Communicable Diseases in Inmates: Public Health Opportunities

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Overview

At midyear 1997, more than 1.7 million people, or 1 of every 155 U.S. residents, were in either jail or prison. At yearend 1997, 1 of every 117 males and 1 of every 1,852 females in this country were sentenced prisoners under State or Federal criminal jurisdiction.[1] Fifteen million arrests are made annually,[2] and more than 10 million individuals are released from detention each year. Approximately two-thirds of incarcerated individuals are in State and Federal facilities, and the remaining one-third are in local, generally short-term-stay jails.[3] Any discussion of the public health implications of prisoners in this country must pay heed to these statistics. The incarcerated community cannot and must not be considered a small, separate population with minimal relevance to the outside community. People who are currently in the criminal justice system, those who have been in the past, and those who are destined to be in the future comprise a large segment of the overall population of this country, particularly in the urban centers. Furthermore, the view that physical separation limits the health threat of prisoners to the outside community is a dangerous misconception. The number of inmates released into the community annually[4] should dispel this myth, as should the average length of stay in local jails, which is often on the order of several days to several weeks. In a worst-case view these facilities can serve as places where arrestees go, acquire and/or transmit infection, and are quickly released to further spread their infection in the outside community.[5]

Although public sentiment in an era of more restricted health care may resist the idea of expanding the scope and intensity of medical services in correctional facilities, the public health community in this Nation resoundingly endorses the aggressive diagnosis and treatment of prisoners as a critical, cost-effective measure to improve health both inside and outside the facilities.[6] The period of incarceration is a crucial window of opportunity for health care interventions because prisoners often have little other interaction with the health care establishment. The correctional facility offers the additional benefit of access to this population at a time when the prisoners' thinking is not clouded by active drug use or pressing survival concerns such as the need for housing or food. The incarcerated men and women of this country suffer from staggering rates of communicable diseases. This review will concentrate on syphilis, gonorrhea, chlamydia, trichomoniasis, human immunodeficiency virus (HIV), tuberculosis, and hepatitis B and C. Some of these diseases are life threatening, some are short-lived, easily curable infections, and some are completely asymptomatic. One feature that all of these conditions have in common is their tremendous public health impact, whether it be the massive suffering and costs associated with HIV infection; the pelvic inflammatory disease (PID), infertility, and ectopic pregnancies caused by gonorrhea and chlamydia; or the cirrhosis and hepatocellular carcinoma caused by viral hepatitis. Another common feature of all of these infections is the ability of a small core group of individuals possessing specific sociodemographic and/or physiologic characteristics to exert a disproportionate force in the spread of illness through communities.

Theoretic Model

This review's goal is not to present a detailed mathematical model of disease transmission through a community. Sophisticated models exist that attempt to define the dynamics of

communicable diseases within given populations, and the development of such models have been the subjects of many articles and texts.[7] However, an understanding of certain parameters that govern the spread of infections through a population is vital to the selection of appropriate interventions to halt the spread. The starting point for most of the mathematical models is the formula, $R_0 = \beta D c$, where the terms of the equation are defined as follows:[8]

- R_0 is the reproductive rate of the infection, and is defined as the mean number of secondary cases of infection generated by a primary case in a susceptible population. It is a fundamental principle of these models that a disease can only survive over time in society when $R_0 > 1$. In other words, a disease for which an average of less than one secondary case is generated from each primary case will disappear over time within the population.

- β is the probability of transmission of disease from an index case to a new contact. There are many sociobiologic parameters that may influence this variable, such as immunity against the pathogen, cofactors of disease transmission, host susceptibility to infection, preventive measures designed to interrupt transmission, etc.

- D is the duration of infectiousness. Factors such as the natural history of the disease, the immune status of the infected individual, timeliness of diagnosis (which depends, in turn, on access to care and level of symptoms) and treatment (if the disease is treatable), and mortality rate of infected persons determine the value of this variable.

- *c* is the appropriately averaged number of new contacts per unit time. As discussed later, there are situations in which the relationship of *c* to R_0 are not linear but exponential.[9] Furthermore, for diseases that are vaccine preventable, *c* may be modulated downward by protective immunity, and may better be defined as the appropriately averaged number of *susceptible* new contacts per unit time.

A related concept that is crucial to understanding the epidemiology of the infections to be discussed is that the influence on disease transmission through a community is not evenly distributed among all infected individuals. An HIV-infected, former injection drug user (IDU) who is in a strictly monogamous relationship and uses an effective means of birth control is unlikely to infect more than one person with HIV and is of lesser public health import than an active IDU supporting his or her habit through prostitution. The concept of a "core group" of highly sexually active "supertransmitters" of disease is widely accepted. The dramatic impact and cost-effectiveness of programs aimed at removing individuals from the core group have been well validated in mathematical models and in real-world studies.[10]

This review will discuss the epidemiology and public health implications of specific disease states in the incarcerated population.

Nonviral Sexually Transmitted Diseases

Epidemiology

Syphilis. Of the nonviral sexually transmitted diseases (STDs), syphilis has received the most attention for a variety of reasons:

- Of the nonviral STDs, syphilis is most closely associated with HIV acquisition and transmission.[11]

- The long-term sequelae of inadequately treated or untreated syphilis are more feared than those of other STDs.

- Of the nonviral sexually transmitted pathogens, the vertical transmission of *Treponema pallidum* is associated with the most serious outcomes.

- The characteristics of diagnostic tests for syphilis lend themselves to rapid screening and treatment that are ideal for the correctional setting.

In a landmark study of STDs in correctional facilities published by Hammett et al.,[12] a review of syphilis serologies in 23 different correctional systems employing routine screening of all inmates (who did not refuse testing) throughout the Nation revealed a prevalence of seropositivity of 4.0 percent in a population of more than 200,000 inmates incarcerated in 1993 and 1994. Rates among females tested were more than triple the rates among males (9.9 versus 2.9 percent, $P<0.001$). Rates were highest in the Northeast, Middle Atlantic, and South. A recent unpublished report by the same author estimates that in 1997, there were almost 78,000 prison and jail inmates and almost 558,000 releasees with syphilis infection.[13] In Chicago, cases diagnosed in Cook County Jail accounted for 22 percent of all newly diagnosed cases in the city in 1996.[14] Similarly, the Rhode Island prison system housed 39 percent of the individuals newly diagnosed with syphilis in that State between 1989 and 1993.[15] Female inmates in the New York City jail system, who have particularly high rates of many STDs, had a prevalence of syphilis requiring treatment of 26 percent in a sample of 727 new admissions in 1993,[16] and the prevalence in a sample of newly incarcerated pregnant women was 19 percent in the same facility in 1996.[17]

The public health potential of interventions to reduce the burden of syphilitic infection in the incarcerated population of this country is great. In many large cities, control of syphilis in the correctional system is a crucial component of citywide control, since the jails and prisons may house a sizable fraction of all city cases. In this sense, delivery of prompt and responsible diagnostic testing and treatment to inmates is similar to providing these services in municipal STD clinics. The concentration of syphilis among inner-city crack-addicted minority women, who often trade sex for drugs or money, has received much attention in recent years.[18] Failure to treat these women properly has been associated with a rise in congenital syphilis cases in New York,[19] and newly instituted initiatives to improve treatment have resulted in a decline in numbers of infants requiring treatment for congenital syphilis.[20] Although crack-addicted prostitutes are a difficult patient population to deliver ongoing medical care to, interventions aimed at changing the risk behaviors of prostitutes have reduced rates of STDs and HIV transmission in other countries.[21]

In response to the reemergence of syphilis, including congenital syphilis, as an urban scourge with a predilection for drug-addicted, minority women, New York City and Chicago initiated innovative programs to better diagnose and treat syphilis in incarcerated females. Both cities instituted a computer link between the correctional system and the city department of health syphilis registry, and performed the Stat rapid plasma reagin (RPR) test on all female admissions to the system. The Stat RPR test yields results within 15 minutes, a characteristic that is crucial in correctional systems where mean lengths of stay are on the order of days. New arrestees were generally kept in the admission area until the test results were available and were offered treatment according to Centers for Disease Control and Prevention (CDC) recommendations before being housed. In the Chicago jail system, women who were seropositive for syphilis and required treatment were twice as likely to receive treatment before release than women who were diagnosed using conventional testing with its attendant 3- to 5-day delay in treatment.[22] A similar program in New York City also led to substantial increases in rates of women receiving therapy (as compared to historical controls), and was accomplished with a startup cost of $8,300 and a per test cost (including quality controls but excluding labor costs) of $0.25.[23]

Despite the availability of fairly inexpensive diagnostic and treatment modalities, and the broad support of the medical and public health community for aggressive screening and treatment of syphilis in the correctional setting, the existing state of affairs is extremely disappointing. In a CDC survey of city and county jails throughout the country, less than one-half (46–47 percent) offered routine screening for syphilis as a matter of policy.[24] Facilities boasting the most aggressive screening policies actually screened less than one-half of arrestees (48

percent). Thus, on average, less than one-quarter of arrestees were tested for syphilis during their incarceration. In those jails offering testing only to patients with suggestive symptoms or signs, a dismal 2–7 percent of inmates were actually tested.

