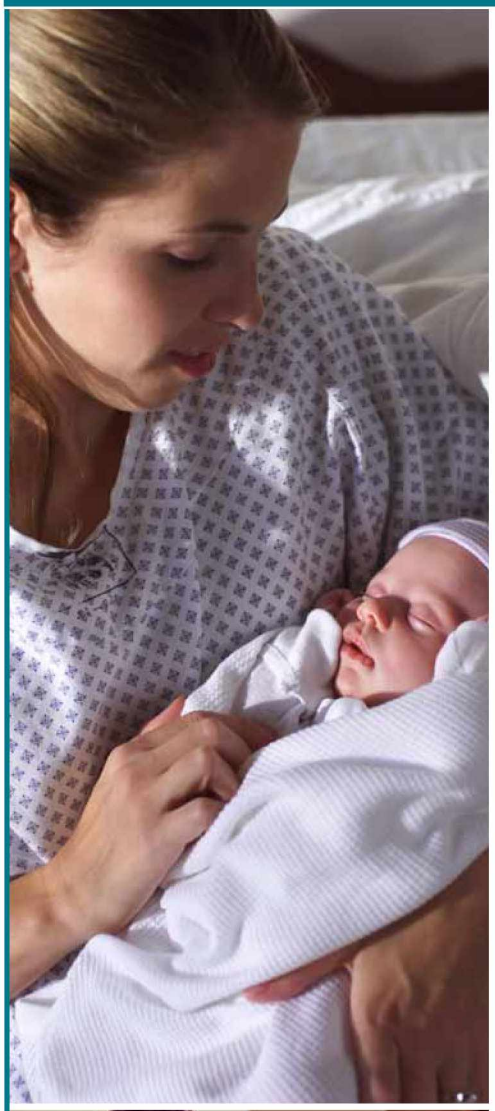
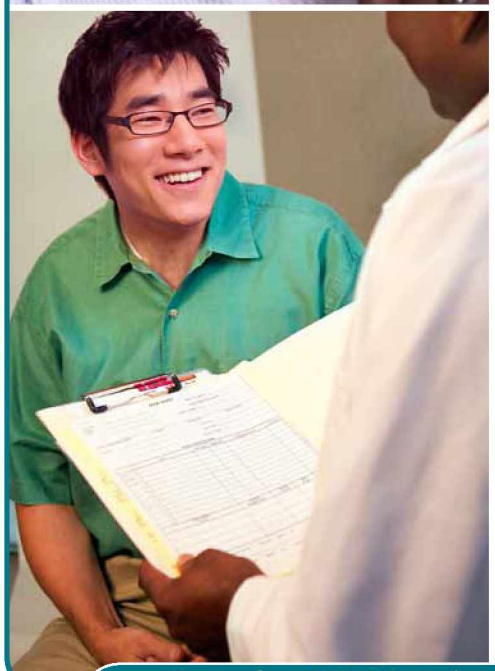
Male Circumcision





This fact sheet summarizes information in four areas of male circumcision: 1) male circumcision and risk for HIV acquisition; 2) male circumcision and other health conditions; 3) risks associated with male circumcision; and 4) HIV infection and male circumcision in the United States.

What Is Male Circumcision?

Male circumcision is the surgical removal of some or all of the foreskin (or prepuce) from the penis [1].

Male Circumcision and Risk for HIV Acquisition by Heterosexual Men

Several types of research have documented that male circumcision significantly reduces the risk of men contracting HIV through penile-vaginal sex.

Biologic Plausibility

Compared with the dry external skin surface of the glans penis and penile shaft, the inner mucosa of the foreskin has less keratinization (deposition of fibrous protein) and a higher density of target cells for HIV infection [2]. Some laboratory studies have shown the foreskin is more susceptible to HIV infection than other penile tissue [3], although others have failed to show any difference in the ability of HIV to penetrate inner compared with outer foreskin surface [4]. The foreskin may also have greater susceptibility to traumatic epithelial disruptions (tears) during intercourse, providing a portal of entry for pathogens, including HIV [5]. In addition, the microenvironment in the preputial sac between the unretracted foreskin and the glans penis may be conducive to viral survival [3]. Finally, the presence of other sexually transmitted diseases (STDs), which independently may be more common in uncircumcised men, increase the risk for HIV acquisition [6-11].

International Observational Studies for Prevention of HIV Acquisition by Heterosexual Men

A systematic review and meta-analysis that focused on male circumcision and heterosexual transmission of HIV in Africa was published in 2000 [12]. It included 19 cross-sectional studies, 5 case-control studies, 3 cohort studies, and 1 partner study. A substantial protective effect of male circumcision on risk for HIV infection was noted, along with a reduced risk for genital ulcer disease. After adjustment for confounding factors in the population-based studies, the relative risk for HIV infection was 44% lower in circumcised men. The strongest association was seen in men at high risk, such as patients at STD clinics, for whom the adjusted relative risk was 71% lower for circumcised men.

