

SEXUALLY TRANSMITTED DISEASES



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"Venereal" comes from "Venus," the name of the Roman goddess of love. Thus, venereal disease, or VD, is that associated with love-making.

What many people do not realize is that VD is more than gonorrhea and syphilis. These two infections are the most familiar, but there are others. Some are less common in this country than elsewhere. A few have just begun to be considered venereal or "sexually transmitted" diseases.

The toll of all these infections is high. The federal government's Center for Disease Control estimates that, in a year, 8 to 10 million Americans have gonorrhea, syphilis, genital herpes, trichomoniasis, or nongonococcal urethritis. These diseases all have in common the fact that they are spread through very intimate — usually sexual — contact.

Accordingly, persons most affected by venereal diseases are those in the most sexually active group — 15 to 30 years of age. Treatment of the various infections differ, as do symptoms and possible complications.

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GONORRHEA

Gonorrhea accounted for slightly over one million reported infections in this country in 1977, but the actual figure is probably many times higher. Most people are treated by private physicians who often do not report their cases to public health authorities. It has been estimated that, worldwide, there are 100 million cases of gonorrhea each year, and the number is rising.

Regardless of numbers, gonorrhea is one of the most common human bacterial infections. The guilty bacterium is *Neisseria gonorrhoeae*, or the gonococcus, which contains a toxic substance that may cause tissue damage.

Gonorrhea can almost always be traced to sexual exposure to an infected individual. Rarely, if ever, does it result from contact with inanimate objects such as toilet seats. This is because the gonococcus is extremely delicate and survives very poorly outside the human body in open air or under significant changes in temperature.

SYMPTOMS first occur, typically, in the lining of the genital and urinary tracts. In males, this results in a pus-producing infection of the urethra, the canal carrying urine outside the body from the bladder. The first sign may be a sudden burning on urination and a discharge two to eight days after exposure.

In females, infection of the urethra and the cervix (the opening of the womb) is usual. This may result in painful urination and a discharge from the vagina (birth canal), although many women (and a significant number of men) have no noticeable symptoms of early infection. Such symptom-free infections may be one reason for the current uncontrolled spread of this disease.

In passing through the mother's infected birth canal, a newborn infant may acquire a

potentially blinding gonococcal infection of the eyes. To prevent this and other eye infections, physicians place silver nitrate solution in the eyes of all infants immediately after birth.

Gonorrhea does not confine itself to the genital and urinary tracts, however. Physicians are finding evidence of gonococcal infection in places like the rectum and throat. This may be related to changing sexual preferences and practices.

DIAGNOSIS is made by microscopic observation of the bacterium in discharge specimens or by growing and observing the gonococcus in material obtained from inside the urethra in males, from the cervix and urethra in females, and, in both sexes, from any other suspected site.

Even if the gonococcus is not seen in a specimen, a physician will probably want to treat anyone who has been exposed to gonorrhea. There are presently no blood tests for the disease in general use.

TREATMENT for gonorrhea consists of two injections of penicillin, given at the same time, with a tablet of a medication — probenecid — used to increase the efficacy of penicillin. An oral medication related to penicillin — ampicillin — may also be used. People allergic to these drugs may be given either of two other antibiotics, tetracycline or spectinomycin hydrochloride.

Treatment differs for complicated forms of gonococcal infection and for those forms of the disease which seem to persist despite therapy. In these infrequent cases, additional amounts of penicillin or one of the alternate antibiotics will usually overcome the infection.

In 1976, a new form of penicillin-resistant gonorrhea was identified. This new form is

caused by gonococci that produce chemicals — enzymes — that actually destroy penicillin and related antibiotics. Patients with this type of gonorrhea can be treated successfully with the drug spectinomycin.

Once treatment of gonorrhea is begun, symptoms begin to clear quickly, and the person may no longer be contagious within 24 hours. However, follow-up specimens should be examined one to two weeks after treatment is completed to be sure of its success.