Gonorrhea. Although generally less prevalent than syphilis in the incarcerated population, gonorrhea is a significant pathogen among prisoners in this country, particularly in younger inmates. Like the other nonviral STDs, *Neisseria gonorrhea* is an important organism both by virtue of its own pathogenicity and because of the company it keeps. Gonorrhea is a disease with significant morbidity including painful urethritis; cervicitis; proctitis; epididymitis; pharyngitis; and, in its disseminated form, tenosynovitis, arthritis, and occasionally, endocarditis. It is often involved in the development of PID and can be transmitted vertically to the newborn causing ophthalmia neonatorum. It is one of the most easily transmitted of the sexually transmitted pathogens with the likelihood of male-to-female transmission of approximately 50–90 percent and the corresponding figure for female-to-male transmission of 20–80 percent.[25] Coinfection with *N. gonorrhea* facilitates the transmission of HIV,[26] and infection with *N. gonorrhea* may render an individual more susceptible to HIV infection.[27]

Several highly reliable testing methods are available for the diagnosis of gonorrhea. The gold standard of culture on Thayer-Martin medium is available through most institutional, governmental, and commercial microbiology laboratories. Although technically simple to perform, the test requires pelvic examination for females, urethral swabbing for males, and at least 24–48 hours of incubation time in the laboratory. Another widely used technique involves direct probing of clinical specimens for gonococcal genetic material. While this method obviates the need for incubation, it is not a rapid test in the sense of yielding results within minutes in the clinic setting. The genetic probe assays suffer from some loss of sensitivity when compared to culture, and they also require pelvic examination or urethral swabbing. A new generation of tests based on amplification of microbial genetic material via the ligase chain reaction (LCR) holds great promise for the future. They are highly sensitive and specific tests that can be performed on urine specimens.[28] At this time, however, the tests are slow and costly.

There is less information available about rates of gonorrhea in jails and prisons than about syphilis. Few correctional facilities incorporate routine screening for gonorrhea into standard practice. The study by Hammett and colleagues that collected information from correctional facilities in 11 States found that 2.5 percent of 80,825 inmates undergoing routine screening were infected with *N. gonorrhea.*[29] Gender-specific data in their survey revealed an overall prevalence of 3.3 percent among women and 2.0 percent among men ($P < 0.001$). In their review of 1997 data, Hammett, Harmon, and Rhodes estimated that almost 18,000 prisoners and almost 77,000 releasees were infected with gonorrhea, and female prevalence rates were 75 percent higher than male prevalence rates.[30] The disease is more common among adolescents, with prevalences as high as 18 percent among females and 5 percent among males.[31] In an unpublished study of universal gonorrhea screening in the Chicago jail system from 1995 that involved more than 81,000 facility admissions, 1.5 percent of men and 4.3 percent of women were infected.[32] In the New York City jail system, the prevalence of gonorrhea was 8 percent in new female arrestees in 1988.[33]

The potential utility of aggressive interventions to control gonorrhea rates has not been as well studied as it has for syphilis. Screening and treatment programs involving prostitutes in the Philippines in the 1960s and selective mass screening and treatment in Greenland during the same decade were effective in decreasing the prevalence of infection in these populations.[34] In the Philippines, the decreased rates among prostitutes resulted in a decreased incidence of gonorrhea in locally stationed U.S. military personnel. Both of these studies demonstrated a failure to sustain benefit after the programs were terminated.[35] It is likely that gonorrhea control

efforts would be more successful today with the availability of more effective oral treatments, less cumbersome diagnostic techniques, and the greater social acceptability of condom usage. The tremendous potential of mass screening and treatment programs to reduce rates of gonorrhea, particularly those aimed at core group members, has been hailed by public health authorities in the United States for more than 20 years.[36] The overall impact of such programs would be compounded greatly today by the reduction in HIV transmission effected by gonorrhea eradication.

Chlamydia. The appreciation of the importance of *Chlamydia trachomatis* as a sexually transmitted pathogen is a recent development when compared to the former two organisms. This, combined with the relatively cumbersome nature of chlamydia culture is responsible for the scarcity of information regarding the prevalence of the disease in prisoners. Like gonorrhea, it is associated with a range of disease presentations in men, women, and infants infected by vertical transmission. It is more likely than gonorrhea to cause asymptomatic or paucisymptomatic infections,[37] and the duration of carriage in untreated patients is longer than that for *N. gonorrhea*. It also has been implicated as a cofactor in the transmission and acquisition of HIV.[38]

Clinicians may diagnose chlamydia through a variety of techniques. The gold standard is McCoy cell culture of a cervical or urethral swab, which is a costly and time-consuming tissue culture procedure. Tests that probe clinical specimens for chlamydial genetic material also are available, either alone or in combination kits with probes that react with *N. gonorrhea.* These tests are highly specific but their sensitivity is variable. While more convenient than tissue culture for the clinical laboratory, these are not rapid tests and they are fairly expensive. Finally, LCR tests can be performed on urine samples, but this promising technique suffers from the same shortcomings in diagnosing chlamydia as it does for the diagnosis of gonorrhea.[39] Because the organism is relatively difficult to isolate for definitive diagnosis and because untreated chlamydial infection may be quite destructive without causing symptoms, public health agencies have endorsed the use of empiric therapy in certain highly selected populations. Because patients with gonorrhea have a high rate of coinfection with chlamydia, gonorrhea patients are generally treated for both diseases.[40] Patients with nongonococcal urethritis are generally treated for chlamydia, and many correctional facilities treat men with leukocyte esterase activity on urinalysis for gonorrhea and chlamydia.[41] Finally, patients with PID and patients seeking assistance for infertility are generally treated for chlamydia because of the pathogen's frequent involvement in these conditions.

The review of Hammett and colleagues found a prevalence of 2.6 percent among women and 3.3 percent among men (2,379 women in four States were studied, and only 30 men) in facilities that screened routinely for chlamydia.[42] Hammett's unpublished report incorporating data from 1997 estimated that almost 43,000 inmates and almost 186,000 releasees had chlamydia infection during that year.[43] The diagnostic methodology was not described. One study in the New York City jail system found a 27 percent prevalence of active chlamydia infection among adult women admitted to the facility in 1988.[44] The authors of this study concluded that rates such as these may justify a program of empiric treatment for all women admitted to the facility. A troubling finding has been the high prevalence of chlamydia found in adolescent prisoners. Male adolescents arrested in Georgia had a 6.9 percent prevalence of chlamydia infection on admission,[45] and infection rates as high as 30 percent in female adolescents admitted to prison have been reported.[46]

The public health objectives of chlamydia control programs are twofold: reducing the incidence of PID and reducing HIV transmission/acquisition. Although neither of these two outcomes has been studied specifically in an incarcerated population or among prostitutes, a large-scale study of selective mass chlamydia screening and treatment was conducted in Washington State between 1990

and 1992. Women who admitted to a risk behavior associated with chlamydia infection were randomly assigned to a screening program or usual care. Those women who were assigned to the screening group were more likely to receive treatment and significantly less likely to develop PID during the specified followup period.[47] Such programs are justifiable not only in terms of reductions in personal suffering but also in terms of cost savings.[48] Although STD control programs have been effective in reducing rates of HIV transmission, the specific contribution of chlamydia control to these effects has not been studied.

Trichomoniasis. *Trichomonas vaginalis* is a pathogen that causes vaginitis, cervicitis, urethritis (in both sexes), and dyspareunia and is associated with poor pregnancy outcomes and vertical infection of newborns. It is also a cofactor in HIV transmission/acquisition,[49] and may be a cofactor in the development of PID.[50] Until recently, direct culture of the organism was not widely available in clinical laboratories. Therefore, the epidemiology of trichomoniasis in various populations has relied on relatively insensitive tests such as Pap smears and direct microscopy of cervical wet preps. The few data that exist on prevalence of trichomoniasis in incarcerated populations suggest that it may be the most common of all the nonviral STDs[51] and the availability of simple, reliable, inexpensive culture kits for the testing of cervical/vaginal swabs in females and centrifuged urine specimens in males will allow better definition of the epidemiology of this infection in correctional facilities in the future.

Three studies in the Northeast have demonstrated astoundingly high rates of trichomoniasis among female inmates. A sample of female detainees in the Rhode Island correctional system between 1987 and 1992 revealed a rate of trichomoniasis on Pap smear of 43 percent.[52] In an unpublished study of new female admissions to a large New York City jail in 1991, direct culture was positive for *T. vaginalis* in 47 percent.[53] In a more recent study conducted in the same facility, newly arrested pregnant women had an identical prevalence of 47 percent on direct culture using the newly available InPouch TV culture system.[54] In the latter two studies, all women were also screened for syphilis, gonorrhea, and chlamydia, and the prevalence of trichomoniasis exceeded the prevalences of all of these other STDs combined. The prevalence of trichomoniasis in male inmates has not been studied, but the medical community has recently begun to appreciate the importance of *T. vaginalis* as a cause of nongonococcal urethritis in men.[55]

No formal studies have been done of the public health benefit of screening and treatment interventions for trichomoniasis in incarcerated populations. A recently published editorial supports instituting routine screening for this extraordinarily common pathogen in correctional facilities.[56] In groups of individuals with prevalences of trichomoniasis approaching one-half of the overall population, it would also be reasonable to explore the role of presumptive therapy of the disease.

Potential interventions

The aforementioned statistics make a persuasive case that the Nation's jails and prisons are crucial targets for establishing better STD control in the community. Although the public health community applauds the concept of better directing STD control programs toward prisoners, the most recent report of the United States Public Health Service has shown existing programs to be woefully inadequate.[57] Although not all prisoners belong to the STD core group that must be a primary target of any sensible STD control policy, jails and prisons house a population among whom core group members are grossly overrepresented. Many of these individuals are relatively or completely asymptomatic and do not obtain routine medical care in the outside community. STD-reduction programs should focus on the elements of the mathematical model described above: reducing the likelihood of disease transmission per contact (β), reducing the duration of infectivity (D), and reducing the mean number of new contacts per unit of time (c).

