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The Epidemiology of HIV and Other Sexually Transmitted Infections in the Developing World

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As for several other infectious diseases, sexually transmitted diseases (STD) in many developing countries are characterized by a high incidence and prevalence, a high rate of complications and sequelae (particularly in women and neonates), a different clinical spectrum (more genital ulcer disease), and a severe problem of antimicrobial resistance (in *N. gonorrhoeae* and *C. trachomatis*). In Africa, HIV is mainly spread heterosexually, resulting in a major problem of vertically acquired HIV infection in children. STDs, in particular those associated with genital ulceration, are enhancing the efficiency of sexual transmission of HIV, and their high prevalence may partly explain the occurrence of a major heterosexual epidemic of HIV in Africa, as opposed to Europe. Factors contributing to the spread of STDs are to a large extent demographic, sociobehavioural and medical such as a larger pool of adolescents and young adults, prostitution, urban migration, indiscriminate use of antibiotics and inadequate medical facilities and STD control programmes. Programmes for the prevention and control of STD and AIDS should be an immediate priority in many developing countries.

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INTRODUCTION

Sexually transmitted diseases (STD) have been a much neglected area in public health in most of the developing world, despite overwhelming evidence of their impact on health, particularly of women and neonates. The emergence of AIDS in the 1980s has highlighted the importance of sexual transmission in the spread of infections, as well as the lack of control programmes for STDs.

We will briefly review some epidemiological characteristics of STDs and HIV infection in the developing world, with emphasis on sub-Saharan Africa. It should be emphasized that there exist many different epidemiologic patterns of STDs and HIV infection, and that data from one particular population or country can often not be extrapolated to other populations. Nevertheless, some common features can be observed, as shown in Table I. The reader is referred to several recent books and reviews for more in depth informaton (1–4).

INCIDENCE AND PREVALENCE

Sexually transmitted diseases

Surveillance for STDs is essentially non-existent in many developing countries, and most data come from point prevalence studies, often in highly selected populations. Thus, prevalence rates of gonorrhoea and chlamydial infection in pregnant women of 5 to 15%, and 7 to 20%, respectively, have been documented in several countries in Africa and the Carribean (5, 6). In the same populations, on the average 10 to 15% of women have a positive serological test for syphilis, though prevalence rates may be as low as 3% and as high as 33% (6).

Prevalence rates for these infections are much higher in high risk populations such as female prostitutes. Thus, in two studies among prostitutes in Kenya and Zaire less than 20% of the women did not have any STD (Table II).

HIV infection

As for other STDs, HIV infection is widely spread in some urban populations in Africa, particularly in the Central and Eastern parts of the continent. However since HIV is a more recently introduced virus, and is still spreading over the world, the situation is still unstable, and even more epidemiological heterogeneity is apparent with HIV infection in most parts of the world. Thus, in those populations where the virus has now been present for some time, the virus seems to spread at a much different speed in different populations and countries. This is most obvious in populations at high risk for HIV infection such as prostitutes and men with STD in Central and Eastern Africa. A similar, if not worse, evolution is currently occurring among injecting drug users in South East Asia, showing that a given epidemiological status may be preliminary and fragile (9). Even in populations in Africa, who are not at particularly high risk, HIV spreads more rapidly in some than in others. Thus, the HIV seroprevalence rate among pregnant women in Kinshasa has been fairly stable over the last 5 years, whereas it increased tremendously among pregnant women in Kampala, Uganda, and Kigali, Rwanda (10–12).

In general, HIV prevalence is much higher in the cities than in rural areas, where still the majority of the African population lives. For instance, whereas in a nationwide health survey in Rwanda over 20% of urban adults were infected in 1987, only approximately 2% of rural adults were HIV antibody positive (12). However, Africa is a continent of rapid urbanization, a phenomenon which may contribute to the further spread of HIV.

Seroprevalence rates in the urban general adult populations are generally lower in the western and southern parts, than in central and eastern Africa. However the rapid emergence of AIDS in Côte d'Ivoire illustrates that this favorable situation in West Africa may change rapidly (13). The high level of STDs in many countries as yet relatively unaffected by the HIV epidemic indicates the strong potential for the sexual spread of HIV.

