



Research Update

The effectiveness of latex condoms for prevention of STI/HIV

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Abstract: Guidelines and statements issued from the Public Health Agency of Canada and the World Health Organization state that the proper and consistent use of latex condoms reduces the risk of infection with human immunodeficiency virus (HIV) and other sexually transmitted infections (STIs). This report summarizes research indicating that latex condoms provide an essentially impermeable barrier to STI/HIV pathogens and, from epidemiological studies, that proper and consistent latex condom use substantially reduces the risk of infection with HIV, Chlamydia, gonorrhoea, herpes simplex virus type-2 (HSV-2), and human papillomavirus (HPV). Clinicians, pharmacists, and educators should strongly recommend proper and consistent latex condom use to reduce the risk of STI/HIV infection.

According to the Public Health Agency of Canada (2002), “Condoms used consistently and correctly provide protection against getting or spreading STIs – including HIV” (p. 1) and the *Canadian Guidelines on Sexually Transmitted Infections* (Public Health Agency of Canada, 2006) indicate that clinical and public health professionals, including physicians and nurses, should strongly recommend consistent condom use to prevent STIs among at-risk persons (p. 334-338). The importance of condom use for the prevention of STIs is echoed by the World Health Organization (WHO, 2000): “Condoms are the only contraceptive method proven to reduce the risk of all sexually transmitted infections (STIs), including HIV” (p. 1).

There are two major ways in which the effectiveness of condoms in preventing STI and HIV has been assessed. The first type is laboratory studies (also known as *in vitro* studies) in which researchers test a condom’s ability to provide a barrier against particles the size of STI/HIV pathogens. The other main type is epidemiological studies which can take several forms. For example, an epidemiological study may compare rates of STI/HIV infection between individuals or couples who use condoms versus individuals or couples who do not use condoms. Another type of epidemiological study may examine rates of infection among people who don’t use condoms compared to people who use condoms some of the time (inconsistent users) or every time (consistent users) they have penetrative sex. As

documented below, both types of studies have clearly indicated that the consistent use of latex condoms significantly reduces the risk of STI/HIV infection.

Impermeability of latex condoms to STI/HIV-sized particles

According to the United States Centers for Disease Control and Prevention (CDC, 2000), “Laboratory studies have demonstrated that latex condoms provide an essentially impermeable barrier to particles the size of STD pathogens” (p. 2). Once it became clear that most cases of HIV/AIDS were sexually transmitted, determining the effectiveness of latex condoms in preventing sexual transmission of the virus became a scientific priority. As a result, a number of laboratory-based studies were conducted to determine if latex condoms block HIV. The United States Food and Drug Administration Division of Physical Sciences conducted laboratory tests and found that under extreme and highly unlikely conditions of stress (i.e., “worst-case condom barrier effectiveness”) using a latex condom was estimated to reduce exposure to HIV by at least 10,000 times compared to not using a condom (Carey et al., 1992). Other laboratory studies have confirmed that HIV-sized particles do not permeate latex condoms or, if leakage does occur, it is in an amount so small that it makes infection extraordinarily unlikely (Conant et al., 1986; Lytle et al., 1992; Lytle et al., 1997; Rietmeijer et al., 1988; Van de Perre, Jacobs, & Sprecher-Goldberger, 1987).



Laboratory studies have also demonstrated that latex condoms provide an impermeable barrier to Chlamydia, gonorrhea, hepatitis B virus, herpes simplex virus, and cytomegalovirus (CDC, 1988; CDC, 1993). Similar studies have shown that latex condoms provide an essentially impermeable barrier to particles the size of human papillomavirus (Gerberding, 2004).

Epidemiological Studies Examining Latex Condom Effectiveness

Human immunodeficiency virus (HIV)

Several methodologically rigorous longitudinal studies have examined whether condoms prevent HIV transmission within couples where one partner is infected with HIV and the other is not. These studies have indicated either that the couples who used condoms consistently had low seroconversion rates compared to couples who used condoms inconsistently (Saracco, Musicco, Nicolosi et al., 1993) or that none of the non-infected partners in couples who used condoms consistently became infected (De Vincenzi, 1994). De Vincenzi followed 256 HIV-infected men and women and their heterosexual seronegative partners. During the study 124 of the couples used condoms consistently, engaging in safer sex approximately 15,000 times and among these consistent condom using couples, 0% of the uninfected partners became infected with HIV. In a Cochrane database systematic review of studies examining the effectiveness of condoms in reducing heterosexual transmission of HIV, Weller and Davis (2002) concluded that consistent condom use results in an 80% reduction in HIV incidence.

Chlamydia and gonorrhea

Chlamydia and gonorrhea are the most commonly reported bacterial sexually transmitted infections with Chlamydia representing just under half of all notifiable disease case reports (Public Health Agency of Canada, 2007). Several methodologically sound studies have found a substantial protective effect for consistent condom use in significantly reducing the risk of infection with these STIs. In a study of 509 sexually active young women, Paz-Bailey, Koumans, Sternberg et al. (2005) found that those who used condoms correctly and consistently over a three-month period reduced their risk of Chlamydia

infection by 60% and their risk of infection with gonorrhea by 90%. In relation to a comparison group of non-users and inconsistent users, Shlay, McClung, Patnaik et al. (2004) examined the medical records of 126,220 sexually active men and women visiting an STI clinic and found that consistent condom users, compared to inconsistent condom users, had significantly lower rates of Chlamydia and gonorrhea. Pelvic Inflammatory disease (PID) is usually the result of an undiagnosed and untreated Chlamydia or gonorrhea infection. In a study of 684 sexually active women who had been diagnosed with PID, Ness, Randall, Richter et al. (2004) found that women who used condoms consistently were half as likely to have a recurrent episode of PID over the course of the average follow-up period of 36 months compared to women who used condoms inconsistently. Warner, Stone, Macaluso et al. (2006) conducted a systematic review of the methodological limitations of studies designed to measure the impact of condom use on Chlamydia and gonorrhea risk and concluded that these study limitations have resulted in an underestimation of condom effectiveness.