Because only certain dosages of penicillin or the other antibiotics will cure gonorrhea, it is extremely important for anyone who thinks he has, or has been exposed to, gonorrhea to seek medical treatment. No one should attempt self-treatment — for example, using an antibiotic left over from some old prescription.

COMPLICATIONS may result if gonorrhea is left untreated or is insufficiently treated. This may be due to continuing local tissue damage or to travel of the organism through the bloodstream to other parts of the body.

In men, narrowing or blockage of the urethra is a common complication. This necessitates mechanical stretching of the urethra to permit urination. Sterility may also result from spread of the infection to the tubes carrying sperm from the testes.

In women, the bacteria may spread up the reproductive tract and cause a painful infection known as pelvic inflammatory disease. If this advances too far, sterility, resulting from scar tissue blocking the tubes which carry eggs from the ovaries to the uterus, may develop. Infected pregnant women experience high rates of spontaneous abortion, prematurity, and stillbirth.

The most common form of disseminated gonococcal infection in both sexes is arthritis.

This arrives suddenly with chills, fever, and joint pains, beginning one to four weeks after the first infection. The knees, wrists, and ankles are involved most frequently.

Much less often, gonococcal infection of the brain (meningitis) or the lining of the heart (endocarditis) or the presence of gonococci in the blood (gonococcemia) may also occur.

Even such complicated cases of gonorrhea do not appear to provide protection against future disease. Since recurrences following appropriate therapy are rare, repeat attacks usually represent new infections.

Thus, the only prevention against further infection is avoidance of sexual contact with known or potentially infected people. The use of a condom by the male will also help protect both partners.

syphilis

It was long believed that syphilis was a New World infection first brought to Europe by the crews of Columbus's ships. New evidence now contradicts this explanation for the great epidemic that swept Europe in the late fifteenth century.

Whatever its origin, syphilis is now not as widespread as gonorrhea. It is, however, potentially more devastating. Caused by a cork-screw-shaped bacterium known as *Treponema pallidum*, this disease was reported in more than 64,000 Americans in 1977. Not all cases are reported by physicians, however, and the actual number might be as high as 500,000.

Syphilis — like gonorrhea — is spread by direct intimate contact with the lesions of someone in the infectious stages of this dis-

ease. Also like the gonococcus, the syphilis bacterium is fragile and, thus, unlikely to be contracted from inanimate objects.

SYMPTOMS begin, ten to 90 days after exposure to syphilis, with the appearance of the characteristic, although sometimes unnoticed, chancre (pronounced shang-ker). This is a small, firm sore which develops at the site of infection, usually the tip of the penis in men and in the cervix or vagina in women. Without treatment, this symptom of *primary syphilis* disappears in three to five weeks.

If early syphilis is not diagnosed and treated, the disease *may* progress through three other stages. After the second stage, *secondary syphilis*, some untreated persons — perhaps one out of four — experience spontaneous cures. About the same number, although not cured, never have further evidence of disease. But the rest eventually develop the complications of *late syphilis*.

Secondary syphilis is heralded by a rash which appears anywhere from two to 12 weeks after the chancre disappears. The rash may cover the body or appear only on the hands or feet. It may be accompanied by tiredness, fever, loss of hair, and lesions in the mouth. These symptoms, too, disappear without treatment, but, meanwhile, the bacteria have probably begun to invade other organs in the body.

Only during these first two stages, which last for up to two years, is an individual infectious to others. An exception is a pregnant women who, even in later stages of untreated syphilis, may transmit her disease to her unborn child.

If untreated, secondary syphilis is followed by *latent syphilis* — a stage of undetermined length. After a long period of dormancy, the

bacteria may begin their damage in the heart, brain, or spinal cord. Thus, *late syphilis* — the final stage — may involve mental illness, blindness, heart disease, or even death.

