

# Condoms, Spermicides, and the Transmission of Human Immunodeficiency Virus: A Review of the Literature

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## Introduction

The acquired immunodeficiency syndrome (AIDS) epidemic shows no sign of abating, and neither a vaccine nor a cure seems imminent. For the present, prevention is the only weapon against the spread of this disease. Most cases of AIDS are transmitted through sexual contact and, apart from abstinence, monogamy, and curtailment of sexual activities, barrier methods of contraception appear to be the only way to prevent sexual transmission of AIDS. There exists the widespread assumption that condoms, and possibly spermicides, can effectively prevent infection with human immunodeficiency virus (HIV). The evidence for this assumption, however, is not strong.

We review studies that have been done, or work that bears indirectly, on the effectiveness of condoms and spermicides in preventing the transmission of HIV. We follow with recommendations for future research.

## Literature Review

### Condoms in vitro

One small *in vitro* study suggested that HIV cannot pass through latex (N=3), synthetic skin (N=1), or natural skin (N=1) condoms, despite the use of higher virus titers than those found in human semen.<sup>1</sup> Spermicidally lubricated condoms may be more effective than plain condoms in preventing HIV transmission. Three recent studies found that intact condoms did not leak HIV, and that when condoms containing the spermicide nonoxynol-9 were deliberately ruptured the HIV organisms were inactivated.<sup>2,3,4</sup>

HIV is approximately 120 nanometers in diameter, considerably larger than the hepatitis B virus (42 nm) that can pass through natural skin condoms<sup>3</sup> and smaller than the herpes simplex virus (about 200 nm) and cytomegalovirus (about 300 nm) that do not pass through any type of condom.<sup>4,5</sup> Scanning electron microscopy of stretched latex condoms has demonstrated surface irregularities but no pores.<sup>6</sup>

### Condoms in vivo

Nine studies among both men and women have shown a protective effect of condoms against bacterial sexually transmitted diseases (STDs), including gonorrhea, mycoplasma, and hospitalized pelvic inflammatory disease.<sup>7</sup> The point estimate of the STD risk for condom users relative to

non-users was less than 1.0 for nine outcomes, and greater than 1.0 for two outcomes (two studies measured two diseases each); four 95 per cent confidence intervals (CI) excluded 1.0. Some of these studies failed to control for sociodemographic factors, and sexual activity and regularity of condom use were unknown.<sup>7</sup> Condom users may be different than non-users in important but unmeasured ways.

Only one early condom study measured rates of viral STDs. The 247 condom users among men attending a London genito-urinary medicine clinic had a slightly lower prevalence of herpes than non-users (0.8 vs 1.7 per cent) but a trivially higher prevalence of venereal warts (caused by human papillomavirus) than non-users (5.0 vs 4.6 per cent).<sup>8</sup>

A US study followed 24 uninfected sexual partners of AIDS patients for 12 to 36 months (median 24 months). Among 10 couples who routinely used condoms, only one partner became infected with HIV. In the 14 couples who did not use condoms, 12 partners became infected (the relative risk [RR] calculated by the present authors is 0.1, 95% test-based CI=0.0, 0.4).<sup>9</sup> Further follow-up with additional couples (median 18 months) continues to show the protective effect of condoms (RR=0.2, 95 per cent CI=0.1, 0.5).<sup>10</sup> In this study, no seronegative person who has abstained from sex with an HIV-positive partner has seroconverted.

Two studies without comparison groups provide anecdotal evidence of condom prophylaxis. In one study of 101 Danish prostitutes, none was seropositive for HIV.<sup>10</sup> The women reported that 68 per cent of their episodes of vaginal intercourse involved condom use; 3 per cent of anal sex episodes were condom-protected; and condoms were used in 54 per cent of episodes of fellatio. The second study included 448 licensed prostitutes in Nuremberg, West Germany.<sup>11</sup> Again, none (of 399 tested) was seropositive, and condom use was widespread. Among women who performed these acts, 74 per cent used condoms when masturbating clients, 90 per cent performed oral sex with condoms, 97.5 per cent had vaginal intercourse with condoms, and 55 per cent had anal intercourse with condoms.