Herpes simplex virus (HSV)

Herpes simplex virus (HSV) infections are extremely common and take several forms. Most genital herpes infections are caused by HSV-2 and less commonly, but increasingly, by HSV-1 (Sen & Barton, 2007). Most HSV-1 infections affect the facial area. By adulthood most people (50-80%) are infected with HSV-1 and while most infections (90%) are asymptomatic some infections can result in cold sores/blisters on the face (American Academy of Dermatology, 2006). According to the U.S. CDC (2004), HSV-1 infection of the genitals can be caused by oral-genital or genital-genital transmission. Most HSV-2 infections affect the genital and surrounding area and transmission is most often through genital to genital contact. Approximately, 20% of the adult population is infected with HSV-2 and approximately 60% are asymptomatic (Public Health Agency of Canada, 2006).

Epidemiological studies examining the effectiveness of condoms in preventing HSV infection have found that consistent condom use significantly reduces the risk of HSV-2 transmission but not HSV-1 transmission. There are several possible explanations



as to why such studies have failed to detect a protective effect for condom use against HSV-1 transmission. In one study where the protective effect of condoms was examined, only a small percentage of subjects became HSV-1 positive over the course of the study and therefore conclusive evidence of the extent to which condoms protected against HSV-1 could not be obtained (Wald, Langenberg, Krantz et al., 2005). In addition, some proportion of genital HSV-1 infections are likely the result of oral-genital contact where condoms are not used (Cherpes, Meyn, & Hiller, 2005) and this may obscure the impact of condoms in preventing genital to genital transmission.

Several studies have provided strong evidence that consistent condom use reduces the risk of HSV-2 transmission. Wald, Langenberg, Link, et al. (2001) followed 528 monogamous heterosexual couples discordant for HSV-2 infection (i.e. one partner had HSV-2 at the beginning of the study and the other did not) and found that using condoms during 25% or more of sex acts provided significant protection against HSV-2 among women. In another study, Wald et al. (2005) examined 1,843 men and women at high risk for STI (4 or more sex partners or having an STI in the previous year) and found that risk of acquiring HSV-2 infection decreased by almost 30% with each increase in the level of condom use (0-25%, 25-75%, more than 75%). Based on their findings, the authors concluded that "...the use of condoms remains an important preventive strategy for sexually active persons who are at risk for HSV-2 infection" (Wald et al., 2005, p. 713).

Human papillomavirus (HPV)

According to the U.S. CDC (2007), HPV is the most common STI with over half of sexually active men and women contracting the infection at some point in their lives. Although over 90% of infections resolve on their own in less than two years, undetected/untreated infections can progress to cervical intraepithelial neoplasia (CIN) and in rare cases cervical cancer. The CDC also notes that vaginal and anal intercourse are the most common routes of HPV infection. However, because male condoms do not cover all skin areas that may harbour the infection, the efficacy of condoms in preventing HPV transmission has been uncertain.

Early research on the effectiveness of condoms in preventing HPV transmission suggested little protective effect from condom use (for review, see Manhart & Koutsky, 2002). However, more recent research has indicated a substantial protective effect against HPV infection among consistent condom users. For example, a randomized clinical trial found that condom use among women with CIN was associated with the regression of CIN lesions and clearance of HPV, presumably by preventing re-infection with the virus, compared to women with CIN who did not use condoms (Hogewoning, Bleeker, van den Brule et al., 2003). A similar study found that condom use among male sexual partners of women with CIN was associated with the regression of HPV penile lesions (Bleeker, Hogewoning, Voorhorst et al., 2003). An additional study of adolescent women found that more consistent condom use was associated with a reduced duration of HPV infection (Shew, Fortenberry, Tu et al., 2006). Results from a longitudinal study following university women who began having sexual intercourse for the first time either during the study period or within 2 weeks before enrolment in the study found that consistent condom use was associated with a 70% reduction in risk for HPV infection (Winer, Hughes, Feng et al., 2006). In sum, the research on the impact of condoms on HPV infection risk indicates that consistent condom use has a substantial, but not absolute, protective effect that significantly reduces the risk of HPV infection.

Conclusion

Latex condoms provide an effective physical barrier to STI/HIV pathogens and it has been demonstrated through epidemiological studies that proper and consistent condom use results in a substantial reduction in the risk of STI/HIV transmission. It is evident that a significant increase in proper and consistent condom use, particularly among adolescents, young adults, and other at-risk groups would result in a substantial reduction in the incidence of STI/HIV and in the negative health outcomes that result from them. Health promotion education and counselling should strongly emphasize the health benefits of proper and consistent condom use. The research cited above provides clinicians, pharmacists, and educators with an ample and



credible body of evidence to support the recommendation that condoms be used to reduce the risk of STI/HIV infection. As Hook (2005) aptly states with respect to the mounting evidence concerning the effectiveness of consistent condom use,

...condoms remain the best proven currently available means to reduce the risk for STDs in at-risk persons. Unfortunately, these individuals do not use condoms as much as they should. Clinicians should tell their at-risk patients that condoms can substantially reduce their risk for these diseases if they use them regularly. This simple message is our best weapon against STDs (p. 752).

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