DIAGNOSIS of syphilis can usually be accomplished quite easily by a combination of symptoms, history of exposure, and a positive blood test, or dark field examination.

Two types of blood tests can be performed. The most common is the VDRL (Venereal Disease Research Laboratory) test developed at the Center for Disease Control. If the results differ from what was expected, a second type of test, the FTA-ABS, or fluorescent treponemal antibody absorption test, can be performed. In the early, infectious stages of the disease, material taken from a lesion of syphilis and observed under a microscope may also reveal the presence of the uniquely shaped bacteria in a dark field examination.

Blood tests for syphilis may be negative for one week after the chancre first appears, but after that they should remain positive until the infection has been cured. In late syphilis, fluid taken from the spinal canal will also show evidence of syphilis infection.

Syphilis has been called the "Great Imitator" because so many of its symptoms are similar to those of other diseases. These include psoriasis, drug rashes, infectious mononucleosis, and cancer. It is, therefore, important to consult a doctor or clinic about any suspicious rash or sore, especially if there is a possibility of exposure to syphilis. Only a doctor can properly diagnose and treat syphilis to prevent complications of the late stage.

TREATMENT of primary and secondary syphilis usually consists of injections of penicillin given in a single visit. Tetracycline,

erythromycin, or cephaloridine are the antibiotics given to people allergic to penicillin. Dosages will vary for the later stages of the disease.

A patient is usually no longer infectious 24 hours after therapy, and, with early treatment, a positive blood test becomes negative within six months to two years. Follow-up blood tests are recommended periodically for one year in primary and secondary syphilis and two years in the later forms. In all stages of syphilis, proper treatment will cure the disease, but, in late syphilis, damage already done to body organs cannot be reversed.

COMPLICATIONS, other than those of late syphilis, relate to the child of a woman infected with syphilis during pregnancy.

After about 16 to 18 weeks of pregnancy, a mother may pass syphilis on to her unborn infant. Treatment of the mother before this time prevents any effect of the infection on the child. Treatment after this time and before birth will cure the child. If there is no evidence of reinfection during later pregnancies, there is no need to re-treat the mother with each pregnancy.

Pregnancy during untreated primary or secondary syphilis may end in stillbirth, whereas pregnancy during later stages leads to a variety of symptoms of *congenital syphilis* in the child.

Early congenital syphilis is that occurring during the first two years of life, and any later symptoms are called late congenital syphilis. Congenital syphilis may involve deformities in the bones, skin, teeth, eyes, and other parts of the nervous system. Care must be taken in handling a child with early congenital syphilis because the moist lesions are infectious.

Most of the drugs used to treat syphilis are also of value in curing congenital syphilis and preventing further deformities.

Like gonorrhea, one syphilis infection does not provide immunity to future attacks. Thus, control of syphilis depends on identifying and treating all persons with infectious disease — those with primary and secondary syphilis, infected pregnant women, and children with early congenital syphilis.

GENITAL HERPES

Although syphilis and gonorrhea are both caused by bacteria, other infectious organisms may also be sexually transmitted. One of these, a virus of growing importance, is the herpes simplex virus, *Herpesvirus hominis*.

The herpes simplex virus is best known as the cause of fever blisters or cold sores that affect many persons from time to time. This, however, is only one form of herpes simplex — type 1 — which produces its familiar lesions generally anywhere above the waist, but most commonly near the mouth.

Another herpes simplex form — type 2 — is commonly found in lesions below the waist, especially in the genital area. Although usually not as serious as gonorrhea or syphilis, genital herpes infections may be quite painful and temporarily disabling. Like fever blisters, these infections tend to recur.

Genital herpes is not a disease which physicians are asked to report, but recent estimates of this infection in this country are as high as 300,000 cases each year.