Heterosexual transmission is the major mode of spread in Africa and parts of the Carribean

Table I. *Some characteristics of sexually transmitted diseases in the developing world*

High incidence and prevalence
High rates of complications and sequelae
Importance of genital ulcer disease
High rates of antimicrobial resistance
Interaction of STDs and HIV infection

Table II. *Sexually transmitted diseases in female prostitutes in Kinshasa (1988) and Nairobi (1984) (%) (7, 8)*

D'Costa et al., 1985; Laga et al., 1989

	Kinshasa $N=801$	Nairobi $N=193$
Gonorrhoea	37	30
Chlamydial infection	13	NT
Positive RPR and TPHA	18	41
Genital ulceration	9	7
Chancroid	4	2.5
Genital herpes	2	NT
HIV antibody	37	59

and, increasingly also in South America (4, 14), with perinatal transmission a growing problem. Though blood donations are increasingly screened for HIV antibody, blood transfusions continue to contribute to the spread of HIV in many areas.

Reasons for high infection rates

A number of hypotheses have been proposed to explain why STDs and HIV infection are highly prevalent in some parts of the Third World.

Firstly, a large proportion of the population is composed of teenagers and young adults. Since in general, the highest rates of STDs are found among urban men and women in their sexually most active years, this demographic factor undoubtedly contributes to the high infection rates observed in some countries. In addition, because of a continuing demographic explosion, the potentially "at risk" population in the developing world will become larger.

Secondly, social and political factors such as rapid urbanization, and increasing mobility for economic and political reasons, may lead to disruption of traditional values, favoring acquisition of STDs. Prostitution is often also associated with these phenomena, and relatively contributes more to the spread of STDs than in the industrialized world (15).

Thirdly, behavioural factors may also explain differences in epidemiological patterns of STDs and HIV infection, but recent data on sexual behaviour of urban populations are poor.

Fourthly, the more frequent occurrence of biological factors such as higher infectiousness of individuals with more advanced HIV infection, and of genital ulcerations and other STDs as risk factors for HIV transmission, may also contribute to a more rapid spread of HIV in some populations.

Lastly, the lack of STD control programmes, of diagnostic facilities and of effective drugs, are all in favour of an STD epidemic.

COMPLICATIONS AND SEQUELAE OF STD

The burden of STDs is mainly due to their complications and sequelae, mainly in women and neonates. Their prevention has traditionally been the major objective of STD control programmes. As is the case for other diseases, complications are more frequent in the developing world, mainly because of inadequate diagnostic and therapeutic means, as well as of poor health seeking behaviour. However, accurate data on their incidence are lacking.

Pelvic inflammatory disease is a common reason for hospitalization in gynaecological wards in many African hospitals, accounting for up to 40% of admissions (16). Postpartum upper genital tract infection may occur in up to 20% of puerperal women (17). Most cases seem due to *Neisseria gonorrhoeae* or *Chlamydia trachomatis* (17–21), but the relative contribution of either agent depends heavily on the selection of patients, and whether only severe hospitalized cases are considered, or also outpatients. The level and patterns of infertility vary widely from country to country, and even within countries. A world wide survey by WHO showed that aetiological factors in infertility are strikingly different in Africa, as compared to other continents (22). Thus, bilateral tubal occlusion was diagnosed in approximately 50% of all cases of infertility in women in Africa, as compared to 11 to 20% in other parts of the world (Table III). This suggests that STDs leading to salpingitis are the major causes of infertility in Africa.

Ectopic pregnancy is also more prevalent in developing countries, with a rate of approximately 1:133 pregnancies (23). It contributes significantly to maternal mortality. As for infertility, post-salpingitis tubal scarring is a major aetiological factor for ectopic pregnancy. There is good serological evidence for a role of both *C. trachomatis* and *N. gonorrhoeae* in the aetiology of ectopic pregnancy in Africa (19), making it one of the most severe consequences of STDs.

STD-related neonatal morbidity is mainly caused by syphilis and gonococcal and chlamydial infection in the mother. As a result of high prevalence rates of syphilis in pregnant women, the incidence of congenital syphilis may be as high as 1 400 cases per 100 000 births, as is the case in Zambia (24). Congenital syphilis is a major cause of stillbirth in countries such as Ethiopia, Zambia and Swaziland (24–26).