Another review that included stringent assessment of 10 potential confounding factors and that was stratified by study type or study population was published in 2003 [13]. Most of the studies were from Africa. Of the 35 observational studies in the review, the 16 in the general population had inconsistent results. The one

large prospective cohort study in this group showed a significant protective effect: The odds of infection were 42% lower for circumcised men [14]. The remaining 19 studies were conducted in populations at high risk. These studies found a consistent, substantial protective effect, which increased with adjustment for confounding. Each of the four cohort studies included in the review demonstrated a protective effect, and two were statistically significant.

Ecologic studies also indicate a strong association between lack of male circumcision and HIV infection at the population level. Although links among circumcision, culture, religion, and risk behavior may account for some of the differences in HIV infection prevalence, the countries in Africa and Asia with prevalence of male circumcision of less than 20% have HIV infection prevalences several times higher than those in countries in these regions where more than 80% of men are circumcised [15].

International Clinical Trials for Prevention of HIV Acquisition by Heterosexual Men

Three randomized controlled clinical trials (RCTs) were conducted in Africa to determine whether circumcision of adult males reduces their risk for HIV infection. The controlled follow-up period in all three studies was stopped early, and the control group offered circumcision when interim analyses found that medical circumcision significantly reduced male participants' HIV infection risk. The controlled follow-up period in the study in South Africa [16] was stopped in 2005, and the controlled follow-up periods for the studies in Kenya [17] and Uganda [18] were stopped in 2006.

In these studies, men who had been randomly assigned to the circumcision group had a 60% (South Africa), 53% (Kenya), and 51% (Uganda) lower incidence of HIV infection compared with men assigned to the wait-list group to be circumcised at the end of the study. In all three studies, a small number of men who had been assigned to be circumcised did not undergo the procedure; likewise, a small number of men assigned to the control groups did undergo circumcision. When the data were reanalyzed to account for these occurrences, men who had been circumcised had a 76% (South Africa), 60% (Kenya), and 55% (Uganda) reduction in risk for HIV infection compared with those who were not circumcised.

A 2008 meta-analysis, which examined data from the three RCTs, as well as from cohort and case-control studies, found that HIV risk was reduced 58% in circumcised men (overall risk ratio [RR], 0.42; 95% confidence interval [CI], 0.33-0.53). The authors concluded that the studies provided enough evidence to conclude that circumcision causes a reduction in transmission of HIV-1 infection [19].

Male Circumcision and Male-to-Female Transmission of HIV

Studies of whether circumcision of males reduces HIV transmission to their female sex partners overall indicate no protective effect.

A RCT of male circumcision in Uganda found no evidence of reduced HIV transmission to female partners. In the study, 922 HIV-infected men with uninfected partners were assigned to either immediate or delayed circumcision. Overall, 18% of women in the intervention group (partners in the immediate circumcision group) acquired HIV during follow-up, compared with 12% of women assigned to the control group (partners in the delayed circumcision group). There was no difference in HIV incidence between the circumcised and control groups when the couples waited to resume sex until the wound had healed, which in 93% of male subjects was within 6 weeks of circumcision [20]. However, women appeared to be at somewhat higher risk for HIV acquisition when the couples resumed sex before the circumcision wounds had healed, although this difference was not statistically significant.

A systematic review and meta-analysis of male circumcision and risk of transmission to women identified 19 studies from 11 populations [21]. The meta-analysis of data from the one RCT and six longitudinal analyses showed little evidence that male circumcision directly affects the risk of transmitting HIV to women (RR, 0.80; 95% CI, 0.53-1.36).

Male Circumcision and Male-to-Male Transmission of HIV

Observational studies have yielded mixed results in attempts to detect a protective effect of male circumcision among men who have sex with men (MSM). While some cross-sectional [22] and prospective [23] studies of MSM have shown statistically significant increases in risk of HIV acquisition by uncircumcised MSM, others have found no evidence that being circumcised was protective against HIV infection among MSM [24]. In a recent meta-analysis of 15 observational studies of male circumcision and HIV acquisition by MSM, a statistically nonsignificant protective association was found (OR, 0.86; 95% CI, 0.65-1.13) [25].