Reducing the likelihood of transmission per contact. The ultimate method of reducing the likelihood of transmission of an STD per contact is by curing the STD, but treatment/cure is subsumed under variable D in the model. The variable β, in the present discussion, assumes that the individual is still actively infected (i.e., screening/treatment programs have failed to cure the patient) or the patient has become reinfected. The best method available to reduce the likelihood of transmission per sexual contact is the use of barrier protection with male and/or female condoms. There is no question that the consistent use of barrier protection reduces the rate of transmission of the nonviral STDs as well as HIV.[58] Even inconsistent use of condoms affords some level of protection. The great challenge is to make condoms socially acceptable, and to empower individuals, particularly women, to insist on their consistent use with all sexual partners. While such ideas are simple in theory, in reality the issue of insistence on condom usage is complicated by a multitude of behavioral and social factors including embarrassment, fear of loss of relationship, and fear of emotional or physical victimization.[59] Notwithstanding these issues, harm-reduction programs stressing education and behavior modification have been effective in increasing condom usage in inner-city populations.[60] These efforts are aided by greater societal acceptance of condoms as a consequence of public health statements, media awareness, and advertisements. Obviously, the cost of condoms must not be prohibitive, and ideally they should be available to these target populations free of charge.

Behavior-modification and harm-reduction research has consistently observed that multiple-session educational interventions are far more effective at curbing risk behaviors than single-session interventions.[61] The ideal approach to reducing β would include multiple culturally appropriate educational sessions led by peer counselors who teach the many dangers of unsafe sexual practices, the importance and proper use of barrier protection, and empowerment techniques to encourage safer sexual practices even under adverse social circumstances. Interventions begun in correctional facilities would be linked to harm-reduction programs in the outside community; would incorporate drug rehabilitation; and would address housing needs, job training, and ongoing medical concerns.[62] Such programs, while expensive, would offer the hope of controlling multiple factors that drive STD transmission in a community. Simultaneous reductions in risk of transmission, rate of partner exchange, and duration of infectivity would have a multiplicative effect in reducing the reproductive force of these infections in the population.

Reducing the duration of infectiousness. Significant reductions in duration of infectiousness are the most readily achievable of all the goals described. Any effort at reducing duration of infectivity in the inmate population must rest upon timely screening and prompt treatment. Screening and treatment programs in correctional facilities should be coordinated closely with local health departments for the purposes of oversight, contact tracing, reporting, and recordkeeping. The following screening and treatment methods are proposed for the specified nonviral STDs.

Syphilis. There is persuasive evidence that correctional facilities, at least in major cities, house a substantial fraction of all syphilis cases in their regions. There is also evidence that rapid screening and treatment can be accomplished inexpensively in the jail and prison settings, and that these programs dramatically increase rates of appropriate treatment delivery.[63] Finally, evidence suggests that a pilot program of this sort has reduced the overall syphilis burden in at least one major urban center.[64] For all these reasons, a Stat RPR test (or its functional equivalent) should be performed on all new admissions to jails and prisons in the Nation and inmates should remain in the clinical area until results are available so that immediate treatment according to CDC guidelines can be administered. These efforts should be closely coordinated with the local public health agencies. All inmates found to be seropositive for syphilis should be referred for immediate HIV testing (unless they are already known to be HIV infected) and for intensive harm-reduction training. Routine screening may

be discontinued in facilities or regions where the prevalence of syphilis is so low that it is not a significant public health concern. In areas where screening is discontinued, syphilis prevalence should be measured periodically in order to detect increases.

Gonorrhea. Every correctional facility in the country should establish the baseline rate of gonorrhea in new arrestees. Direct culture, genetic probe assays, or LCR may be used as diagnostic modalities. The latter test, while costly, has the advantage of higher acceptance rates, particularly among males, because urethral swabbing is not necessary. Males who refuse these tests should be screened for urine leukocyte esterase activity. All inmates diagnosed with gonorrhea (including males who are urine leukocyte esterase positive) should receive single-dose oral therapy for the infection according to CDC guidelines and should be referred for immediate HIV testing and intensive harm-reduction training. Correctional facilities with very low rates of gonorrhea may elect to restrict screening to high-risk groups such as adolescents and prostitutes, as well as inmates with symptoms or signs suggestive of gonorrhea. Communities with low prevalences of gonorrhea should institute routine screening in correctional facilities when significant increases in incidence are detected in the community or during periodic screening in the local jails or prisons. All other facilities should institute the practice of routine screening of new admissions. Testing and treatment should be offered in the most expeditious manner possible.

Chlamydia. The morbidity and societal costs associated with chlamydial disease in terms of acute symptomatic infection, PID, ectopic pregnancy, infertility, and amplified HIV transmission/acquisition are so great that broad screening of sexually active females is widely supported.[65] If such a measure is considered cost effective in the general community, it is certainly indicated in correctional facilities where rates are higher and core group members are over-represented. Every correctional facility in the Nation should screen new admissions for chlamydial infection. Until the LCR is adapted for economical, quick mass screening, women should be tested with one of the widely available genetic probe kits and males should be tested for leukocyte esterase activity in urine samples. Inmates testing positive for chlamydia infection should receive single-dose therapy with azithromycin and should be referred for intensive harm-reduction training and immediate HIV testing. These programs should be coordinated with the local public health authorities. Facilities in which the entire inmate population or identifiable subsegments thereof demonstrate chlamydia prevalence greater than 20 percent should consider empiric treatment without diagnostic screening of these groups immediately upon admission.

Trichomoniasis. The medical community is just beginning to understand the importance of *T. vaginalis* in prisoners. The few studies available suggest that it is the most prevalent of the non-viral STDs in females.[66] Its prevalence in male inmates remains undefined. Correctional facilities throughout the country should conduct studies to define the prevalence of trichomoniasis in their locales using inexpensive culture kits such as the InPouch TV for testing cervicovaginal specimens in female inmates and centrifuged urine specimens in males. Inmates who are culture positive for *T. vaginalis* should receive single-dose therapy with metronidazole, and should be referred for immediate HIV testing and intensive harm-reduction training. For populations with very high rates of trichomoniasis, the advisability of empiric therapy without screening should be considered in a cost-benefit model.

Reducing the mean number of new contacts per unit of time. The rate of partner exchange may be the most important of the variables in the mathematical model. It is not simply an arithmetic mean of new partners per unit of time across the community, but also incorporates a measure of variance that is related to *c* exponentially. Community members who have a substantially higher rate of partner exchange than the remainder of the community affect the reproductive force (R_0) of

STDs exponentially and produce an effect that is far out of proportion to their numbers.[67]

For the purpose of the present discussion, it would be best to divide nonmonogamous inmates into two groups, those who trade sex as a commodity for drugs or money (i.e., prostitutes) and those who do not. There is evidence that educational interventions that heighten awareness regarding the dangers of having sexual contact with numerous partners may be effective in inner-city populations.[68] Culturally appropriate messages delivered by respected personalities and peers are the most likely to be effective.[69] Even among nonprostitutes, efforts to encourage moderation in the use of alcohol and other drugs should go hand-in-hand with discussions of sexual practices. As with all attempts at behavior modification, ongoing reinforcement of the message through media campaigns, ongoing group sessions, and advertisements are the most likely to have a lasting impact. For inmates who rely on sex as
a means of income, the problem is more complicated. The complex and tragic interplay of drug use, prostitution, nonviral STDs, and HIV in inner-city minority women is well established.[70] Efforts to control these processes must hinge on drug rehabilitation programs, and correctional facilities are a reasonable target for resources committed to these pursuits.

Furthermore, society should not give up on those individuals who continue to engage in prostitution and drug use. Legal and educational interventions have been highly effective in reducing rates of STDs and HIV among prostitutes and their clients and have proven successful in active IDUs.[71] Harm-reduction programs in correctional facilities should teach inmates who are active drug users and prostitutes how to mitigate the health risks that are inherent in their practices. Limitations on the practice of prostitution through mass educational and legal interventions aimed at prostitutes and their clients also play an important role in reducing rates of partner exchange.

Human Immunodeficiency Virus

Epidemiology

HIV, the pathogen that causes acquired immunodeficiency syndrome (AIDS), is responsible for perhaps the most significant epidemic of our era. From the time that the virus first penetrated urban communities in the late 1970s it has caused an epidemic in continuous evolution. Beginning in the early 1980s, when AIDS was first described by the medical community, it involved primarily men who had sex with men.[72] Almost from the outset, the involvement of IDUs and their heterosexual partners in the epidemic was recognized.[73] The two decades of the epidemic have witnessed some of modern medicine's greatest victories and its most abysmal failures. In the United States as a whole, AIDS is becoming an endemic rather than an epidemic disease,[74] and antiretroviral therapy allows infected patients to live longer and better with a new-found hope of prolonged survival.[75] Mortality rates from AIDS have dropped dramatically.[76] At the same time, HIV infection is decimating the populations of many third world countries that lack the resources to treat the afflicted. There are also populations within this country that are being ravaged even as the overall effect levels off in the Nation as a whole. In the early days of the epidemic, females constituted a very small fraction of those infected. In the 1990s, as the epidemic slowed in the male homosexual and bisexual population, an alarming trend of steadily increasing incidence among women was noted. AIDS case rates are increasing in women, particularly urban women belonging to ethnic minority groups, more rapidly than any other major demographic category.[77] The HIV epidemic in the United States today is being driven by IDUs and their sexual partners.[78] In certain neighborhoods of cities in this country cumulative AIDS case rates exceed 5 percent of the entire population and a great many more are infected with HIV but have not developed AIDS.[79] Persuasive evidence that in some, if not most, of the major urban epicenters of HIV in this country, the jails and prisons represent epicenters within epicenters.[80]

Data are available from U.S. correctional facilities in the 1990s to define the extent of HIV infection and AIDS within the inmate population. Many, probably most, inmates with HIV infection are not aware of their diagnosis and are relatively asymptomatic. Therefore, the most legitimate method for defining the prevalence of HIV infection in prisoners is blinded serologic testing or mandatory universal testing. Both of these methods have been employed in jurisdictions throughout the United States.[81] Inmates with AIDS, the advanced stage of HIV infection characterized by severe immune system dysfunction, come to the attention of public health agencies because AIDS is a reportable disease throughout the country. Although individuals with AIDS consume a larger share of health cost resources per capita and they have been at the center of legal and ethical controversies surrounding such issues as adequate treatment, segregation, quarantine, and compassionate release, they are probably a less significant threat to the public health than asymptomatic, undiagnosed, HIV-infected prisoners. As with all STDs, asymptomatic infectious individuals who remain undiagnosed comprise the segment of the core group that is most likely to infect numerous partners.[82] Studies investigating HIV seroprevalence provide the best reflection of this group in correctional facilities.