In countries where eye prophylaxis at birth is not or insufficiently applied, gonococcal ophthalmia neonatorum is still common, occurring in up to 3% of all live births (27). It is associated with keratitis in nearly 20% of cases and may lead to blindness (28). *N. gonorrhoeae* is also an important cause of keratoconjunctivitis in adults in the tropics (29). However, *C. trachomatis* is probably the most common cause of neonatal conjunctivitis, but cases are often milder and may come less often to medical attention. The contribution of chlamydial infection to cases of neonatal pneumonia in the developing world has as yet not been documented.

HIV infection

Because HIV infection in Africa affects women more than elsewhere, perinatal transmission of HIV is increasingly occurring. Ongoing studies in Central and East Africa have documented a 25 to 40% vertical transmission rate from mother to child, with women with a more immunological defect apparently being more infectious for their offspring (30). However, estimates of the risk of transmission should be considered preliminary, since diagnosis of neonatal HIV infection is still unreliable. Whereas anecdotical reports suggest that HIV transmission through breast milk can occur, it is not clear how often this occurs. However, recent data from Kinshasa suggest that if there is a risk of transmission, it is probably low (31). Because of its tremendous overall benefits, promotion of breast feeding should continue, including in HIV endemic areas.

The mortality associated with HIV infection seems very high in Africa. In the Project SIDA cohort of children born to HIV seropositive mothers, over 20% had died by one year of age (32).

Between one and two years, another 20% of the perinatally infected children had died. In populations with high HIV prevalence rates in pregnant women, such as in Kampala or Kigali, an average of 20% of all infant deaths are due to HIV infection (32). The proportion of HIV related infant deaths will undoubtedly increase in many countries as the AIDS epidemic spreads further.

HIV infection may also affect the outcome of pregnancy, though data are conflicting between studies in North America/Europe and Africa (33–35). In a case control study in Kenya, HIV was the only infectious agent significantly and independently associated with preterm delivery, low birth weight and intra-uterine growth retardation (35). The biological basis for these complications is not clear.

Table III. *Specific diagnoses of infertility in women (% of women)*

Adapted from W. Cates et al., Lancet 1985 (22)

	Europe/ North America	Africa	Asia	Latin America	Middle East
Bilateral tubal occlusion	11	49	14	15	20
Pelvic adhesions	13	24	13	17	13
Acquired tubal abnormality	12	12	12	12	9

GENITAL ULCER DISEASE

Genital ulcer disease is relatively more common in many developing areas than in Europe and North America. Cases of genital ulceration may represent up to half of all patients with an STD in Africa (36).

Chancroid is the most common cause of genital ulcer disease in both men and women in Africa, and probably in many other parts of the developing world (Table IV) (37–40). The epidemiology of chancroid is poorly documented, as a result of both little interest in the disease until recently and the lack of accurate and simple diagnostic tools. Patients usually belong to lower socioeconomic strata, and often name a prostitute as a source of infection (41). Lack of circumcision increases the susceptibility of men to chancroid. It is not clear whether there is an asymptomatic reservoir of *Haemophilus ducreyi* and what the risk of transmisson is.

Both genital herpes and syphilis are also important causes of genital ulcer disease in the tropics. As will be discussed below, genital ulcers appear to be important risk factors for the spread of HIV (42).

ANTIMICROBIAL RESISTANCE

Antimicrobial resistance has become a major problem for the control of gonorrhoea, and to a lesser extent, of chancroid in large parts of the developing world. *N. gonorrhoeae* strains are generally less susceptible to antibiotics in the tropics than in the industrialized world. Approximately half of the isolates in most parts of Africa and south-east Asia are now penicillinase producing (PPNG), and a major proportion of NON-PPNG strains show high-level chromosomal resistance to penicillin as well (5, 6). This problem appears to be less common in South America (43). Penicillinase production in *N. gonorrhoeae* is encoded by 3 different plasmids, which can all be found in Africa (44–45).