Male Circumcision and Other Health Conditions

Carcinogenic subtypes of human papillomavirus (HPV)—which are believed to cause 100% of cervical cancers, 90% of anal cancers, and 40% of cancers of the penis, vulva, and vagina [26]—have also been associated with lack of circumcision in men. A Ugandan RCT found a lower prevalence of high-risk HPV subtypes among men in the circumcised group [27]. In a South African trial, circumcision was also associated with a lower prevalence of high-risk HPV subtypes [28]. These prevalence associations may result from an effect of circumcision on HPV acquisition by men, its persistence, or both. The Ugandan RCT also found incidence of high-risk HPV infection among women to be lower among those with circumcised male partners [29].

The lifetime risk for a U.S. male of ever being diagnosed with penile cancer is 1 in 1,437 [30]. In a retrospective analysis of 89 cases of invasive penile cancer diagnosed from 1954 through 1997, 98% were in uncircumcised men; of 118 cases of carcinoma in situ, 84% were in uncircumcised men [31]. Schoen published a retrospective review of 5 studies with 592 cases of invasive penile cancer in the United States; none of the cases were in men who had been circumcised in infancy [32].

In a meta-analysis of male circumcision status and cervical cancer in female partners, data from 7 case-control studies were pooled [33]. Circumcision was associated with significantly less HPV infection in men. In an analysis restricted to monogamous women, there was a nonsignificant reduction in the odds of having cervical cancer among women with circumcised partners (OR, 0.75; 95% CI, 0.49-1.14). When the couples with men with 5 or fewer lifetime partners (40% of the study population) were excluded, there was a significantly reduced odds of cervical cancer in female partners of circumcised men compared with the female partners of uncircumcised men (OR, 0.42; 95% CI, 0.23-0.79).

Studies have consistently demonstrated decreased incidence of urinary tract infections (UTIs) among circumcised compared with uncircumcised boys. A meta-analysis including 18 studies found a pooled UTI prevalence of 20.1% among febrile uncircumcised boys <3 months of age and a prevalence of 2.4% among febrile circumcised boys <3 months of age [34]. Another systematic review [35] included 12 studies and over 400,000 children and concluded that male circumcision was associated with a significantly reduced risk of UTI (OR, 0.13; 95% CI, 0.08-0.20; $p<0.001$).

Overall, UTIs are not common among male infants, with estimates of the annual rate of UTI in uncircumcised infants being 0.70% versus 0.18% for circumcised infants [36].

Data from clinical trials also provides evidence that circumcision is significantly associated with decreased incidence of herpes simplex virus type 2 (HSV-2) [27, 37, 38]. The Ugandan trial also found that male circumcision may reduce self-reported genital ulcer disease in men [18]. In female partners of circumcised men, evidence from the trials showed a significant reduction of female genital ulceration, bacterial vaginosis, and trichomoniasis [39].

Results from observational studies have been mixed but have found lower risk for some STDs in circumcised men. A 2006 meta-analysis included 26 studies that assessed the association between male circumcision and risk for male genital ulcer disease. The analysis concluded that, overall, there was a significantly lower risk for syphilis (however, an RCT showed that syphilis was not reduced) and chancroid among circumcised men, whereas the reduced risk of herpes simplex virus type 2 infection had a borderline statistical significance [6].

Risks Associated with Male Circumcision

Reported complication rates depend on the type of study (e.g., chart review vs. prospective study), setting (medical vs. nonmedical facility), person operating (traditional vs. medical practitioner), patient age (infant vs. adult), and surgical technique or instrument used.

In large studies of infant circumcision in the United States, reported inpatient complication rates are approximately 0.2% [1, 40, 41]. The most common complications are bleeding and infection, which are usually minor and easily managed [1, 40-43].

A recent meta-analysis of 16 prospective studies from diverse settings worldwide that evaluated complications following neonatal, infant, and child male circumcision found that median frequency of severe adverse events was 0% (range, 0%-2%). The median frequency of any complication was 1.5% (range, 0%-16%). Male circumcision by medical providers on children tended to be associated with more complications (median frequency, 6%; range, 2%-14%) than for neonates and infants [44].

In the three African trials of adult circumcision, complication rates for adult male circumcision ranged from 2% to 8%. The most commonly reported complications were pain, bleeding, infection, and unsatisfactory appearance. There were no reported deaths or long-term sequelae documented [16, 17, 18, 45, 46].

Minimizing pain is an important consideration for male circumcision. Appropriate use of analgesia is considered standard of care for the procedure at all ages and can substantially control pain. One study found that 93.5% of neonates circumcised in the first week of life using analgesia gave no indication of pain on an objective, standardized neonatal pain rating system [47].

Effects of Male Circumcision on Penile Sensation and Sexual Function

Well-designed studies of sexual sensation and function in relation to male circumcision are few, and the results present a mixed picture. Taken as a whole, the studies suggest that some decrease in sensitivity of the glans to fine touch can occur following circumcision [48]. However, several studies conducted among men after adult circumcision suggest that few men report their sexual functioning is worse after circumcision; most report either improvement or no change [49-52]. The three African trials found high levels of satisfaction among the men after circumcision [16, 17, 18, 46].