Facilitywide HIV seroprevalence studies. The review by Hammett and colleagues.[83] summarizes the findings of mandatory and blinded HIV testing from jails and prisons in 32 States from 1985 to 1994. Prevalences of HIV infection ranged from 0 to 25.6 percent (the latter among women in New York City). States with prevalences of HIV among prisoners exceeding 5 percent were New York, New Jersey, Massachusetts, Florida, and Illinois. Although HIV infection in the United States is a disease predominantly of men, in jails and prisons, particularly in the Northeast, rates among female inmates are higher. This observation is related to the high rate of drug use among female arrestees and the intersecting epidemics of crack use, syphilis, and HIV in urban minority women.[84]

Voluntary HIV testing studies. Testing for HIV in response to the inmate's request is the prevalent system for HIV testing in the Nation's correctional facilities. This system has advantages and disadvantages. The advantages are that it respects prisoner autonomy, it most closely resembles what occurs in the outside community, and results are useful to the individual patient (in contrast to blinded serosurveys) and may be useful in estimating overall facility prevalences. The disadvantages are that voluntary testing programs generally fail to test inmates who do not actively seek out testing, thus missing a sizable and important population. Furthermore, aggregate results of such programs may underestimate actual prevalences because individuals who are less likely to be infected are more likely to volunteer for testing.[85] Voluntary testing programs, which are the most common testing strategy in correctional facilities throughout the Nation, have been useful for individual HIV diagnoses, but have been a public health failure of the first order because the numbers of inmates availing themselves of the testing services have fallen far short of the ideal.

AIDS prevalence studies. In 1994, a survey of 47 State and Federal prison systems revealed 4,827 cases of AIDS among prisoners with institutional prevalences ranging from 0 to 2.4 percent.[86] By the end of that year, 4,588 individuals in the United States had died of AIDS while behind bars representing 2 percent of all AIDS-related deaths in the Nation. Inmates in the New York and New Jersey correctional systems bore the greatest brunt of this fatal epidemic. Hammett, Harmon, and Rhodes estimate that 8,900 prison and jail inmates had AIDS in 1997 representing 4 percent of those living with AIDS in the United States. Moreover, they estimate that 17 percent of those living with AIDS in this country passed through a correctional facility at some point during the year. According to their mathematical model there were three to four HIV-infected inmates without AIDS for every one with AIDS.[87]

Theoretic model

Although the forces that govern the spread of the nonviral STDs through a community—likelihood of transmission per contact (β), duration of infectivity (D), and average rate of new partner acquisition (*c*)—also apply to HIV infection, a number of sociological and physiological distinctions complicate efforts at HIV control in the community. Important sociological differences include the following:

- In most cases, testing for HIV requires an informed consent and counseling process that is unique among STDs.
- Information pertaining to individual HIV status requires a higher level of confidentiality than that for other STDs.
- HIV-infected individuals are subject to stigmatization and discrimination to an extent unrivaled by other STDs.
- Medications used to treat HIV infection are extremely expensive.
- The Nation's populace and Government recognize HIV as a problem of major importance.

Important physiologic differences include the following:

- HIV causes an incurable illness.
- The natural history of untreated HIV infection in most patients eventuates in death.
- HIV infection is transmitted not only sexually, but also by contact with infected blood, most commonly in the context of injection drug use.
- All effective treatments for HIV require lengthy, perhaps lifelong, medication administration.
- When antiretroviral medications (the medications used to control HIV infection) are used improperly, the virus has the capacity to develop resistance quickly. This resistance is genetically stable and can be transmitted to new cases throughout the community.[88]
- Because HIV is incurable, patients cannot move in and out of the infected pool of individuals within a community. They are either once and always infected or not yet infected.

These differences complicate the mathematical modeling of the epidemic in the community. Whereas β is easily reduced to zero for the nonviral STDs through the use of curative antimicrobial agents, it is not clear that β can ever be zero for an HIV-infected patient. Reliance, therefore, on partially effective means such as condom use, bleach disinfection of needles, treatment of transmission cofactors (such as other STDs), and antiretroviral treatment is necessary to modulate the likelihood of transmission downward. In marked contrast to the curable STDs, effective treatment of HIV has the paradoxical effect of increasing D by prolonging the life and thus the period of contagion of each infected individual. Similarly, *c* may increase with effective treatment as a result of an increased sense of well-being and a societal view that HIV is now a treatable illness. These harmful trends are likely outweighed by a probable decrease in communicability of infection from effectively treated patients.

The final physiological difference of HIV infection listed above deserves emphasis. With the curable STDs, individuals can move in and out of the infected and uninfected populations many times, whereas individuals from the HIV-uninfected population can enter the HIV-infected population but cannot exit it while still alive. From a strictly mathematical standpoint, one can counterbalance the effect of a single new gonorrhea infection in a prostitute by diagnosing and curing a case of gonorrhea in another prostitute. With HIV, however, there is no easy or inexpensive way of neutralizing the community health impact of new cases of infection. It is

clearly less expensive in terms of both human suffering and actual dollars to prevent new cases of HIV than to manage them effectively. This reality has led to public health policies that concentrate not only on infected individuals but also on the segment of the population that is not yet infected, especially those who are at increased risk.

Because the mathematical model employed in the section on the nonviral STDs is rendered cumbersome by the distinctive properties of the HIV epidemic, the ensuing discussion will be structured according to the four main categories of HIV control interventions and will comment on the merits and limitations of each within the correctional setting: (1) HIV testing services, (2) harm-reduction training, (3) treatment of HIV disease, and (4) diagnosis and treatment of other STDs.

HIV testing. HIV counseling and testing services are a major component of HIV control efforts in the Nation.[89] In theory, the advantages of broad or universal testing for this illness in prisoners are great. The wide use of an inexpensive and highly reliable test would identify those inmates infected with HIV, allowing them the best possible opportunity for early treatment and offering past, present, and future partners a chance at early diagnosis or avoidance of disease acquisition. Testing pregnant inmates would allow for early treatment of mothers while dramatically improving the outlook for their children.[90] Inmates testing negative for HIV antibodies could receive reassurance about their infection status together with aggressive harm-reduction counseling. Reality diverges markedly from this ideal scenario. Although most facilities offer HIV counseling and testing services,[91] they are generally staffed only to process the small number of prisoners requesting their services or referred by physicians for specific reasons. Attendance at testing sites is generally limited by the movement constraints that govern all activities within jails and prisons and by discrimination from staff and other prisoners who are aware of testing appointments. Prisoners considering testing may defer it for a variety of reasons including misunderstanding, lack of interest, inconvenience, fear of positive test results, breaches in confidentiality, and possible discrimination if diagnosed as HIV infected.[92] Although the effects of discrimination are difficult to define in a quantitative sense, inmates with HIV infection often suffer from discrimination at the hands of correctional officers and other inmates. Screening programs in correctional facilities, particularly jails, function at maximum efficiency when they are a part of the intake process[93] because inmates who are already housed may be occupied with their daily routines, legal proceedings, anticipated release dates, and family visits and may not wish to disrupt these activities with multihour excursions to counseling and testing sites. At Rikers Island, a jail with an organized, full-time staff of HIV counselors/testers, but without HIV testing services incorporated into the intake process, approximately two-thirds of the most crucial, high-risk populations (e.g., pregnant women, men who have sex with men) complete their incarceration without having had their HIV status determined.[94] It is likely that facilities that are less attuned to the problem of HIV perform even more poorly. Unless existing practices undergo a dramatic change, pregnant prisoners in the United States will fail to meet the Government's goal of 95 percent prenatal HIV testing for the year 2000[95] in a most dismal way. This tragedy is compounded by the reality that incarcerated pregnant women are arguably the segment of the population in greatest need of these diagnostic initiatives. On a more positive note, correctional facilities in Maryland and Wisconsin have achieved 47–83 percent testing rates for new inmates after incorporating a convenient counseling and testing session into the intake procedure.[96] These programs are a highly cost-effective means of preventing new HIV infections in the community, with one new case of HIV infection averted for every five cases newly diagnosed, according to CDC estimates.[97] Reductions in new infections may be even greater in settings such as jails and prisons where the core group of supertransmitters is overrepresented. Voluntary programs for prisoners should attempt to assuage the main concerns that lead to test refusal—fear of positive test results and lack of confidentiality—and should strive to correct the

common misperception that prior negative HIV test results, even those obtained more than 1 year previously, render repeat testing unnecessary.[98] These programs should not write off inmates who refuse an initial attempt at testing because the intake period is often a time characterized by anger, frustration, and drug and alcohol withdrawal. A number of studies in urban populations have demonstrated that individuals who refuse testing have a higher prevalence of HIV infection than those who accept it.[99] Ideally, screening programs should maintain logs of inmates who have refused testing and recontact them periodically during their incarceration. Prisoners who test HIV seropositive should be referred for comprehensive care of their illness. They should be screened for curable STDs and treated (as indicated), and they should receive harm-reduction counseling tailored to their infection status. The success of such efforts in curbing activities likely to result in HIV transmission has been documented in inner-city populations.[100] Inmates who test negative for HIV should also receive aggressive counseling as well as STD screening, because a troubling trend of increased high-risk behavior in subjects receiving knowledge of seronegativity has been observed.[101] Inmates who refuse testing should, of course, receive the same range of STD screening and harm-reduction counseling as those accepting testing. Within the context of the theoretic mathematical model, $R_0 = \beta D c$, aggressive HIV testing programs may directly reduce the level of infectiousness (β) by encouraging condom usage and safer needle habits and by referring patients for effective antiretroviral treatment. The duration of infectiousness, D, may be reduced by removing certain individuals from the infectious pool by ending needle sharing or through sexual abstinence. The average rate of new partner acquisition, *c*, could also be reduced as a result of effective harm-reduction counseling. Although antiretroviral treatment is a strategy limited to HIV-infected inmates, the rest of these benefits of effective HIV testing programs apply to both HIV-infected and HIV-uninfected prisoners.