Spectinomycin-resistant strains of *N. gonorrhoeae* have also been identified in various parts of the world, though not in Africa (46–47). They do not seem to be spread as PPNG.

High level tetracycline resistant gonococcal strains (TRNG) have now also been found in Central Africa. In 1988 in Kinshasa, they represented 10% of isolates, with an additional 40% being moderately resistant (48). TRNG were not found in an earlier survey in the same city in 1986, indicating that such strains have been introduced recently. Their emergence will further complicate gonorrhoea treatment in Africa.

Most recent isolates of *H. ducreyi* have been shown to produce a TEM-1 type of β-lactamase encoded by various plasmids containing a Tr-2-like ampicillin resistance transposon as in

Table IV. *Aetiology of genital ulcer disease in consecutive patients*

From: Mabey et al.; Nsanze et al.; Taylor et al.; Vacca and MacMillan (37–40)

Diagnosis	Gambia $N=104$	Kenya $N=97$	Thailand $N=120$	Papua New Guinea $N=174$
Chancroid	52	62	36	0
Syphilis	22	9	1	14
Herpes	6	4	10	0
LGV	4	NT	0	9
Donovanosis	0	0	0	22
Mixed	14	2	2	37
Other/unknown	27	13	52	18

PPNG (49). In addition, there is considerable geographical variation in the antimicrobial susceptibility of *H. ducreyi* and in the effectiveness of different antimicrobial regimens. Thus, whereas trimethoprim-sulfamethoxazole is the recommended treatment in Africa (50), it cured only 55 to 87% of men with chancroid in Thailand (51). Sulfonamides and tetracyclines are not effective any longer for the treatment of chancroid because of wide spread resistance to these agents.

INTERACTION OF HIV INFECTION AND STDs

Interactions between HIV infection and various other STDs are increasingly documented, and involve both the impact of STDs on the sexual transmission of HIV, and the impact of HIV infection on the natural history and response to therapy of STDs (42, 52).

Numerous studies, mainly in Africa, have consistently found that genital ulcers increase the risk of sexual transmission of HIV (42, 52, 53). This appears to be the case for all major causes of genital ulcer disease but is mostly documented for chancroid. Cohort studies on female prostitutes in Kenya and Zaire suggested that the presence of genital ulcer disease greatly increases the risk of acquiring HIV infection (8, 54). In another prospective study in Kenya, men who were sexually exposed to an HIV infected woman, had a much higher risk of becoming infected with HIV if they simultaneously acquired a genital ulcer (55). This suggests that HIV infected women with a genital ulcer are more infectious for their sex partners.

The evidence for non-ulcerative STDs as risk factors for HIV transmission is less strong, though it is biologically plausible. The inflammation associated with STDs may interact in two ways with HIV transmission: 1) by increasing the pool of potential target cells at the genital level in HIV uninfected people; and 2) by increasing the number of HIV infected cells in the genital secretions of infected individuals. Infection with *C. trachomatis* was a risk factor for incident HIV infection in two prospective studies in prostitutes in Africa, as was trichomoniasis in one cohort study in Zaire (8, 54). If it is confirmed that very common STDs such as genital chlamydial infection and trichomoniasis are increasing the risk of HIV infection, then they will represent a much higher population attributable risk than genital ulcers which are less common.

Some diseases that may be influenced by a concomitant HIV infection are listed in Table V. The clinical course and the response to standard therapy of syphilis, chancroid, hepatitis B and human papillomavirus infection are modified in the presence of HIV infection (56–60), and other STDs may be in that case. This is an important area for further research.

CONCLUSION

All the data stress the need for the urgent initiation of effective STD control programmes in the Third World, and for the development of appropriate tools and strategies to be used in

Table V. *Impact of HIV infection on other endemic diseases*

Disease	Natural history	Response to therapy
Tuberculosis	+	+
Syphilis	+	+
Chancroid	+?	+
Hepatitis B	+	
Genital human papillomavirus infection	+?	
Measles	+	

developing countries. Such programmes should focus on all STDs if we ever want to control HIV infection and AIDS (61).