HIV Infection and Male Circumcision in the United States

The United States has a much lower population prevalence of HIV infection (0.4%) than sub-Saharan Africa [53], and an epidemic that is concentrated among men who have sex with men, rather than men who have sex with women [54, 55]. In 2006, it is estimated that approximately 56,300 new HIV infections occurred, of which 73% were in males [54]. Of all new infections, 53% were in MSM, 31% in heterosexuals with reported high risk of exposure, 12% in injection drug users (IDUs), and 4% in MSM-IDUs. Among men, 72% of estimated new infections occurred in the male-to-male sexual contact transmission category, while heterosexual transmission accounted for 13% [53].

In one prospective study of heterosexual men attending an urban STD clinic, when other risk factors were controlled, uncircumcised men had a 3.5-fold higher risk for HIV infection than men who were circumcised. However, this association was not statistically significant due to small sample size [11]. And in an analysis of clinic records for African American men attending an STD clinic, circumcision was not associated with HIV status overall, but among heterosexual men with known HIV exposure, circumcision was associated with a statistically significant 58% reduction in risk for HIV infection [56].

Male Circumcision in the United States

In national probability samples of adults surveyed during 1999–2004, the National Health and Nutrition Examination Surveys (NHANES) found that 79% of men reported being circumcised, including 88% of non-Hispanic white men, 73% of non-Hispanic black men, 42% of Mexican American men, and 50% of men of other races/ ethnicities [57]. It is important to note that reported circumcision status may be subject to misclassification. In a study of adolescents, only 69% of circumcised and 65% of uncircumcised young men correctly identified their circumcision status as verified by physical exam [58].

According to the National Hospital Discharge Survey (NHDS), 65% of newborns were circumcised in 1999, and the overall proportion of newborns circumcised was stable from 1979 through 1999. In 2007, the NHDS found that 55% of male infants were circumcised [59]. Notably, the proportion of black newborns circumcised increased during this reporting period (58% to 64%); the proportion of white newborns circumcised remained stable (66%). In addition, the proportion of newborns in the Midwest who were circumcised

increased during the 20-year period—from 74% in 1979 to 81% in 1999—while the proportion of infants born in the West who were circumcised decreased from 64% in 1979 to 37% in 1999. In another survey, the National Inpatient Sample (NIS), circumcision rates increased from 48% during 1988–1991 to 61% during 1997–2000 but declined to 56% in 2008. Circumcision was more common among newborns who were born to families of higher socioeconomic status, born in the Northeast or Midwest, and who were black [60].

In 1999, the American Academy of Pediatrics (AAP) changed from a neutral stance on circumcision to a position that the data then available were insufficient to recommend routine neonatal male circumcision. The Academy also stated, "It is legitimate for the parents to take into account cultural, religious, and ethnic traditions, in addition to medical factors, when making this choice" [61]. This position was reaffirmed by the Academy in 2005. AAP is currently reviewing their policy in light of new data. Medicaid does not reimburse the costs of neonatal male circumcision in all states, which poses a barrier to male circumcision for individuals without private insurance. In a recent study conducted in 37 states in which the NIS is conducted, hospitals in states where Medicaid covers routine male circumcision had 24% higher circumcision rates than hospitals in states without such coverage [62].

Cost-Effectiveness and Ethical Issues for Neonatal Circumcision in the United States

A large, retrospective study of circumcision in nearly 15,000 infants found neonatal circumcision to be highly cost-effective, considering the estimated number of averted cases of infant urinary tract infection and lifetime incidence of HIV infection, penile cancer, balanoposthitis (inflammation of the foreskin and glans), and phimosis (a condition where the male foreskin cannot be fully retracted from the head of the penis). The cost of postneonatal circumcision was 10-fold the cost of neonatal circumcision [63]. There are also studies showing very marginal cost-effectiveness.

A 2010 study estimated that newborn circumcision reduces a U.S. male's lifetime risk of HIV acquisition through heterosexual contact by 15.7% overall, by 20.9% for black males, 12.3% for Hispanic males, and 7.9% for white males. In this model, the number of circumcisions needed to prevent one case of HIV was 298 for all males and ranged from 65 for black males to 1,231 for white males. Based on these estimates, the study concluded that newborn male circumcision was a cost-saving HIV prevention intervention [64].

Little has been published on the cost-effectiveness of adult circumcision among MSM. A study in Australia found that although a relatively small percentage of HIV infections would be prevented, adult circumcision of MSM could be cost effective or cost saving in some scenarios [65].

