevention using the combination of these biomedical and behavioral interventions that are implemented cost effectively among the high-risk groups as well to halt the epidemic. These prevention strategies remind us that successful programs deal with both individual risk and underlying causes of vulnerability. They require biomedical and behavioral interventions that are specifically selected and tailored to suit local needs as articulated by affected communities.

Prevention is much easier and better than cure, especially for HIV infection. There is an urgent need for greater demand and greater support from communities and policymakers for rights-based, evidence-informed prevention strategies. To build this support, prevention experts need to speak with one voice, responding in real time with strategic advocacy to overcome the prejudices and political sensitivities that have often impeded implementation of the programs most likely to reduce HIV incidence. Effective implementation of this type of combined prevention strategies requires sufficient personnel to define and tailor programs at the sub-national level, to synthesize available evidence, to manage multi-component programs for specific results. Quality assurance and quality improvement are very important in behavioral and biomedical interventions ones. And to succeed, these must be coordinated, efficient, consistent, and inspired by a shared commitment to common goals.

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