REFERENCES

1. Osoba AO (ed). Sexually transmitted diseases in the tropics. London: Baillière Tindall, 248 pp., 1987.
2. Piot P, Mann JM (eds). AIDS and HIV infection in the tropics. London, Baillière Tindall, 171 pp., 1988.
3. Rozenheim M, Itona-Ngaporo A. SIDA. Infection à VIH aspects en zône tropicale. Paris, Ellipses, 336 pp., 1989.
4. Piot P, Plummer FA, Mhalu FS, Lamboray JL, Chin J, Mann JM. AIDS: An international perspective. Science 239: 573–579, 1988.
5. Meheus A. Gonorrhoea. In: Osoba AO, ed. Sexually transmitted diseases in the tropics. London: Baillière Tindall, 17–31, 1987.
6. Piot P, Holmes KK. Sexually transmitted diseases. In: Warren K, Mahmoud AAF, eds. Tropical and geographical medicine. 2nd ed. New York: McGraw-Hill, 1989, in press.
7. D'Costa LJ, Plummer FA, Bowmer I, Fransen L, Piot P, Ronald AR, Nsanze H. Prostitutes are a major reservoir of sexually transmitted diseases in Nairobi, Kenya. Sex Transm Dis 12: 64–67, 1985.
8. Laga M, Nzila N, Manoka AT, Behets F, Piot P, Ryder R. High prevalence and incidence of HIV and other STD among 801 Kinshasa prostitutes. Abstract, Vth International Conference on AIDS, Montreal, June 1989.
9. Phanuphak P, Poshyachinda V, Un-eklabh T, Rojanapithayakorn W. HIV transmission among intravenous drug abusers. Abstract T.G.O.25, V International Conference on AIDS, Montreal, June 1989.
10. N'galy B. Difficulties and obstacles for optimal management of AIDs and HIV infection in the developing world. Plenary presentation. V International Conference on AIDS, Montreal, June 1989.
11. Carswell JW, Lloyd G. Rise in prevalence of HIV antibodies recorded at an antenatal booking clinic in Kampala, Uganda. AIDS 1: 192–193, 1987.
12. Rwandan HIV seroprevalence study group. Nationwide community-based serological survey of HIV-1 and other human retrovirus infections in a central African country. Lancet 1: 947–943, 1989.
13. De Cock KM, Porter A, Moreau J, Diaby L, Odehouri K, Heyward W. Sentinel site surveillance for AIDS in Abidjan, Côte d'Ivoire. Abstract W.G.O.27, V International Conference on AIDS, Montreal, June 1989.
14. Quinn TC, Zaccharias F, St. John R. AIDS in the Americas. An emerging public health crisis. N Engl J Med 320: 1005–1007, 1989.
15. Piot P, Caraël M. Epidemiological and sociological aspects of HIV infection in developing countries. Br Med Bull 44: 68–88, 1988.
16. Muir DG, Belsey MA. PID and its consequences in the developing world. Am J Obstet Gynaecol 138: 913–928, 1980.
17. Plummer FA, Laga M, Brunham RC et al. Postpartum upper genital tract infections in Nairobi, Kenya: Epidemiology, etiology and risk factors. J Infect Dis 156: 92–97, 1987.
18. Meheus A, Reniers J, Collet M et al. *Chlamydia trachomatis* in women with acute salpingitis and infertility in Central Africa. In: Oriel D, Ridgway G, Schachter J et al., eds. Chlamydial infections. Cambridge University Press, 201, 1986.
19. De Muylder X, Laga M, Tennstedt C, Van Dyck E, Piot P. Role of *C. trachomatis* and *N. gonorrhoeae* in salpingitis and its sequelae in Zimbabwe. Submitted.
20. Perine PL, Duncan MA, Krauze DW et al. Pelvic inflammatory diseases and puerperal sepsis in Ethiopia. 1. Ethiology. Am J Obstet Gynecol 138: 969, 1980.
21. Ratnam AV, Din SN, Catterjee TK. Gonococcal infection in women with PID in Lusaka, Zambia. Am J Obstet Gynecol 138: 965, 1980.
22. Cates W, Farley TMM, Rowe PJ. Worldwide patterns of infertility: is Africa different? Lancet 2: 596–598, 1985.
23. Urquhart J. Effect of the venereal disease epidemic on the incidence of ectopic pregnancy. Implications for the evaluation of contraceptives. Contraception 19: 455–480, 1979.
24. Hira SK, Hira RS. Congenital syphilis. In: Osoba AO, ed. STD in the tropics. London: Baillière Tindall, 113, 1987.
25. Friedman PS, Wright DJM. Observations on syphilis in Addis Ababa. 2. Prevalence and natural history. Br J Ven Dis 53: 276, 1977.
26. Mabey DC. Syphilis in sub-Saharan Africa. Afr J Sex Transm Dis 3: 61, 1986.
27. Laga M, Plummer FA, Nsanze H et al. Epidemiology of ophthalmia neonatorum in Kenya. Lancet 2: 1145, 1986.