Many parents now make decisions about infant circumcision based on cultural, religious, or parental desires, rather than health concerns [66]. Some have raised ethical objections to parents making decisions about elective surgery on behalf of an infant, particularly when it is done primarily to protect against risks of HIV and STDs that do not occur until young adulthood. But other ethicists have found it an appropriate parental proxy decision [67].

Considerations for the United States

A number of important differences from sub-Saharan African settings where the three male circumcision trials were conducted must be considered in determining the possible role for male circumcision in HIV prevention in the United States. Notably, the overall risk of HIV infection is considerably lower in the United States, changing risk-benefit and cost-effectiveness considerations. Also, studies to date have demonstrated efficacy only for penile-vaginal sex, the predominant mode of HIV transmission in Africa, whereas the predominant mode of sexual HIV transmission in the United States is by penile-anal sex among MSM. There are as yet no convincing data to help determine whether male circumcision will have any effect on HIV risk for men who engage in anal sex with either a female or male partner, as either the insertive or receptive partner. Receptive anal sex is associated with a substantially greater risk of HIV acquisition than is insertive anal sex. It is more biologically plausible that male circumcision would reduce HIV acquisition risk for the insertive partner rather than for the receptive partner, but relatively few MSM engage solely in insertive anal sex [68].

In addition, although the prevalence of circumcision may be somewhat lower in U.S. racial and ethnic groups with higher rates of HIV infection, most American men are already circumcised; and it is not known whether men at higher risk for HIV infection would be willing to be circumcised or whether parents would be willing to have their infants circumcised to reduce possible future HIV infection risk.

Summary

Male circumcision reduces the risk that a man will acquire HIV from an infected female partner, and also lowers the risk of other STDs, penile cancer, and infant urinary tract infection. In female partners, it reduces the risk of cervical cancer, genital ulceration, bacterial vaginosis, trichomoniasis, and HPV. Although male circumcision has risks including pain, bleeding, and infection, more serious complications are rare.

In April 2007, the Centers for Disease Control and Prevention (CDC) held a consultation with external experts to discuss the potential value, risks, and feasibility of circumcision as an HIV prevention intervention in the United States. Since the consultation, CDC has further analyzed its own data, as well as the research of others, and published studies on circumcision among heterosexual men and MSM and cost-effectiveness of the procedure. CDC has also consulted with experts on the ethical issues surrounding circumcision. In August 2011, CDC released draft recommendations that outline the benefits and risks of male circumcision. After a public comment period and a formal peer review, final recommendations will be made.

The draft recommendations include the following:

Heterosexually active adolescent and adult males (including bisexual males)

All uncircumcised adolescent and adult males at risk of acquiring HIV infection and other STDs through penile-vaginal sex should be informed about the significant, but partial, efficacy of male circumcision in reducing the risk of acquiring HIV and some STDs through heterosexual contact, as well as the potential harms of male circumcision.

Uncircumcised, HIV-uninfected men and male adolescents at increased risk for HIV acquisition through penile-vaginal sex should be counseled about the risk and benefits of male circumcision. Men who choose to be circumcised should be referred for surgical consultation and provided access to high-quality, voluntary male circumcision surgical services.

Accurate information should be made available to heterosexually active men, including those who are already circumcised and those who are HIV infected. This should include the fact that male circumcision reduces—but does not eliminate—the risk for HIV and STD acquisition; reinforcement of messages regarding the importance of other risk-reduction strategies; and the message that HIV-positive men who are circumcised are not at lower risk than uncircumcised men of transmitting HIV to female sex partners.

Men who have sex with men (exclusively)

Although the available data do not indicate that male circumcision reduces the overall risk for HIV infection among MSM, it is biologically plausible, and some epidemiologic data suggest that there is partial protection from male circumcision during insertive penile-anal sex. However, being circumcised provides no plausible HIV risk reduction benefit for the partner engaging in anal-receptive sex, which carries a higher risk for acquisition of HIV.

Men who have sex with men should be fully informed of these findings, and they should be encouraged to continue to use other proven HIV and STD risk-reduction strategies.

Male newborns

Parents and guardians should be informed about the medical benefits and risks of neonatal male circumcision. Other considerations, such as religion, societal norms and social customs, hygiene, aesthetic preference, and ethical considerations also influence decisions about male circumcision. Ultimately, whether to circumcise a male neonate is a decision made by parents or guardians on behalf of their newborn son.

When desired by parents and guardians, medically attended neonatal male circumcision should be performed by trained practitioners according to accepted standards of clinical care, with appropriate use of analgesia.

Financial and other barriers to male circumcision

Male circumcision is a proven effective prevention intervention with known medical benefits. Financial and other barriers to access to male circumcision should be reduced or eliminated.