Harm-reduction training. The health care community faces a daunting task in attempting to provide harm reduction training to inmates of HIV-positive, HIV-negative, and unknown status. The majority of correctional facilities in the United States offer educational material pertaining to HIV, ranging from printed information to videotapes to individual and group counseling sessions.[102] The need for and efficacy of such programs are much more difficult to define than for HIV treatment programs. There are, however, some instructive data available. Two separate studies assessing knowledge levels of prisoners utilizing a standardized questionnaire in facilities in Maryland and Pennsylvania found that the vast majority of participants knew that HIV may be transmitted by sharing needles or through sexual contact.[103] The knowledge level of prisoners equaled that of the general population. There were, however, misperceptions concerning the risk of contracting HIV through casual contact and the risk of acquiring HIV during the period of incarceration. The prisoners tended to exaggerate the magnitude of these risks. Since levels of drug- and sex-related risk behaviors prior to incarceration are very high, it is clear that a rudimentary knowledge of routes of HIV transmission is necessary but not sufficient for effective control of HIV risk behaviors in this population. Harm-reduction programs must attempt to reinforce preexisting awareness of routes of transmission and correct any misperceptions. Moreover, these interventions must surpass awareness-level programs and include risk-reduction skill building (emphasizing self-empowerment for females). They should consider the affective dimensions of risk-reduction behavior change.[104] Messages imparted by peer counselors and respected members of ethnic minority groups are particularly effective.[105] All programs must recognize that many inmates on release confront basic survival needs such as housing and food requirements, as well as the very powerful influence of addiction. Because of these many factors, it is clear that progress in harm reduction can occur only incrementally and it becomes obvious why single-encounter educational interventions have negligible influence. Although

few, if any, correctional facilities offer multi-session harm-reduction programs to large portions of their inmate populations, there is reason to believe that they could be effective. Community-based harm-reduction programs have been highly successful in reducing sex- and drug-related risk behaviors in indigent inner-city populations in this country including prostitutes and active, out-of-treatment IDUs.[106] Programs such as these can simultaneously influence multiple variables from the theoretical model defining transmission of HIV through the community. These simultaneous effects would be expected to reduce HIV transmission exponentially.

Treatment of HIV infection. Newer antiretroviral medications and combinations have revolutionized the treatment of HIV infection. When used properly these medications can reduce levels of virus in the bloodstream to undetectable levels, improve the quality of life, and prolong survival, perhaps indefinitely.[107] When used improperly, these complex regimens can promote the development of drug-resistant viral strains that can render the patient virtually untreatable and can doom those individuals infected by the patient with the mutated virus to an inexorable progression to AIDS and death.[108] Jail and prison health services have an ethical obligation to administer antiretroviral medications as they would in the outside community. According to current recommendations, the vast majority of HIV-infected individuals should receive combination antiretroviral therapy.[109] The proper use of antiretroviral medications is most likely achieved under the supervision of providers with expertise and experience in infectious diseases and HIV management.[110] Testing of T-lymphocyte subsets and plasma viral load levels must be available in order to assess the need for and response to therapy. Provisions must be made for continuing therapy without interruptions despite court appearances, intrafacility and interfacility transfers, punitive detentions, and release from incarceration. These arrangements require close coordination with the correctional administration and the health care community in the surrounding area. Without aggressive efforts to ensure followup, high rates of interruption of care are inevitable.[111] Little is known about inmate interest in such programs or the success of antiretroviral therapy prescribed behind bars. In 1995, when enthusiasm originated for combination antiretroviral therapy concurrent with the release of lamivudine, the number of inmates on Rikers Island in New York City receiving antiretroviral therapy quickly tripled and has remained at the higher level. Patients receiving such therapy on Rikers Island demonstrated a rise in CD4 lymphocyte counts almost identical to that reported in controlled trials, suggesting that compliance in the jail was satisfactory.[112] A study of antiretroviral therapy in 217 prisoners in the Connecticut correctional system in 1996 found that among the 101 prisoners who were offered antiretroviral therapy, 93 percent accepted and 84 percent of these inmates were compliant with greater than 80 percent of their doses.[113] The belief was prevalent, however, that antiretroviral medications were harmful if there were illicit drugs in one's system. Better antiretroviral acceptance was associated with nonblack race and trust in physicians, and better compliance was associated with male gender and less complex regimens. Both the New York City and Connecticut State correctional systems have experience and expertise in delivering care to HIV-infected inmates and both employ full-time infectious disease specialists to supervise HIV care. These data suggest that effective antiretroviral therapy can be administered in correctional facilities, and that successes achieved in systems where HIV prevalences are extremely high could probably be matched at lesser expense throughout the country. They also suggest that the correctional facility may be an important site for initiating antiretroviral therapy in this population and that HIV management strategies should be culturally appropriate for black prisoners, especially women, and should strive to employ the least complex medication regimens possible. Several lines of evidence suggest that effective antiretroviral therapy may decrease β, the likelihood of HIV transmission per contact. Reduced levels of HIV in seminal fluid parallel those in plasma in treated patients, suggesting that the exposure inoculum of contacts of treated individuals is lower than that of the untreated.[114] Studies of vertical transmission of HIV from mothers to newborns have shown a direct

correlation between maternal viral load and likelihood of transmission to the infant.[115] Finally, the likelihood of HIV acquisition by health care workers experiencing needlestick injuries is related to a number of parameters governing exposure inocula, including end-stage AIDS in the source patient, a status generally associated with a high viral load.[116] Administering effective antiretroviral therapy may produce a number of indirect benefits to the patients and their communities by fostering ongoing relationships with health care providers. Continued contact with well-organized HIV clinics allows the regular reinforcement of harm-reduction messages and allows for social-service interventions that address substance abuse, economic, and housing issues in a legal and responsible way. Less tangible benefits such as the development of a sense of autonomy and self-determination among clinic patients, participation in support groups, and access to the most up-to-date information and therapy are also important byproducts of a good HIV treatment program. These effects may translate into communitywide benefits by further reducing β as a result of safer sexual and drug habits, as well as decreasing c, the appropriately averaged number of new contacts per unit time, through the behavioral changes produced by harm-reduction education.

Diagnosis and treatment of nonviral STDs. The magnitude of the hidden epidemic[117] of the curable STDs in prisoners has been discussed in prior sections. As mentioned earlier, these diseases, especially syphilis, gonorrhea, chlamydia, and trichomoniasis, are important not only vis-a-vis their own morbidities, but also as cofactors in the transmission and acquisition of HIV.[118] Underdeveloped countries without resources to commit to other aspects of HIV control have achieved dramatic reductions in HIV rates by instituting aggressive diagnostic and treatment measures for these easily curable diseases.[119] The CDC has recently highlighted this strategy as a key component of HIV control in this country.[120] State correctional facilities are currently failing to capitalize on this important public health opportunity. Recommendations for better utilization of screening and treatment programs for the curable STDs are outlined in a prior section.

Potential Interventions

HIV testing. Correctional facilities should incorporate easy, convenient HIV testing into the intake procedure for all inmates who are not known to be HIV infected. Testing programs of this magnitude are accomplished efficiently and affordably in the U.S. military (approximately $2.50 per test),[121] attesting to their feasibility. Because pretest counseling sessions and drawing blood are labor intensive, larger facilities should consider innovative approaches such as videotape counseling sessions and fingerstick blood, urine, or oral samples as testing substrate. Logs of inmates who refuse testing on intake should be maintained and these inmates should be recontacted periodically during their incarceration. Efforts such as these should be particularly strenuous when they involve critically important populations such as pregnant women, prostitutes, active IDUs, and men who have sex with other men. Results of HIV tests should be confidential and should be available in a timely fashion. Facilities should coordinate with local health departments to ensure delivery of test results to inmates who have been released from incarceration prior to test completion.

Harm-reduction training. All correctional facilities should offer programs with content aimed at fostering harm-reduction skills including condom usage and safer injection practices. At a minimum this can be accomplished with culturally appropriate printed materials and videotapes. Programs likely to have greater impact utilizing a multisession format, peer counselors, and communications from respected members of the community should be focused on groups of inmates at highest risk of acquiring HIV infection or of transmitting it to others (e.g., inmates with active STDs, prostitutes, active IDUs). Innovative approaches such as programs to promote inmates to the status of peer counselors after satisfactory completion of curricula should be encouraged. Funding bodies should authorize studies of the

short- and long-term effects of aggressive versus "standard" harm-reduction interventions in correctional facilities to evaluate the economic feasibility of more widespread programs.

Treatment of HIV disease. Prisoners with HIV infection should receive comprehensive therapy for the illness. This must include access to standard diagnostic testing (including T-cell subsets and plasma viral load measurement) and all antiretroviral medications. Many regimens must be taken on a strict schedule and require dosing on an empty stomach or after a full meal. Some require free access to fluids. Facilities must demonstrate flexibility in their generally rigid meal schedules to accommodate the requirements of HIV-infected inmates. Furthermore, antiretroviral medications must not be subject to confiscation during searches. Studies have shown that the outcomes of HIV-infected patients are better when they are cared for by providers with expertise in managing HIV infection.[122] All facilities housing HIV-infected individuals should have access to consultation with an infectious-diseases or HIV specialist. Facilities with large numbers of HIV-infected inmates should arrange for such consultation onsite.

Diagnosis and treatment of the nonviral STDs. Recommendations may be found in an earlier section of this paper.