The herpes virus is present in the fluid of the skin lesions, as well as in some bodily secretions such as saliva and urine, and is believed to be transmitted by close human contact. Genital herpes infections are generally not recognized until the age of sexual activity. First or *primary* infections are, therefore, most common between the ages of 15 and 30. *Recurrent* infections, however, may be completely unrelated to any type of human contact.

SYMPTOMS differ somewhat depending on the nature of the herpes infections. Both types 1 and 2 begin with a primary infection. The virus then goes into hiding in certain parts of nerve cells, only to re-emerge almost spontaneously from time to time. In genital herpes these recurrences may be brought on by sexual contact, menstruation, other infections, emotional upsets, and nonspecific conditions.

The primary genital herpes infection may be more disabling than later recurrences. Two to 12 days after exposure to the virus a small sore or cluster of sores appears at the site of exposure. This site is most often on the penis or in the urethra in men and on the cervix, vagina, or the external genital area of women. The sore may be quite painful with local swelling. There may also be fever and other general symptoms of infection. These symptoms disappear within 2 to 3 weeks. Then the virus may remain hidden for weeks to years before recurring.

Most recurrences involve only the local lesion, often at the same site as the primary infection. There may be pain, but some sores in the cervix, upper vagina, urethra, or prostate have no symptoms at all. Recurrences are usually healed in one to two weeks.

TREATMENT for genital herpes infections, as with most viral infections, is not specific.

Antibiotics, which are useful against bacteria, are of little help in fighting a virus.

Therefore, treatment is directed toward relieving the symptoms until the body itself fights off the infection. For example, pain-relieving ointments may be applied to lesions on the outer genital organs. Good genital hygiene and wearing loose-fitting undergarments will help prevent secondary bacterial infections. Sexual intercourse should also be avoided during an outbreak — to prevent both irritation of existing lesions and transmission of the disease.

Several more specific methods of therapy have been tried by some physicians in an attempt to relieve the symptoms of herpes infection and prevent recurrences, but there is little evidence that these are of value. For example, repeated smallpox vaccinations have been used to prevent recurrences. However, the efficacy of this method has not been proved, and it is not recommended.

The "dye-and-light" method has also been tried by many doctors. This involves application of a specific dye to the lesions and then exposure of this painted area to light for approximately 15 minutes. However, there are questions about the safety of this method, and recent studies by scientists at Harvard Medical School and Baylor University have suggested that the dye-and-light treatment provides little benefit.

A herpes simplex type 2 vaccine has been tried in West Germany to treat these infections. However, this vaccine has not been proved completely safe or effective.

Two drugs currently available for treating a viral infection are idoxuridine and vidarabine, licensed to treat herpes type 1 infections in the eye. Ointments or creams containing these

medications have been tried on outer genital lesions, but they are of no benefit.

Antiviral drugs are still being studied. In addition to idoxuridine and vidarabine, experimental chemicals — specifically zinc sulfate and acycloguanosine — have shown significant effectiveness against herpes infections in animals. Studies are continuing to test their safety and efficacy in animals and, later, in humans before they can be released for general use.

COMPLICATIONS are less common with genital herpes than with untreated gonorrhea or syphilis. A few persons may experience narrowing of the urethra or inflammation of nerves. The two most serious problems linked to this disease are both related to the infection in women.

First of all, a primary attack of genital herpes during pregnancy may have very serious complications. The full effects of a mother's infection on the unborn child are not completely understood. However, evidence suggests that, early in pregnancy, spontaneous abortion may result and, later in pregnancy, premature delivery may be the outcome.

Physicians do know, however, that, as in gonorrhea, the infant may contract herpes as it passes through an infected birth canal. This may lead to a frequently crippling or fatal form of meningitis (inflammation of the tissues surrounding the brain and spinal cord) in the newborn baby. When obstetricians diagnose genital herpes in an expectant mother, they can reduce the risk of this complication by delivering the baby by caesarean section to avoid its exposure to the virus.