References

1. Alanis MC, Lucidi RS. Neonatal circumcision: a review of the world's oldest and most controversial operation. Obstet Gynecol Surv. 2004 May;59(5):379-95.
2. Hirbod T, Bailey RC, Agot K, et al. Abundant expression of HIV target cells and C-type lectin receptors in the foreskin tissue of young Kenyan men. Am J Pathol. 2010;[publication ahead of print].
3. Patterson BK, Landay A, Siegel JN, et al. Susceptibility to human immunodeficiency virus-1 infection of human foreskin and cervical tissue grown in explant culture. Am J Pathol. 2002 Sep;161(3):867-73.
4. Ding M, al. e. HIV-1 interactions and infection in adult male foreskin explant cultures. 16th Conference on Retroviruses and Opportunistic Infections. Montreal, Canada; 2009.
5. Szabo R, Short RV. How does male circumcision protect against HIV infection? BMJ. 2000 Jun 10;320(7249):1592-4.
6. Weiss HA, Thomas SL, Munabi SK, Hayes RJ. Male circumcision and risk of syphilis, chancroid, and genital herpes: a systematic review and meta-analysis. Sex Transm Infect. 2006 Apr;82(2):101-9; discussion 10.
7. Kamali A, Nunn AJ, Mulder DW, et al. Seroprevalence and incidence of genital ulcer infections in a rural Ugandan population. Sex Transm Infect. 1999;75:98-102.
8. 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. Sex Transm Infect. 1999;75:3-17.
9. Corey L, Wald A, Celum CL, et al. The effects of herpes simplex virus-2 on HIV-1 acquisition and transmission: a review of two overlapping epidemics. J Acquir Immune Defic Syndr. 2004;35:435-45.
10. Bailey RC, Mehta SD. Circumcision's place in the vicious cycle involving herpes simplex virus type 2 and HIV. J Infect Dis 2009;199:923-5.
11. Telzak EE, Chiasson MA, Bevier PJ, et al. HIV-1 seroconversion in patients with and without genital ulcer disease. A prospective study. Ann Intern Med. 1993;119:1181-6.
12. Weiss HA, Quigley MA, Hayes RJ. Male circumcision and risk of HIV infection in sub-Saharan Africa: a systematic review and meta-analysis. AIDS. 2000 Oct 20;14(15):2361-70.
13. Siegfried N, Muller M, Volmink J, et al. Male circumcision for prevention of heterosexual acquisition of HIV in men. Cochrane Database Syst Rev. 2003;(3):CD003362.
14. Gray RH, Kiwanuka N, Quinn TC, et al. Male circumcision and HIV acquisition and transmission: cohort studies in Rakai, Uganda. AIDS. 2000 Oct 20;14(15):2371-81.
15. Halperin DT, Bailey RC. Male circumcision and HIV infection: 10 years and counting. Lancet. 1999 Nov 20;354(9192):1813-5.
16. Auvert B, Taljaard D, Lagarde E, Sobngwi-Tambekou J, Sitta R, Puren A. Randomized, controlled intervention trial of male circumcision for reduction of HIV infection risk: the ANRS 1265 Trial. PLoS Med. 2005 Nov;2(11):e298. Erratum in: PLoS Med. 2006 May;3(5):e298.
17. Bailey RC, Moses S, Parker CB, et al. Male circumcision for HIV prevention in young men in Kisumu, Kenya: a randomised controlled trial. Lancet. 2007 Feb 24;369(9562):643-56.
18. Gray RH, Kigozi G, Serwadda D, et al. Male circumcision for HIV prevention in men in Rakai, Uganda: a randomised trial. Lancet 2007;369:657-666.
19. Byakika-Tusiime J. Circumcision and HIV infection: assessment of causality. AIDS Behav. 2008;12:835-41.
20. Wawer M, Makumbi F, Kigozi G, et al. Circumcision in HIV-infected men and its effect on HIV transmission to female partners in Rakai, Uganda: a randomised controlled trial. Lancet. 2009;374:229-37.
21. Weiss HA, Hankins CA, Dickson K. Male circumcision and risk of HIV infection in women: a systematic review and meta-analysis. Lancet Infect Dis. 2009;9:669-77.
22. Kreiss JK, Hopkins SG. The association between circumcision status and human immunodeficiency virus infection among homosexual men. J Infect Dis. 1993 Dec;168(6):1404-8.
23. Buchbinder SP, Vittinghoff E, Heagerty PJ, et al. Sexual risk, nitrite inhalant use, and lack of circumcision associated with HIV seroconversion in men who have sex with men in the United States. J Acquir Immune Defic Syndr. 2005 May 1;39(1):82-9.
24. Millett GA, Ding H, Lauby J, et al. Circumcision status and HIV infection among black and Latino men who have sex with men in 3 US cities. J Acquir Immune Defic Syndr. 2007 Dec;46(5):643-50.
25. Millett GA, Flores SA, Marks G, Reed JB, Herbst JH. Circumcision status and risk of HIV and sexually transmitted infections among men who have sex with men: a meta-analysis. JAMA. 2008;300(14):1674-1684.
26. Parkin D. The global health burden of infection-associated cancers in the year 2002. Int J Cancer. 2006;118:3030-44.
27. Tobian AA, Serwadda D, Quinn TC, et al. Male circumcision for the prevention of HSV-2 and HPV infections and syphilis. N Engl J Med. 2009;360:1298-309.
28. Auvert B, Sobngwi-Tambekou J, Cutler E, et al. Effect of male circumcision on the prevalence of high-risk human papillomavirus in young men: results of a randomized controlled trial conducted in Orange Farm, South Africa. J Infect Dis. 2009;199:14-9.
29. Wawer MJ, Tobian AA, Kigozi G, Kong X, Gravitt PE, Serwadda D, Nalugoda F, Makumbi F, Ssempijja V, Sewankambo N, Watya S, Eaton KP, Oliver AE, Chen MZ, Reynolds SJ, Quinn TC, Gray RH. Effect of circumcision of HIV-negative men on transmission of human papillomavirus to HIV-negative women: a randomised trial in Rakai, Uganda. Lancet. 2011 Jan 15;377(9761):209-18. Epub 2011 Jan 6.
30. Wingo PA, Tong T, Bolden S. Cancer statistics, 1995. CA Cancer J Clin. 1995 Jan-Feb;45(1):8-30.
31. Schoen EJ, Oehrli M, Colby CJ, Machin G. The highly protective effect of newborn circumcision against invasive penile cancer. Pediatrics. 2000 Mar;105(3):e36. Accessed Jan 24, 2008.
32. Schoen E. The relationship between circumcision and cancer of the penis. CA Cancer J Clin. 1991;41(5):306-9.
33. Castellsague X, Bosch FX, Munoz N, Meijer CJ, Shah KV, de Sanjose S, et al. Male circumcision, penile human papillomavirus infection, and cervical cancer in female partners. N Engl J Med. 2002 Apr 11;346(15):1105-12.