Tuberculosis

Overview

In contrast to other diseases discussed in this document, the problem of tuberculosis (TB) in correctional facilities has long been recognized by the medical establishment, is the subject of comprehensive guidelines by the major governmental health agencies,[123] and has been at the center of numerous court cases involving prisoners' rights.[124] Tuberculosis is unique among the diseases discussed in this paper in that it is transmitted via an airborne route. The destructive potential of a single inmate spreading disease in a poorly ventilated facility by coughing, sneezing, laughing, and talking is large. Similarly, the potential of highly contagious prisoners to transmit disease to numerous individuals in the community after release from incarceration is large, particularly if the postrelease destination is a congregate housing facility such as a homeless shelter, hospice, hospital, or crack house. A recent report that 35 percent of new TB cases in a large urban center in 1992 were attributable to one individual who infected others in a neighborhood bar starkly illustrates the need to control every single contagious case.[125]

The pathophysiology of TB is distinct enough from the other diseases to warrant a separate, detailed discussion. *Mycobacterium tuberculosis* is the organism that causes TB. When a patient with TB coughs or otherwise emits the organism into the air, it attains a form called a *droplet nucleus* that can remain airborne for many hours and is the proper size to reach deep into the airways and establish a new infection in an individual who inspires it. When this occurs, the organism has the opportunity to multiply in the lung and disseminate through the body unchecked for several weeks until a meaningful immune response develops and contains (but does not eliminate) the infection. This process is asymptomatic and generally results in the conversion of the TB skin test, also called the tuberculin test, Mantoux test, or purified protein derivative (ppd), from negative to positive. The medical term referring to this scenario is tuberculosis infection. Patients with TB infection are not contagious to others, but are at some risk of developing symptomatic, progressive disease referred to as active tuberculosis. Certain factors are associated with a high risk of progression from TB infection to active TB. These include recent infection with the organism (especially within the first 1–2 years), HIV infection or other forms of immunosuppression, diabetes, and a history of gastrectomy. Many studies have shown that a 6- to 12-month course of single-drug therapy with isoniazid dramatically reduces the risk of progression to active TB.[126] Such treatment is called tuberculosis preventive therapy. Although active TB can develop almost anywhere in the body, the most common site is the lung. Patients with active TB generally have symptoms and signs such as cough, sputum production, weight

loss, night sweats, and fever. At this stage of disease, most patients have a positive tuberculin test and an abnormal chest roentgenogram. Definitive diagnosis rests upon obtaining sputum (or other anatomic material if the site of disease is not the lung) for Kinyoun, fluorochrome, or acid fast bacilli (AFB) staining, Genprobe, and mycobacterial culture and susceptibility testing. Kinyoun, fluorochrome, or AFB staining are simple, rapid, inexpensive techniques that take advantage of properties of the *Mycobacterium tuberculosis* cell wall to detect the organism on direct microscopic examination of the sputum or other biologic material. A positive stain is very suspicious for active TB and generally mandates separation or isolation from other individuals as well as antituberculous therapy. Patients with enough organisms to detect on direct microscopic examination of the sputum are considered highly contagious. The diagnosis of TB cannot rest entirely on sputum smears, however, because occasional patients with positive smears have diseases other than active TB and many patients with active TB have negative smears. The Genprobe assay is a rapid, fairly expensive test, licensed for use on smear-positive specimens, that employs genetic means to verify that organisms detected on the Kinyoun, fluorochrome, or AFB stains are *Mycobacterium tuberculosis*. A negative Genprobe test on a positive smear specimen casts doubt on the diagnosis of active TB. This technology represents a significant advance by speeding the positive diagnosis of active TB from a period of weeks or months to a single day. Ultimately, the definitive diagnosis of active TB rests upon the growth of the organism in culture. Testing of the organism for resistance to antimicrobial agents is also accomplished through the culture technique. Although recent advances have made culture identification and resistance testing of the organism faster, these processes generally take at least several weeks to complete.

Tuberculosis control in a community is a complex matter and depends mainly on two strategies. First, and most important, is the rapid isolation and effective treatment until cure of all patients with active TB. The second goal is preventing the progression to active TB in individuals who have TB infection.

The isolation and treatment of all patients with active TB requires an organized, proactive, and thoughtful approach containing the following elements:

Screening. All new entrants into a community (whether a nation, hospital workforce, or correctional facility) should be screened for active TB. The least expensive system of screening consists of a review of symptoms and a tuberculin test. Individuals with positive findings on either test would undergo further screening. A more expensive approach that would be less apt to miss cases of active TB would require universal chest roentgenography of all new entrants. A middle ground between these two approaches is also possible (i.e., roentgenographic screening of all individuals in high-risk groups such as HIV-infected patients, immigrants from countries with high rates of active TB, or IDUs). Screening programs should not be limited to new entrants into communities. Long-term members of communities where TB is endemic or epidemic require similar screening tests on a periodic basis, generally every 6–12 months. Finally, more aggressive screening and treatment must be directed at individuals who have had close contact with a patient with active TB. Such screening is often referred to as contact investigation.

Isolation. Individuals with a constellation of findings upon screening that are suggestive of active TB must be promptly isolated until they are deemed noninfectious. Adequate isolation involves placing the patient into a solitary room with negative pressure and frequent air exchanges. Negative pressure refers to air pressure within the patient's room. It must be negative to the outside corridor to prevent the escape of airborne bacteria into common areas. Air exchanges refer to the movement of air out of the patient's room to the outside of the building (or to elsewhere in the building after the air has passed through a high-efficiency particulate air [HEPA] filter). Ultraviolet light may also be a useful adjunct in inactivating airborne *Mycobacterium tuberculosis*

in a variety of settings. Depending on the rate of TB in a particular facility, it may be necessary to maintain isolation rooms onsite, or it may be appropriate to transfer all patients requiring isolation to local hospitals. The duration of isolation is based on the clinical judgment of the patient's care providers, and timely release from isolation depends heavily on the turnaround time of sputum specimens submitted for microscopic examination.

Treatment. The vast majority of patients with active TB are curable with a 6- to 12-month course of medications. The obvious benefit to the patient of such treatment is complemented by the societal benefit of quickly rendering the patient noninfectious to others. The most important lesson learned from the TB resurgence of the late 1980s is the critical role that directly observed therapy plays in achieving acceptable rates of medication completion. Directly observed therapy requires that a trained observer watch the patient ingest each and every dose of medication prescribed until the course of treatment is completed. Large studies have demonstrated the dramatic success of directly observed therapy programs in several urban centers.[127] All patients with active TB should be encouraged to enroll in a directly observed therapy program, and in some settings it should be mandatory.

The second arm of TB control in a community, TB prevention in patients at risk, is in certain respects a lesser challenge and in certain respects greater. It is easier in that patients do not require expensive isolation rooms, extensive diagnostic testing, and complex treatment regimens. It is more difficult, however, in that TB preventive therapy is indicated for far more individuals, and often patients who are free of symptoms are reluctant to commit themselves to 6–12 months of therapy to mitigate a theoretic risk. The challenge, therefore, has been to foster a communitywide understanding of the importance of TB preventive therapy, and to encourage patient commitment to long-term medication compliance using such innovative approaches as voucher systems and directly observed preventive therapy.

Epidemiology

Tuberculosis has been recognized throughout the centuries as one of the most feared and destructive scourges known to mankind. Rates of TB have declined throughout most of this century as a result of better living and housing conditions and with the later advent of effective medical therapy. The United States began compiling national TB reporting statistics in 1953. After 32 consecutive years of declines, the incidence of TB rose in 1985. Although the reasons for this observation were multiple, the HIV epidemic in the United States was a main contributor to the upsurge.[128] Since 1992, when Federal funding of State and local TB control programs increased dramatically, the national incidence of TB has again fallen to historically low levels.[129]

Even as the Nation enjoyed declines in TB incidence between the 1950s and the early 1980s as a consequence of antimycobacterial pharmacotherapy and decreased urban squalor, high rates of TB in correctional facilities were recognized.[130] The association between residence in correctional facilities and TB is an old one. A study of 512 New York City inmates in the early 1900s found 15 (2.9 percent) to have active TB and noted, "The finding of cases of this kind in congested barrack rooms accentuates the necessity for a careful examination of all inmates."[131] The authors suggested that, as a routine, sputum "should be submitted to microscopic examination if there is cough with expectoration and the physical examination of the chest leads to suspicion that tuberculosis may be present."[132] The public health law of New York State in 1902, in discussing the housing requirements of juvenile delinquents, ordered that, "The beds in every dormitory in such institution shall be separated by a passageway of not less than 2 feet in width, and so arranged that under each the air shall freely circulate and there shall be adequate ventilation. . . . The physician of the institution shall immediately notify in writing the local board of health and the board of managers or directors of the institution of any violation of any provision of this section."[133] It is clear that the fundamental elements of screening, environmental control, and

public health agency involvement in TB control in correctional facilities have existed, at least in New York City, for the past century.