The other problem of genital herpes in women is a possible link to cancer of the cervix. Although viruses are known to cause various cancers in laboratory animals, no such

association has yet been proved in humans. Circumstantial evidence, however, has been marshalled against herpes type 2. This is the most common viral infection of the cervix, and there are many similarities between the groups of women most often affected by this infection and by cervical cancer. This does not mean necessarily that genital herpes *causes* any changes in the cervical cells, including cancerous changes. The infection may be just one of several factors which, in combination, produce such changes. Research is continuing on this question to better understand the problem. Physicians often recommend semi-annual Pap smears for women with genital herpes.

Immunity — probably lifelong — does develop following primary herpes infection, but, apparently, protects only against another primary infection with the same type — type 1 or 2. Recurrent infections are common.

Prevention of primary type 2 infection is best accomplished by avoiding sexual contact with someone with active herpes lesions. Physicians know that while the lesions are present, the person is infectious, although they do not know how long the virus is still present in body secretions after the lesions are gone. At present, recurrences can only be prevented by identifying and avoiding situations that may precipitate an attack.

chlamydial infections

Once believed to be unique organisms, chlamydiae are now accepted as rather unusual forms of bacteria. Among the human diseases they cause are trachoma (an eye infec-

tion which may become chronic and lead to blindness) and two venereal diseases — non-gonococcal urethritis and lymphogranuloma venereum.

NONGONOCOCCAL URETHRITIS or NGU affects an estimated 2.5 million men in this country each year although scientists debate the exact figure. Different forms of *Chlamydia trachomatis* probably cause about half of the cases. The cause of the remaining cases is not yet known.

The symptoms of NGU mimic those of early gonorrhea. The discharge and the pain during urination may be slightly less severe, and the time between exposure and appearance of symptoms somewhat longer. In fact, because of the similarity between the two diseases and because NGU does not respond to penicillin, cases of NGU may be inaccurately diagnosed as drug-resistant gonorrhea.

In women, the disease is less well-defined at present. Many women have no symptoms at all. Others may have a discharge, bleeding from the cervix, or infection of the cervix. Often, chlamydial infection in women may not be suspected until they deliver babies with a chlamydia-caused eye infection, have eye disease themselves, or report that their sexual partners have NGU.

Chlamydia-caused eye infections in newborns have been considered mild and self-limited. However, a recent study indicates that these eye infections may precede pneumonia in infants, and that the incidence of chlamydia-caused pneumonia is much greater than previously recognized.

Diagnosis of NGU involves first ruling out gonorrhea with appropriate tests. Then, if further confirmation is needed in men or in suspected cases of chlamydial infection in

women, blood tests and direct examination of the discharge with a microscope are helpful.

Once chlamydia-caused NGU, or a similar infection in women, is recognized, the infection will usually respond to treatment with tetracycline, erythromycin, or sulfonamide pills taken for one to three weeks. Postgonococcal urethritis — the persistence of symptoms after proper treatment for gonorrhea — often responds to these same drugs because the original infection may have been a combination of gonorrhea and NGU.

Doctors are not sure what the complications of untreated genital chlamydial infection are. In fact, there is evidence that many untreated cases may be cured on their own in four to six weeks.

Sexual contact is believed to be a major factor in the spread of genital chlamydial infections. Scientists are not sure yet whether one type of genital chlamydial infection will protect against others.

LYMPHOGRANULOMA VENEREUM, or LGV as it is commonly called, is caused by certain forms of *Chlamydia trachomatis*. Most important in the tropics and semi-tropics, LGV, along with two other venereal diseases — chancroid and granuloma inguinale — accounted for only approximately 800 reported cases in this country in 1977.

One to three weeks after exposure to LGV, a small lesion appears on the genitals or rectum. This will heal, but later, nearby lymph nodes may become enlarged and filled with pus if the infection is not treated with sulfonamides or tetracycline. Swelling of the genital organs may also occur.