In 1985, 377 female prostitutes were enrolled in a study of sexual practices and HIV seroprevalence in Kinshasa, Zaire.<sup>12</sup> Of these women, 23 per cent reported that at least one of their clients had used a condom in the past year. There was a substantial difference in seroprevalence among the eight women reporting condom use by half or more of their partners (none of eight) compared with women reporting less frequent use (26 of 77, 34 per cent). The two groups were similar with regard to other risk factors for HIV.

The Centers for Disease Control's ongoing multi-city HIV prevalence study of US prostitutes found that of 835 women tested, 98 (11.7 per cent) were HIV seropositive.<sup>13</sup> Among the 546 prostitutes interviewed, 11 per cent of those reporting unprotected vaginal intercourse were seropositive. Of the 22 prostitutes who used condoms for every episode of vaginal intercourse, none was seropositive.

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\*Scesny SM, Gantz NM, Sullivan JL: Impermeability of condoms to HIV and inactivation of HIV by the spermicide nonoxynol-9. Presented at the Third International Conference on AIDS, June 1-5, 1987, Washington, DC.

\*\*Reitmeijer CAM, Krebs JW, Feorino PM, Judson FN: *In vitro* tests demonstrate condoms containing nonoxynol-9 provide effective physical and chemical barriers against human immunodeficiency virus. Presented at the Third International Conference on AIDS, June 1-5, 1987, Washington, DC.

\*\*\*Fischl MA, Dickinson GM, Segal A, Flanagan S, Rodriguez M: Heterosexual transmission of human immunodeficiency virus (HIV): relationship of sexual practices to seroconversion. Presented at the Third International Conference on AIDS, June 1-5, 1987, Washington, DC.

### Spermicides in vitro

Laboratory studies have shown that nonoxynol-9 and various commercial spermicidal products inactivate a variety of STD pathogens,<sup>14</sup> including HIV. In one study, HIV inactivation occurred within 60 seconds of exposure to a nonoxynol-9 concentration of 0.05 per cent or greater; this concentration was also toxic to the lymphocytes infected by HIV.<sup>15,16</sup> Commercial spermicidal preparations contain at least 1 per cent of this active ingredient. As noted above, condoms treated with nonoxynol-9 have also proven effective against HIV, even when ruptured.<sup>2,\*\*\*</sup>

### Spermicides in vivo

Epidemiologic studies of the effect of spermicide use on viral STDs are lacking, although two British case-control studies found cervical dysplasia and cervical neoplasia (thought to be associated with human papillomavirus) less common among diaphragm users than other women (the use of spermicide is inferred).<sup>7</sup> A study of the protection offered by the contraceptive vaginal sponge (Today® containing one gram of nonoxynol-9) against the transmission of the AIDS virus is underway in Africa. Other studies have confirmed that use of the contraceptive sponge or other spermicidal methods reduces the risk of the most common bacterial STDs—gonorrhea and chlamydial infection.<sup>7,14,17</sup> An important limitation of some observational studies on this topic is that they did not distinguish between the different types of barrier methods (diaphragms, spermicides alone, condoms), often because of small numbers of users. Also, type and amount of sexual activity was rarely measured.

### Discussion

While use of condoms or spermicides is unlikely to be harmful, there is the potential for harm if their use is substituted for abstinence, monogamy, or good judgment. More research and better data are required to fill the following important gaps in our knowledge:

- the risk of seroconversion among fully compliant condom users or spermicide users relative to non-users per unit of time or per sexual encounter;
- the efficacy of condoms or spermicides in preventing HIV transmission during vaginal, anal, and oral intercourse; and
- the acceptability of condoms and spermicides, and regularity and correctness of their use, among different risk groups and among communities with different seroprevalence rates.