34. Shaikh N, Morone NE, Bost JE, Farrell MH. Prevalence of urinary tract infection in childhood: a meta-analysis. Pediatr Infect Dis J. 2008 Apr;27(4):302-8.

35. Singh-Grewal D, Macdessi J, Craig J. Circumcision for the prevention of urinary tract infection in boys: a systematic review of randomised trials and observational studies. Arch Dis Child. 2005 Aug;90(8):853-8.

36. To T, Agha M, Dick PT, Feldman W. Cohort study on circumcision of newborn boys and subsequent risk of urinary-tract infection. Lancet. 1998 Dec 5;352(9143):1813-6.

37. Sobngwi-Tambekou J, Taljaard D, Lissouba P, Zarca K, Puren A, Lagarde E, et al. Effect of HSV-2 serostatus on acquisition of HIV by young men: results of a longitudinal study in Orange Farm, South Africa. J Infect Dis. 2009 Apr 1;199(7):958-64.

38. Sobngwi-Tambekou J, Taljaard D, Nieuwoudt M, et al. Male circumcision and Neisseria gonorrhoeae, Chlamydia trachomatis and Trichomonas vaginalis: observations after a randomised controlled trial for HIV prevention. Sex Transm Infect. 2009;85:116-20.

39. Gray RH, Kigozi G, Serwadda D, et al. The effects of male circumcision on female partners' genital tract symptoms and vaginal infections in a randomized trial in Rakai, Uganda. Am J Obstet Gynecol. 2009;200:42 e1-7.

40. Wiswell TE, Geschke DW. Risks from circumcision during the first month of life compared with those for uncircumcised boys. Pediatrics. 1989;83:1011-5.

41. Christakis DA, Harvey E, Zerr DM, et al. A trade-off analysis of routine newborn circumcision. Pediatrics. 2000;105:246-9.

42. Gray R, Wawer MJ, Thoma M, et al. Male circumcision and the risks of female HIV and sexually transmitted infections acquisition in Rakai, Uganda [Abstract 128]. Presented at: 13th Conference on Retroviruses and Opportunistic Infections. Feb 5-9, 2006; Denver, CO. Accessed Jan 24, 2008.

43. Wawer MJ. Trial of male circumcision: HIV, sexually transmitted disease (STD) and behavioral effects in men, women and the community. Available at www.clinicaltrials.gov. Accessed Jan 23, 2008.

44. Weiss HA. Complications of circumcision in male neonates, infants and children in a systematic review. BMC Urol. 2010;10:2.