Diagnosis of LGV is best done by taking a specimen of the pus, growing the microorganism in the laboratory, and then observing it

under a microscope. A blood test may also be used.

A person with LGV may transmit the disease to others through sexual contact as long as there is fluid escaping from the open lesions. However, one attack of LGV appears to provide lifelong immunity against further infection.

OTHER VENEREAL DISEASES

In addition to the major sexually transmitted diseases already discussed, there are others that may *sometimes* be transmitted by sexual contact.

CHANCROID or soft chancre is a rather uncommon bacterial infection, caused by *Hemophilus ducreyi*, and spread by contact — usually sexual — with an open lesion. One to five days after exposure, one or more painful ulcers appear at the site of contact. It is diagnosed by symptoms and a microscopic examination of fluid from the lesion or of a sample of surrounding tissue. This infection usually responds to antibiotics such as sulfonamides or tetracycline, but one infection probably does not provide future immunity.

GRANULOMA INGUINALE is a much rarer bacterial infection caused by *Donovania granulomatis*. Probably transmitted by sexual contact, this disease involves the development of a small, spreading, potentially destructive lesion, usually on the genital organs. Tetracycline and streptomycin are the most effective antibiotics for treatment.

TRICHOMONIASIS is a parasitic infection caused by a protozoan (a single-celled organism) known as *Trichomonas vaginalis*. An estimated 2.5 to 3 million Americans have this in-

fection each year. In humans, this organism only infects the genitourinary tract, causing vaginal lesions and a discharge in females. In men, the infection is usually without symptoms.

Direct sexual contact is the most common mode of transmission, and at birth the newborn may acquire a genitourinary infection from an infected mother. Also, since this parasite may survive up to 24 hours where there is moisture, non-sexual direct contact with a recently contaminated object, such as a towel, may sometimes lead to infection.

Within 4 to 20 days after exposure, symptoms of trichomoniasis may appear. Diagnosis is then accomplished by microscopically examining the discharge or growing the parasite in laboratory culture. The usual treatment consists of giving both sexual partners, by mouth, a drug known as metronidazole. This should not be used during early pregnancy, however, and in this case localized treatment in combination with good genital hygiene may be prescribed.

Although trichomoniasis does not, as far as is known, lead to serious complications, it is personally annoying and costly to the nation in terms of increased health care expenses and lost time from work or school. Furthermore, the presence of trichomoniasis can confuse the evaluation of a Pap smear, the test for cervical cancer. This parasite can make the cells observed during this test appear atypical, often resulting in a false-positive test reading.

The CRAB LOUSE or *Phthirus pubis* is transmitted by direct contact with an infested person. Since these lice usually are found in the pubic hair, this means sexual contact is of primary importance. The lice may also be spread by contact with an intermediate object

such as a person's clothing or bedclothes. The eggs of lice hatch in a week and reach sexual maturity in about two weeks. Specific ointments or shampoos are available for getting rid of these pests.

SCABIES, an infestation with *Sarcoptes scabiei*, a small parasitic mite, is spread in a manner similar to crab lice. Formerly widespread only in areas of poverty or during times of turmoil such as war, scabies is now found frequently among the "clean." Sexual contact is, thus, becoming a more important means of spreading the disease. Besides severe itching, especially at night, the most common symptom is the appearance of small red bumps or lines on the body when the female mite burrows into the skin to lay her eggs. These skin lesions are found most often in areas such as between the fingers, on the wrists or elbows, the lower abdomen, and the external genitals. Diagnosis involves obtaining the female mite from inside a burrow and identifying it under a microscope. Treatment consists of bathing followed by application of one percent gamma benzene hexachloride or crotamiton. Washing, dry cleaning, or ironing of clothes and bedding should destroy the mites.

HEPATITIS B or serum hepatitis is a form of viral hepatitis, an infection of the liver. Symptoms include fever, loss of appetite, tiredness, nausea, and a yellowing of the skin, known as jaundice. These occur in a susceptible person about six weeks to six months after exposure to hepatitis B.