Clinical trials are needed to evaluate the effectiveness of different barrier methods. To the extent that it is ethically possible, participants in the studies should be randomly allocated. The outcome measures in studies should usually be the HIV seroconversion rate, but the infection rate for other more prevalent STDs (e.g., gonorrhea because it is efficiently transmitted) could be used as a proxy outcome variable where HIV prevalence is low.

Retrospective (case-control) studies could address the effect of contraceptive methods other than barriers (i.e., IUDs and oral contraceptives) on seroconversion rates. Prospective (cohort) studies could follow populations at high risk of seroconversion (prostitutes, STD clinic attenders, etc.). Occasions may arise when it is ethical to compare use of one method of contraception with use of no method, for instance, women who stop using barrier contraceptives in order to become pregnant.

Even a highly effective prophylactic measure is ineffective if not used, and many factors influence the use of contraceptives as a means of avoiding disease. Surveys are needed to determine the prevalence of particular health beliefs<sup>18</sup> in different populations, as are studies to assess the relative acceptability, compliance, and continuation rates of different types of barrier contraceptives. The wide range of reported barrier method effectiveness rates against pregnancy<sup>19,20</sup> probably reflects inconsistent and/or incorrect use in some groups; the motivation of disease prophylaxis may lead to greater compliance.

Moreover, it is important to recognize that the pattern of barrier use for AIDS prevention will differ from that for pregnancy prevention. Condoms or spermicides must be used at every sexual encounter to prevent HIV transmission whether or not one of the partners is sterilized, during menstruation, after surgical or natural menopause, and during vaginal, anal, and possibly oral intercourse.

The family planning community potentially has much to contribute to efforts to contain the AIDS epidemic. Necessity has forced recommendations for the use of condoms or spermicides in advance of satisfactory measurement of their potential to interrupt the transmission of HIV, and advice is being given on the grounds of common sense substantiated by a small amount of less than conclusive clinical evidence.

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## COMMENTARY

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### Joint Commission Selects Hospitals to Test New Survey Process

Seventeen hospitals will participate in the initial pilot testing of the Joint Commission on Accreditation of Healthcare Organizations new performance-oriented survey process. The hospitals have agreed to assist the Joint Commission in evaluating mechanisms for collecting, analyzing, transmitting, and using quality indicator data. Various survey methods will also be tested at the hospitals.

The hospitals, listed below, were selected from a large group of volunteers; they vary by ownership, size, teaching status, location, and system affiliation. Differences in quality assurance and data processing capabilities were also sought in the selection process.

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|---------------------------------------------------|---------------------------------------------------|------------------------------------------------------------|
| 1. Bethany Hospital<br>Chicago, IL                | 7. Maine Medical Center<br>Portland, ME           | 13. St. Clair Memorial Hospital<br>Pittsburgh, PA          |
| 2. Bremerton Naval Hospital<br>Bremerton, WA      | 8. Millard Fillmore Hospital<br>Buffalo, NY       | 14. St. Joseph Hospital<br>Mishawaka, IN                   |
| 3. Dixie Medical Center<br>St. George, UT         | 9. Montgomery General Hospital<br>Olney, MD       | 15. South Haven Community<br>Hospital<br>South Haven, MI   |
| 4. Ellwood City Hospital<br>Ellwood City, PA      | 10. Morristown General Hospital<br>Morristown, NJ | 16. University of Cincinnati<br>Hospital<br>Cincinnati, OH |
| 5. Johns Hopkins Hospital<br>Baltimore, MD        | 11. Providence Medical Center<br>Seattle, WA      | 17. VA Medical Center<br>Seattle, WA                       |
| 6. Los Robles Medical Center<br>Thousand Oaks, CA | 12. Seton Medical Center<br>Daly City, CA         |                                                            |