7-908563

28. Fransen L, Nsanze H, Klauss V, Van der Stuyft P, D'Costa L, Brunham RC, Piot P. Ophthalmia neonatorum in Nairobi, Kenya: The roles of *Neisseria gonorrhoeae* and *Chlamydia trachomatis*. J Infect Dis 153: 862–869, 1986.
29. Kesteleyn P, Bogaerts J, Meheus A. Gonorrheal keratoconjunctivitis in African adults. Sex Transm Dis 14: 191–194, 1987.
30. Ryder R, Nsa W, Hassig S et al. Perinatal transmission of the human immunodeficiency virus type 1 to infants of seropositive women in Zaire. N Engl J Med 320: 1637–1642, 1989.
31. Manzilla T, Baende E, Kabagabo U, Paquot E, Colebunders R, Ryder R. Inability to demonstrate a dose–response effect between receipt of mother's milk and perinatally acquired infection in a cohort of 114 infants born to HIV (+) mothers. Abstract W.G.O.1 V International Conference on AIDS, Montreal, June 1989.
32. Valleroy LA, Harris JA, Way PO. The impact of HIV infection on child survival in Africa. Abstract W.G.P.7, V International Conference on AIDS, Montreal, June 1989.
33. Selwyn PA, Schoenbaum EE, Davenny K, Robertson VJ, Feingold AR, Shulman JF, Mayers MM, Klein RS, Friedland GH, Rogers MF. Prospective study of HIV infection and pregnancy outcomes in intravenous drug users. JAMA 261: 1289–1294, 1989.
34. Blanche S, Rouzioux C, Guihart Moscato M-L et al. A prospective study of infants born to women seropositive for HIV-1. N Engl J Med 320: 1643–1648, 1989.
35. Temmerman M, Mirza N, Plummer F, Ndinya-Achola JO, Wamola I, Piot P. HIV infection as a risk factor for poor obstetrical outcome. Abstract Th.G.O.53, V International Conference on AIDS, Montreal, June 1989.
36. Piot P, Meheus A. Epidémiologie des maladies sexuellement transmissibles dans les pays en développement. Ann Soc Belge Méd Trop 63: 87–110, 1983.
37. Mabey D. Aetiology of genital ulceration in the Gambia. Genitourin Med 63: 312–314, 1987.
38. Nsanze H, Fast M, D'Costa LJ et al. Genital ulcer in Kenya: a clinical and laboratory study of 100 patients. Br J Vener Dis 57: 378–381, 1981.
39. Taylor DN, Duangmani C, Suvongse C et al. The role of *Haemophilus ducreyi* in penile ulcerations in Bangkok, Thailand. Sex Transm Dis 11: 148–152, 1984.
40. Vacca K, MacMillan LL. Anogenital lesions in women in Papua New Guinea. Papua N Guin Med J 23: 70–73, 1980.
41. Plummer FA, D'Costa LJ, Nsanze H et al. Epidemiology of chancroid and *Haemophilus ducreyi* in Nairobi, Kenya. Lancet 2: 1293, 1983.
42. Piot P, Laga M. Genital ulcers and other sexually transmitted diseases as cofactors for the sexual transmission of HIV. Br Med J 298: 623–624, 1989.
43. Moreno JG, Dillon JR, Assoyave R et al. Identification of penicillinase-producing *Neisseria gonorrhoeae* during clinical and microbiological study of gonococcal susceptibility to antimicrobial agents. Genitourin Med 63: 6–10, 1987.
44. Bogaerts J, Vandepitte J, Van Dyck E, Van Hoof R, Piot P. In vitro antimicrobial sensitivity of *N. gonorrhoeae* in Rwanda. Genitourin Med 62: 217–220, 1986.
45. Plummer FA, D'Costa LJ, Nsanze H et al. Development of endemic penicillinase-producing *Neisseria gonorrhoeae* in Kenya. In: Schoolnick GK, ed. The pathogenic Neisseriae. Washington, DC: American Society for Microbiology, 101–104, 1985.
46. Centers for Disease Control Spectinomycin-resistant penicillinase producing *Neisseria gonorrhoeae*California. MMWR 30: 221–228, 1981.
47. Ashford WA, Potts DW, Adamas HJU et al. Spectinomycin resistant penicillinase-producting *Neisseria gonorrhoeae*. Lancet 2: 1035–1037, 1981.
48. Van Dyck E, Rosseau R, Duhamel M, Behets F, Laga M, Van Heuverswijn H, Piot P. Antimicrobial sensitivity of *Neisseria gonorrhoeae* in Zaire: High level plasmid-mediated tetracycline resistance in Africa. Submitted.
49. Maclean IW, Bowden GHW, Albritton WL. TEM-type β-lactamase production in *Haemophilus ducreyi*. Antimicrob Agents Chemother 17: 897–904, 1980.
50. Plummer FA, Nsaze H, D'Costa LJ et al. Single-dose therapy of chancroid with trimethoprim-sulfametrole. N Engl J Med 309: 67–73, 1983.
51. Taylor DN, Pitarangsi C, Echeverria P et al. Comparative study of ceftriaxone and trimethoprim-sulfamethoxazole for the treatment of chancroid in Thailand. J Infect Dis 152: 1002–1007, 1985.
52. Pepin J, Plummer FA, Brunham RC, Piot P, Cameron DW, Ronald AR. The interaction of HIV infection and other sexually transmitted diseases: an opportunity for intervention. AIDS 3: 3–10, 1989.
53. World Healthy Organization. Consensus statement from consultation on sexually transmitted diseases as a risk factor for HIV transmission. WHO/GPA/INF/89.1, 1989.
54. Plummer FA, Cameron W, Simonsen N et al. Cofactors in male–female transmission of HIV. Abstract 4554, IV International Conference on AIDS, Stockholm, Sweden, June 1988.