Once believed associated solely with the administration of contaminated blood or blood products, hepatitis B is now recognized as having other means of transmission, including sexual contact. The hepatitis B virus has been identified in body fluids other than blood, in-

cluding semen, saliva, urine, and feces. Thus, many experts now believe that sexual contact with a hepatitis B patient or a chronic carrier may lead to hepatitis B infection. As there is no specific treatment for this viral infection, such close contact with anyone presently or recently infected should be avoided.

CYTOMEGALOVIRUSES (CMV) belong to the same group of viruses as the herpes simplex viruses and, like them, may infect infants. In fact, CMV infection may currently be the most important cause of birth defects, such as mental retardation, blindness, and deafness. There is increasing evidence that these viruses, too, are transmitted by sexual contact. The virus has been found in the cervix of women and in the semen of their sex partners. There is no treatment for CMV infection, and in most adults there are few, if any, symptoms of infection. Thus, further research is needed in order to determine the role of sexual transmission in congenital CMV infection and to develop ways to prevent or treat these infections.

MYCOPLASMAS (a group of microbes which, like chlamydiae, are now considered bacteria) are other infectious organisms found in the genital tracts of men and women. While the sexual transmission of some mycoplasmas is undisputed, their exact role in causing genital infections is not completely understood.

RESEARCH APPROACHES

For centuries, venereal diseases have afflicted king and commoner alike and may even have changed the course of history. Henry

VIII and Ivan the Terrible are only two of the rulers now believed to have had syphilis and to have suffered from its complications. But, when antibiotics were discovered, many thought that the problem of venereal diseases had been solved.

Such has not been the case. Recent VD increases around the world have indicated that the traditional methods of control—treating with drugs and tracing an infected person's sexual contacts for treatment—have not been completely effective. Some causative organisms have become increasingly drug resistant and, like other infections, venereal diseases are often transmitted *before* symptoms occur and treatment is begun.

With these developments in mind, the National Institute of Allergy and Infectious Diseases initiated several years ago an expanded program in research on sexually transmitted diseases—primarily syphilis and gonorrhea. These studies are carried out by grant and contract-supported investigators at institutions around the country.

The NIAID program is based on the opinion of experts that a better basic understanding of all sexually transmitted diseases and of the organisms causing them must be developed before there can be substantial improvement in methods of prevention or therapy.

Many of these organisms have been recognized for years but little else is known about them. For example, scientists do not yet understand why immunity to gonorrhea and syphilis infections is so difficult to establish or why the syphilis bacterium cannot yet be grown in a test tube.

Some researchers believe that the key to gonorrhea control is a better understanding of the proteins, called antigens, on the bacterium's

surface. Antibodies, usually considered protective substances, are formed in response to some of these antigens. By identifying gonococcal antigens and antibodies, it may be possible for investigators to learn more about how the body responds to this infection. It should be possible, too, to discover why one attack of gonorrhea does not provide lasting immunity and to develop, perhaps, a vaccine which could provide protection against the disease.

Scientists believe, also, that they can use gonococcal antigens as a means of identifying and grouping the bacteria. A rapid means of identifying a particular strain would allow disease control experts to trace the transmission of the gonococcus in a manner similar to that used now to track influenza viruses causing epidemics.

Furthermore, studies of the bacterium's antigens should make possible the development of reliable blood tests for gonorrhea. Diagnoses could be obtained more easily and rapidly by use of such blood tests than by currently available culture methods.

Basic studies of the syphilis bacterium should also answer many fundamental questions and might lead to the development of methods for growing this organism in the laboratory. So far it can only be cultivated in rabbit testes—not a practical means for producing the large quantities of bacteria needed for vaccine studies.