With the resurgence of TB in the mid-1980s came a recognition that jails and prisons were serving as hotbeds of TB transmission, leading to studies that have better defined the epidemiology of TB in correctional institutions. A large-scale survey in 1984 and 1985 of TB cases in 29 States found that the incidence of active TB in correctional facilities was 3.9 times greater (95 percent confidence intervals, 3.35–4.49) than the rate in the surrounding communities.[134] This disparity was observed in high-, medium-, and low-incidence States. In the New York State correctional system, the incidence of TB increased sevenfold between 1976 and 1986.[135] In 1994, 4.6 percent of the incident cases of TB nationally were diagnosed in the correctional setting.[136] In New York City, the national epicenter of TB, 3.5 percent of individuals diagnosed with TB were incarcerated at the time of or within 1 year before diagnosis.[137] In 1997, 768 inmates were treated for active TB, and 7.8 percent of inmates nationally were diagnosed with TB infection (tuberculin test positive).[138] Over the past decade, numerous outbreaks of TB have been reported in correctional facilities across the country.[139] The role of the correctional facility as a breeding ground for TB has been a familiar topic in the mainstream medical, public health, and lay press.[140]

One other important epidemiologic trend that deserves mention is the emergence of multi-drug-resistant tuberculosis as a common phenomenon in the late 1980s. Multi-drug-resistant TB is caused by strains of *Mycobacterium tuberculosis* that are resistant to both isoniazid and rifampin (the two best agents for the treatment of active disease) and is characterized by the necessity for lengthy, expensive, toxic treatment regimens and high rates of mortality. This daunting problem originated from poor patient compliance with standard treatment regimens that were prescribed without supervision or observation.[141] Not surprisingly, correctional facilities played a major role in the growth of the multi-drug-resistant TB epidemic.[142] Directly observed therapy programs have recorded dramatic success in recent years in controlling this disease.[143] While case rates of TB (including multi-drug-resistant TB) nationally, in cities, and in jails and prisons have dropped in response to increased funding of public control programs, at least one noted authority has predicted future resurgences because of a lack of governmental foresight leading to diminished rather than redoubled efforts to stamp out the disease.[144]

Potential interventions

Efforts to control the spread of TB both inside and through the bars of correctional facilities should focus on those parameters mentioned in prior discussions—reducing the likelihood of disease transmission per contact (β), the duration of infectivity (D), and the mean number of new contacts per unit of time (c).

Reducing the likelihood of disease transmission per contact. The prisoner population can be divided conceptually into three groups: A small number of inmates with active TB who can spread their disease to others, a larger number of inmates with TB infection but without active TB who are at risk for progression of disease to an active state, and a majority of inmates who have neither and are susceptible contacts of contagious patients. Even with highly efficient screening programs, it is inevitable that congregate housing prior to screening, failure of screening procedures to detect all cases of active TB, or the progression of TB infection to active TB during the term of incarceration will lead to some exposures of susceptible individuals. Certain common sense measures can mitigate the risk of transmission from contagious patients to susceptible individuals (β). First, areas within jails and prisons that contain large numbers of prisoners for substantial time intervals (especially housing dormitories and mess halls) should be well ventilated. Areas that are likely to contain patients with undiagnosed active TB, such as initial intake areas and sick-call clinics, should have adequate ventilation and should consider such additional measures as HEPA filtration and microbicidal

ultraviolet radiation. Dormitories and infirmaries housing inmates with suppressed immune systems, such as AIDS patients, should be particularly stringent in screening current and prospective admissions for active TB because the pace of TB spread through immunosuppressed populations may be extremely rapid.[145] Finally, correctional staff throughout all facilities should be attuned to the problem of TB and should be on the alert for inmates with persistent coughs, sputum production, fever, and weight loss. Inmates who are coughing should be encouraged to wear a mask or at least to cover their coughs with their hands or with tissues until medical evaluation is complete.

Reducing the duration of infectiousness. Three methods are available to reduce the duration of infectiousness (D) of active TB cases. First is timely diagnosis of disease. Authoritative recommendations for screening of prisoners for TB infection and active TB are available to the interested reader.[146] All facilities should have a formal program of TB screening of new admissions and housed prisoners with new symptoms, as well as periodic evaluation of all housed prisoners. The elements of the program should be history and physical examination by a qualified health care provider, tuberculin skin testing, chest roentgenography, and cross-check with the local health department for evidence of a TB diagnosis. Each facility should, in cooperation with local public health agencies, modulate the intensity of these screening tools in accordance with the epidemiology of TB in the surrounding community. A large survey of TB screening practices in correctional facilities in 1994 found that 98 percent of State and Federal systems and 66 percent of city and county systems screened incoming inmates for TB infection. Ninety percent of State and Federal systems and 41 percent of city and county systems screened prisoners annually.[147] Although these statistics are improved over those of the past, higher rates of compliance with these screening procedures, particularly in city and county systems, are an important goal.

The second effective method for reducing the duration of infectivity is airborne isolation. Guidelines for appropriate isolation of patients with proven or suspected active TB are readily available to the interested reader.[148] All correctional facilities should have access to appropriate isolation rooms either onsite or at local hospitals. Patients should remain in isolation until they are deemed to be noninfectious by their medical provider. The duration of isolation may range from several days for inmates who turn out not to have active TB, to several weeks for patients with uncomplicated active TB, to several months or more for patients with multi-drug-resistant TB. Any legal proceedings that cannot await the completion of the isolation process should be conducted within the confines of the isolation facility; patients with suspected or proven active TB who may be infectious should not attend courtroom proceedings. In 1994, 61 percent of State and Federal systems reported that they housed patients with suspected or confirmed active TB in appropriate airborne isolation rooms onsite and 59 percent reported that they housed such patients in community hospital isolation rooms (some systems housed inmates both onsite and in local hospitals).[149] Forty-eight percent of city and county systems housed patients in appropriate isolation rooms onsite and 52 percent sent patients to community hospitals for isolation (some systems housed inmates both onsite and in local hospitals).[150] These statistics were dramatically better than in 1992, but more than 25 percent of the systems still reported inappropriate isolation practices for patients with suspected or proven active TB, most commonly involving placement in single rooms without air exchanges or negative pressure. Approximately 75 percent of the systems reported appropriate practices surrounding sputum smear examination and discontinuation of airborne isolation. It is both unethical and illegal to subject prisoners to exposure to confirmed or suspected active TB. Therefore, every facility must have a responsible plan to provide acceptable isolation for individuals who may have contagious disease.

The final method for reducing duration of infectivity is prompt and effective treatment. Studies suggest that patients without drug-resistant TB are rapidly rendered noninfectious by appropriate medical therapy.[151] All treatment for active TB in correctional facilities should be administered under direct observation.[152] Cases presenting diagnostic or therapeutic dilemmas, such as drug-resistant cases, should be managed under the supervision of a practitioner with expertise in this field. Case management should be closely coordinated with the local health department and provisions for followup in the community must be arranged for all inmates who may be released during their course of treatment. In 1994, 94 percent of State and Federal systems and 90 percent of city and county systems reported that they employed directly observed therapy for all inmates receiving treatment for active TB.[153]

Reducing the mean number of new contacts per unit of time. Many of the measures outlined in the section entitled "Reducing the likelihood of disease transmission per contact" also serve to reduce the mean number of new contacts per unit of time. The occasional inmate who penetrates into the general population despite existing screening practices will do the least public health damage in a facility that is not overcrowded and where progressive symptoms and signs of diseases lead an attuned correctional staff to evaluate and isolate the prisoner in a timely manner.

Miscellaneous. Several other ingredients are required for TB control in correctional facilities. First is TB preventive therapy for inmates with TB infection. The CDC recommends that all preventive therapy for TB within jails and prisons be directly observed.[154] Given a national mean prevalence of TB infection at time of intake of 4.3–8.9 percent, many hundreds of thousands of inmates per year would be candidates for directly observed preventive therapy. Since few, if any, facilities have the personnel to administer such programs, compliance with these recommendations has been inconsistent. One pilot program of directly observed preventive therapy in the Seattle jail system with aggressive community followup yielded disappointing results.[155] An earlier study in the New York City system demonstrated that the best predictors of compliance with preventive therapy were a higher level of understanding of the disease process and ease of access to medication.[156] TB preventive therapy is a key strategy in preventing new cases of active TB from emerging in a community and innovative approaches are needed in order to optimize the use of this powerful public health tool.

Additionally, every correctional facility must have the ability to conduct thorough contact investigations when cases of active TB occur in the general inmate population. Because newly infected patients are at high risk of progression to active TB, contacts of active TB cases must be evaluated and screened for signs of new infection according to established protocols.[157] Some groups, such as HIV-infected patients, are at such high risk that empiric TB preventive therapy should begin at the earliest possible opportunity after exposure.[158] The ability to conduct thorough contact investigations depends on the correctional facility's ability to identify other inmates who shared airspace with the infected individual at the time of contagion and on the organized efforts of personnel designated to complete this task. Employees of the facility may also require screening.

Finally, all TB control activities in jails and prisons should be performed in concert with local health departments. Access to health department registries are invaluable in identifying TB patients who may fail to report their diagnosis at the time of intake.[159] These agencies may also assist in completing the community components of contact investigations, ensuring followup of inmates after release, and tracking epidemiologic trends pertaining to TB, both inside and outside the facility.

Hepatitis B and C

Overview/epidemiology

The problems of hepatitis B and C in correctional facilities have received relatively little attention.

In the era antedating current recommendations for universal vaccination of children, approximately 300,000 new cases of hepatitis B occurred per year, mostly in young adults, resulting in 10,000 hospitalizations and 300 deaths from fulminant disease annually. Approximately 25,000 of each year's new cases develop chronic disease with the virus, accounting for a national chronic carrier population approaching 1 million individuals and for approximately 5,000 deaths annually attributable to consequences of chronic infection (approximately 4,000 from cirrhosis and 1,000 from hepatocellular carcinoma).[160] While the epidemiology of hepatitis B in the United States will undergo dramatic changes as a result of universal vaccination of children, the virus will remain an important pathogen for the foreseeable future.

Hepatitis C is receiving increasing attention from the medical and lay community. In the 10 years since the discovery and identification of the pathogen, it has become clear that hepatitis C is the most common chronic bloodborne viral infection in the United States.[161] Approximately 3.9 million individuals in the Nation have been infected with this virus. In contrast to hepatitis B, the majority of these people remain chronically infected. Complications of hepatitis C infection account for an estimated 25,000 deaths annually, or approximately 1 percent of all deaths.[162]

Although hepatitis B and C are two distinct diseases their routes of transmission are similar. Both viruses may be acquired through exposure to contaminated blood products especially during injection drug use and historically during transfusion. Rates of transfusion-associated hepatitis B and C have dropped dramatically since routine testing of all blood products was begun.[163] Infants are at high risk for hepatitis B acquisition if their mothers are actively infected and vertical transmission of hepatitis C also occurs. Sexual transmission is another important route for hepatitis B, less so for hepatitis C. In general, patients with active or chronic hepatitis B are more likely to transmit their infection to susceptible contacts than patients with hepatitis C. This transmission advantage is, however, counterbalanced by the longer average duration of infectivity of individuals who acquire hepatitis C infection and the lack of a means (i.e., vaccine) to promote protective immunity in those uninfected with hepatitis C.