45. Kigozi G, Watya S, Polis CB, et al. The effect of male circumcision on sexual satisfaction and function, results from a randomized trial of male circumcision for human immunodeficiency virus prevention, Rakai, Uganda. BJU Int. 2008 Jan;101(1):65-70.

46. Kigozi G, Gray RH, Wawer MJ, et al. The safety of adult male circumcision in HIV-infected and uninfected men in Rakai, Uganda. PLoS Med. 2008;5:e116.

47. Banieghbal B. Optimal time for neonatal circumcision: An observation-based study. J Ped Urol. 2009;5:359-62.

48. Sorrells ML, Snyder JL, Reiss MD, et al. Fine-touch pressure thresholds in the adult penis. BJU Int. 2007 Apr;99(4):864-9. Erratum in: BJU Int. 2007 Aug;100(2):481.

49. Krieger JN, Bailey RC, Opeya JC, et al. Adult male circumcision outcomes: experience in a developing country setting. Urol Int. 2007;78(3):235-40.

50. Collins S, Upshaw J, Rutchik S, et al. Effects of circumcision on male sexual function: debunking a myth? J Urol. 2002;167:2111-2.

51. Senkul T, Iseri C, Sen B, et al. Circumcision in adults: effect on sexual function. Urology. 2004;63:155-8.

52. Masood S, Patel HRH, Himpson RC, et al. Penile sensitivity and sexual satisfaction after circumcision: are we informing men correctly? Urol Int. 2004;75:62-6.

53. McQuillan GM, Kruszon-Moran D, Kottiri BJ, et al. Prevalence of HIV in the US household population: the National Health and Nutrition Examination Surveys, 1988 to 2002. J Acquir Immune Defic Syndr. 2006;41:651-6.

54. Hall HI, Song R, Rhodes P, et al. Estimation of HIV incidence in the United States. JAMA. 2008;300:520-9.

55. Centers for Disease Control and Prevention. HIV/AIDS Surveillance Report, 2007. 2009; 1-55. Available at: http://www.cdc.gov/hiv/topics/surveillance/resources/reports

56. Warner L, Ghanem KG, Newman DR, et al. Male circumcision and risk of HIV infection among heterosexual African American men attending Baltimore sexually transmitted disease clinics. J Infect Dis. 2009;199:59-65.

57. Xu F, Markowitz LE, Sternberg MR, Aral SO. Prevalence of circumcision and herpes simplex virus type 2 infection in men in the United States: the National Health and Nutrition Examination Survey (NHANES), 1999–2004. Sex Transm Dis. 2007 July; 34(7):479-84.

58. Risser JM, Risser WL, Eissa MA, Cromwell PF, Barratt MS, Bortot A. Self-assessment of circumcision status by adolescents. Am J Epidemiol. 2004 Jun 1;159(11):1095-7.

59. Centers for Disease Control and Prevention. Trends in circumcisions among newborns. Accessed Jan 24, 2008.

60. Nelson CP, Dunn R, Wan J, Wei JT. The increasing incidence of newborn circumcision: data from the nationwide inpatient sample. J Urol. 2005 Mar;173(3):978-81.

61. American Academy of Pediatrics, Task Force on Circumcision. Circumcision policy statement. Pediatrics. 1999 Mar;103(3):686-93.

62. Liebowitz AA, Desmond K, Belin T. Determinants and policy implications of male circumcision in the United States. Am J Public Health. 2009;99:138-45.

63. Schoen E, Colby C, Ray G. Newborn circumcision decreases incidence and costs of urinary tract infections during the first year of life. Pediatrics. 2000;105(4):789-93.

64. Sansom SL, Prabhu VS, Hutchinson AB, et al. Cost-effectiveness of newborn circumcision in reducing lifetime HIV risk among U.S. males. PloS ONE. 2010;5:e8723.

65. Anderson J, Wilson D, Templeton DJ, et al. Cost-effectiveness of adult circumcision in a resource-rich setting for HIV prevention among men who have sex with men. J Infect Dis. 2009;200:1803-12.

66. Adler R, Ottaway S, Gould S. Circumcision: we have heard from the experts; now let's hear from the parents. Pediatrics. 2001:107:e20. Accessed Jan 24, 2008.

67. Benatar M, Benatar D. Between prophylaxis and child abuse: the ethics of neonatal male circumcision. Am J Bioeth. 2003 Spring;3(2):35-48.

68. Koblin BA, Chesney MA, Husnik MJ, et al. High-risk behaviors among men who have sex with men in 6 US cities: baseline data from the EXPLORE study. Am J Public Health. 2003 Jun;93(6):926-32. Erratum in: Am J Public Health 2003 Aug;93(8):1203.