Only recently has an NIAID grantee shown that, contrary to previous belief, *T. pallidum* may need oxygen to grow and reproduce. Further study should reveal the true growth requirements of this organism and may show whether this latest research finding is the key to growing this bacterium in the laboratory.

Other research findings have shed unexpected light on the body's immune response to

the syphilis bacterium. Scientific interest has generally focused on the large amounts of circulating antibody to the bacterium found in the blood of syphilis patients. It has long puzzled scientists how untreated syphilis could progress from one state of infection to another, despite the presence of such antibody (usually considered protective). It is now believed that cellular immunity—that part of the immune response involving mobilization of specialized cells—plays an important role in recovery from this disease. Researchers are studying both antibodies and these specialized cells in an effort to learn how protection against attacks of syphilis might be stimulated.

A fundamental need of research on any human disease is an animal model in which the illness can be induced to simulate infection in man. This need has been exceedingly difficult to meet for studies of gonorrhea since this disease attacks only man. The chimpanzee shows promise as a laboratory animal but is expensive and difficult to obtain. NIAID grantees are, therefore, investigating other potential animal models, including the chick embryo and the rabbit.

More success has been realized in developing animal models for other venereal infections. For example, NIAID-supported scientists, following up on earlier observations, recently showed that certain adult female mice may be used to study herpes virus type 2 infection. This animal model should permit the evaluation of potential drugs for treating both the local genital infection and the more serious, but rare, systemic form of herpetic disease.

Research today seems to hold the key to the control of sexually transmitted diseases that antibiotics once promised. New or improved diagnostic tests, better therapy, and perhaps even

vaccines are potential rewards of medical research on diseases that have plagued mankind for hundreds, if not thousands, of years.

**MICROORGANISMS THAT MAY BE
SEXUALLY TRANSMITTED AND SOME
DISEASES THEY MAY CAUSE***

<i>Organism</i>	<i>Disease</i>
Bacteria	
<i>Neisseria gonorrhoeae</i>	<i>gonorrhea, conjunctivitis, pelvic inflammatory disease, disseminated gonococcal infection</i>
<i>Chlamydia trachomatis</i>	<i>nongonococcal urethritis, infection of the cervix, conjunctivitis in newborns and adults, trachoma, lymphogranuloma venereum</i>
<i>Ureaplasma urealyticum</i> (T-mycoplasma)	<i>possibly nongonococcal urethritis</i>
<i>Treponema pallidum</i>	<i>syphilis</i>
<i>Hemophilus ducreyi</i>	<i>chancroid</i>
<i>Donovania granulomatis</i> (<i>Calymmatobacterium granulomatis</i>)	<i>granuloma inguinale</i>
<i>Hemophilus vaginalis</i>	<i>possibly vaginal infection</i>
group B-hemolytic streptococcus	<i>blood infection in the newborn</i>
Viruses	
<i>Herpesvirus hominis</i> , type 2	<i>genital herpes, meningitis, neonatal herpes</i>

* Information obtained from Dr. King K. Holmes, University of Washington School of Medicine, Seattle

hepatitis B virus	<i>hepatitis</i>
cytomegalovirus	<i>Infectious mononucleosis-like illness, congenital birth defects</i>
genital wart virus	<i>condyloma acuminatum (genital or venereal warts)</i>
molluscum contagiosum virus	<i>genital molluscum contagiosum</i>
Epstein-Barr virus, herpes group	<i>infectious mononucleosis</i>
Others	
<i>Trichomonas vaginalis</i>	<i>vaginal infection, urethritis</i>
<i>Phthirus pubis</i>	<i>pubic lice infestation (crabs)</i>
<i>Candida albicans</i>	<i>external genital and vaginal infection in female, lesions on penis in male</i>
<i>Sarcoptes scabiei</i>	<i>scabies</i>
<i>Shigella</i> species	<i>shigellosis in male homosexuals</i>
Intestinal protozoa	<i>Amebiasis and giardiasis in male homosexuals</i>

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