Despite significant advances in the treatment of viral hepatitis, there is no consistently effective regimen available to cure either disease. Regimens offering some hope of cure are lengthy, expensive, and fairly toxic.

Although viral hepatitis in the correctional setting is becoming the focus of renewed attention, it is by no means a new problem. It has a colorful history dating back to the decades preceding the identification of the viral causes of serum hepatitis. Forty years ago, in the early days of transfusion medicine, units of blood were generally obtained from one of two sources, family and friends of the patient requiring transfusion or professional donors.[164] Professional donors were paid small fees to donate blood and were often drawn from the most indigent segments of society including alcoholics and drug addicts. Another common category of professional donor was the prisoner, and prison blood donation was an important part of the transfusion blood supply into the 1970s.[165] Because no serologic tests for viral hepatitis were available, screening was limited to donor-supplied reports of prior hepatitis or jaundice. In commenting on this donor pool, one authority stated, "The purchase of blood at low rates attracts many alcoholics or other unfortunates who return every 8 or 10 weeks and who know that they will not get the money if they answer 'Yes' to questions not only about jaundice but malaria and other infectious diseases."[166] A study of transfusion recipients in Chicago between 1946 and 1956 found a rate of serum hepatitis of 0.3 percent in patients who received 1 unit of blood from a family member compared to 3.2 percent in patients who received one unit of blood from a prisoner donor.[167] By the late 1950s it was clear not only that the incarcerated population had a high prevalence of contagious, bloodborne hepatitis, but also that the correctional facilities themselves were serving as amplifiers of disease through the

routes of intrafacility injection drug use; use of nondisposable, nonsterile needles for medicinal purposes; use of nonsterilized dental equipment; and tattooing.[168] Over the ensuing decades, the practice of obtaining blood donations from prisoners fell out of favor. During the era of modern diagnostic testing for viral hepatitis, there have been sporadic reports detailing prevalences of hepatitis B and C in jail and prison populations. High rates of hepatitis B and C in IDUs and in the socioeconomically disadvantaged have, not surprisingly, resulted in a disproportionate burden of disease in prisoners. Numerous series from around the country have consistently shown prevalences of these diseases in correctional facilities at least several times higher than in the general U.S. population.[169] These observations have led to recommendations for more aggressive screening of prisoners and a consideration of more intensive vaccination efforts.[170]

Few recent studies are available to define the current epidemiology of hepatitis B and C in correctional facilities and most of these data have been presented in abstract form, not in peer-reviewed medical journals. Two large surveys conducted during the 1990s found a seroprevalence of acute or chronic hepatitis B infection of 1.8 percent in the New York State correctional system[171] and 2.2 percent in the California correctional system.[172] An unpublished study in the early 1990s of 1,271 patients on Rikers Island in New York City who were initiating TB therapy or prophylaxis, initiating antiretroviral therapy, or had abnormal liver function tests demonstrated an 8 percent prevalence of chronic hepatitis B.[173] These rates are an order of magnitude greater than those of the general population.[174] Mathematical modeling of hepatitis C rates in prisoners and releasees based on serosurveys of prisoners and IDUs in a report by Hammett, Harmon, and Rhodes estimated that 17.0–18.6 percent of prisoners and releasees in 1996 and 1997 were infected with hepatitis C, translating into populations of 303,000–332,000 prisoners and 1.3–1.4 million releasees infected with hepatitis C. These investigators suggested that an astounding 29–32 percent of all persons with hepatitis C in the Nation passed through a correctional facility in 1996.[175]

Potential interventions

As pathogens that are transmitted by both the bloodborne and sexual routes, strategies to curb the transmission of hepatitis B and C are very similar to those employed for HIV. These strategies must rely on interventions that decrease the likelihood of transmission of infection from an infected person to an uninfected person, the duration of infectiousness, and the average number of contacts with uninfected individuals during a unit of time.

Reducing the likelihood of disease transmission per contact. Methods to reduce the likelihood of transmission (β) include harm-reduction messages identical to those employed for HIV. An additional educational component is needed, however, to inform prisoners that viral hepatitis is a serious threat separate from that of HIV and that safer needle sharing and sexual practices are necessary even when all involved have tested negative for HIV. Public health agencies support the institution of widespread testing for hepatitis B and C in inmates.[176] Such testing programs are justifiable on the premise that individuals who are identified as infected may receive intensified harm-reduction counseling and curb their high-risk behaviors. In turn, β could be reduced through safer injection and sexual practices. Furthermore, better and earlier diagnosis of hepatitis B and C may allow for successful treatment of certain prisoners with antiviral agents. Such treatment, while far from uniformly effective, may offer some hope of reducing viral burden and hence transmissibility and may lead to actual cure in a minority of patients.[177] Prisoners receiving antiviral treatment for hepatitis B or C must be managed by a physician with expertise in this area, generally a gastroenterologist or an infectious-diseases specialist. Finally, screening prisoners will identify a population of high-risk individuals who are not yet infected with hepatitis B or C. For these prisoners, educational messages may provide useful strategies for avoiding infection in the future, including safer injection and sexual behaviors, as well as the possibility of

hepatitis B vaccination for prisoners who are both hepatitis B surface antigen and antibody negative.

As with HIV, these interventions are able to affect multiple parameters determining disease transmission in a community simultaneously and the beneficial effects of behavior modification aimed at avoiding hepatitis transmission would, by extension, augment efforts to decrease HIV transmission and vice versa.

Reducing the duration of infectiousness. Cessation of injection drug use and sexual contact with uninfected partners as a result of harm-reduction training could effectively reduce the duration of infectiousness (D) in a subset of patients. Cure of disease by antiviral therapies could also serve to reduce the mean duration of infectiousness. The effect of such treatments on hepatitis transmission in the community may become more profound as new and better therapeutic options emerge.

Reducing the mean number of susceptible new contacts per unit of time. Harm-reduction counseling and behavior modification techniques together with social and legal remedies may lead to reductions in numbers of susceptible contacts per infected individual (*c*). These issues have already been discussed in greater detail in the section on HIV infection. In the case of hepatitis B, however, vaccination offers another route to decrease *c*. The number of susceptible contacts exposed per unit time can be reduced effectively by increasing the rate of hepatitis B immunity in the population. In the decades to come, there is hope that universal pediatric vaccination will increase herd immunity in the United States to a point that disease transmission and long-term sequelae become uncommon.[178] In the meantime, although the disease continues to thrive among those subsets of the adult population that tend to reside in correctional facilities,[179] much benefit can be derived from and much expense and illness averted by the use of aggressive, targeted hepatitis B vaccination in adults. A number of high-risk groups, including prisoners, have been suggested as potential target populations.[180] The idea of mass vaccination of prisoners is attractive. An extremely safe and effective vaccination could protect large numbers of prisoners from a serious health threat. Immunization of all inmates is probably not the proper approach, however. Up to 80 percent of prisoners in some facilities may show serologic evidence of prior hepatitis B infection[181] and therefore would not benefit from vaccination. A complete vaccination series requires 3 injections administered over 6 months. Prisoners who are incarcerated for less than 6 months, especially in jail systems, are unlikely to properly complete the series once released. These two realities, combined with the fairly high cost of the hepatitis B vaccine, necessitate a more selective approach to hepatitis B vaccination in prisoners. Screening for serologic markers of hepatitis B infection and vaccination in short-term stay facilities in which mean lengths of stay are often on the order of several days would be fairly senseless because few prisoners would remain to complete the vaccination or even to receive their serologic test results. If, however, a subset of the prisoner population could be identified with likely durations of incarceration exceeding 6 months, members of this group would be good candidates for hepatitis B surface antigen and antibody testing and for vaccination if these markers were absent. In prisons, where lengths of stay are longer and better defined, a program of universal hepatitis B screening and vaccination of uninfected, nonimmune individuals would doubtless save thousands of preventable new cases of hepatitis B each year. Methods of vaccine administration that could lessen the cost and perhaps the duration of the series are under investigation[182] and offer the hope of broader hepatitis B vaccination in correctional facilities in the future.

In summary, jails and prisons should be targets for intensified education about the dangers of hepatitis B and C and about methods available to decrease the rates of transmission and acquisition.

Broad-based screening for hepatitis B and C are recommended, as is vaccination of all uninfected, nonimmune prisoners against hepatitis B. These efforts should not be applied wastefully, however, and their applicability to a given facility depends primarily on the mean length of stay of inmates. Certainly, these programs should be universal or near universal in prison systems where lengths of stay are longer and better defined. Finally,

facilities must offer antiviral treatments supervised by appropriate subspecialty trained physicians to prisoners with hepatitis B and C who are deemed to be candidates. As therapies become more effective and better accepted, the need for these resources in correctional facilities will increase.

Conclusions

The burden of infectious diseases in correctional facilities in this country is staggering. The likelihood of active infection with a variety of serious pathogens among prisoners is many times higher than in the surrounding communities. In studies that have analyzed the proportion of cases of significant infectious diseases inside versus outside the bars of the facilities, the results have proven that prisoners and releasees can be major driving forces behind epidemics. Although correctional facilities have achieved some measure of success nationally in controlling TB and syphilis (in specific regions), overall efforts to control other infections, such as HIV, have been dismally ineffective. To implement appropriate screening, treatment, and prevention programs for the infections discussed in this document is expensive, but not nearly as expensive as a failure to do so. The problem of infectious diseases among prisoners represents not only a daunting challenge but also an extraordinary opportunity for the private and public health of this Nation.

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