55. Cameron W, D'Costa LJ, Ndinya-Achola JO, Piot P, Plummer FA. Incidence and risk factors for female to male transmission of HIV. Abstract 4061, IV International Conference on AIDS, Stockholm, Sweden, June 1988.
56. Johns DR, Tierney M, Flesenstein D. Alteration in the natural history of neurosyphilis by concurrent infection with HIV. N Engl J Med 316: 1569–1572, 1987.
57. Berry CD, Hooton TM, Collier AC, Lukehart SA. Neurologic relapse after benzathine penicillin therapy for secondary syphilis in a patient with HIV infection. N Engl J Med 316: 1587–1589, 1987.
58. Cameron DW, Plummer FA, D'Costa LJ, Ndinya-Achola JO, Ronald AR. Prediction of HIV infection by treatment failure for chancroid, a genital ulcer disease. IV International Conference on AIDS, Stockholm, Sweden, 1988.
59. Taylor PE, Stevens LE, Rodriguez de Cordoba S, Rubinstein P. Hepatitis B virus and HIV: possible interactions. In: AJ Zuckerman, ed. Viral hepatitis and liver disease. New York: Alan R. Liss, 198–200, 1988.
60. Feingold AR, Vermund SH, Burk RD, Kelley KF, Schrager LK, Klein RS. HIV infection increases the frequency and severity of papillomavirus induced cervical cytologic abnormalities. Abstract Th.A.P.104, V International Conference on AIDS, Montreal, June 1989.
61. Holmes KK, Kreiss JK. Heterosexual transmisson of human immunodeficiency virus: overview of a neglected aspect of the AIDS epidemic. J AIDS 1: 602–610, 1989.