Contributions of Premarital and Prenatal Blood Testing in Syphilis Control

By HAROLD J. MAGNUSON, M.D., JAMES F. DONOHUE, M.P.H., JOHANNES STUART, Ph.D., and GERALDINE A. GLEESON, A.B.

MUCH OF THE PROGRESS in syphilis control during recent years has been accomplished through the cooperative efforts of the national venereal disease control program, State and local health departments, and various private agencies. The control measures and techniques used by these health agencies form such a closely integrated system that it is difficult to break down the contributions of certain components or to evaluate the efficiency of specific control measures. However, in this report two segments of the program, namely, premarital and prenatal blood-testing legislation, have been isolated, and an attempt has been made to measure the specific accomplishments of required blood testing.

Aside from the case-finding aspects of required blood-testing programs, the primary purpose of premarital and prenatal blood testing is to preserve the health and welfare of the family unit by preventing the transmission of syphilis to marital partners and by protecting unborn children from infection with congenital syphilis. Such blood testing also has its educative values.

One of the most immediate results of effective premarital and prenatal blood-testing legislation should be reduction of infant mortality due to syphilis. But since there has been a general downward trend in infant mortality from syphilis during the past 20 years, it is difficult to determine by observation alone whether this reduction in rates would have occurred regardless of blood-testing legislation, or whether there is a definite relationship between the two factors.

In an attempt to distinguish between the reduction in infant mortality due to blood-testing legislation and the general downward trend in infant mortality, composite rates per 1,000 live births for infant deaths due to syphilis were computed for States having prenatal blood-testing laws during 3 years prior to the year the law became effective. Assuming these three yearly rates to be representative of the general trend of infant mortality due to syphilis immediately preceding the passage of the law, a straight line trend (a+bx) was fitted to these rates and then extended through 5 years following prenatal legislation. Confidence limits at the 1 percent level of significance were set up about this extended line to allow for chance variation. The actual observed rates were plotted for the 5 years.

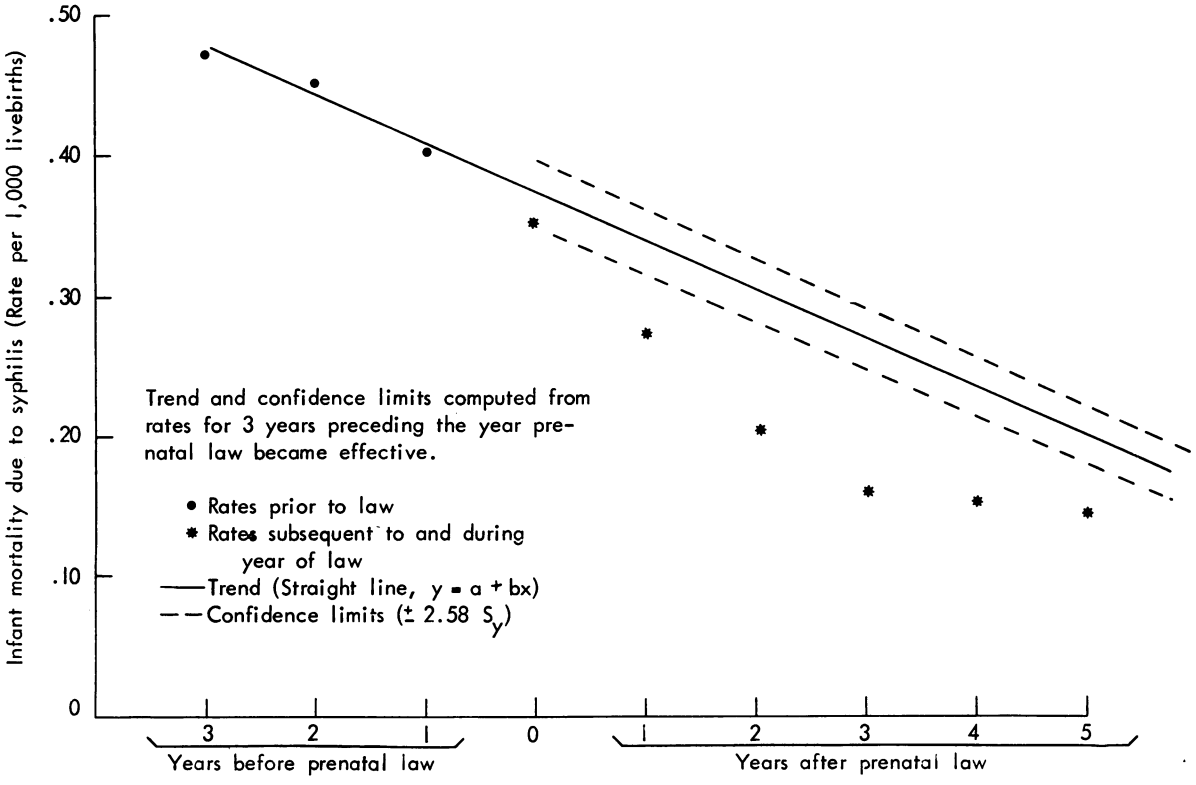
Figure 1 shows that the observed infant mortality rates for all years are significantly lower

---

Mr. Donohue and Dr. Stuart are chief statistician and program management officer, respectively, Venereal Disease Program, Public Health Service. Dr. Magnuson, chief of the Occupational Health Program, and Mrs. Gleeson, a statistician with the Air Pollution Medical Program, were formerly with the Venereal Disease Program, Dr. Magnuson as chief of the Operational Research Section and Mrs. Gleeson as a statistician.

This paper was presented at the Third Biennial Planning Conference of the Association of State and Territorial Health Directors, Washington, D. C., May 25, 1956.

Figure 1. Composite rate of infant mortality due to syphilis in 42 States before and after enactment of prenatal blood-testing law.



than the expected trend based on rates prior to blood-testing legislation. As a specific contribution to syphilis control, it is estimated that through the effectiveness of prenatal blood testing 1,000 infant deaths from syphilis were prevented in 42 States during the first 5 years following enactment of the law. Since 30 of the 42 States with prenatal blood-testing laws had enacted these laws during 1943, or earlier, the interval represented in the 5-year period is largely coincident with the war years and the immediate postwar years. This reduction in infant mortality due to syphilis becomes even more remarkable in view of the fact that it was accomplished during a period when infectious syphilis case rates among civilians were at a peak and before penicillin became available for civilian use. This points up the vital importance of the operation of required blood-testing programs before, during, and after national crises which boost the rate of venereal disease infection.

The procedure used in evaluating the effectiveness of prenatal blood testing was also used in examining the efficiency of premarital blood testing. Figure 2 shows that, except for a longer time interval, rates are essentially the same as would be expected before the reduction in infant mortality rates became readily apparent.

Prenatal Testing

To investigate the effectiveness of prenatal blood testing in individual States, the trend established by pre-law rates was related to post-law rates in each of the 42 States having prenatal blood-testing legislation. The results were as follows:

1. Fourteen States had an upward trend in infant mortality from syphilis during the 3 years preceding the effective date of the prenatal blood-testing law. After the passage of the law, all of these States had a downward trend in infant mortality from syphilis and experienced significantly lower rates than expected during 5 years following prenatal blood-testing legislation.

2. Two States with a steady level of infant

mortality due to syphilis during the 3 years preceding passage of the prenatal blood-testing law had significantly lower rates than expected during the subsequent 5 years.

3. Twenty-six States had a downward trend of infant mortality due to syphilis during the 3 years preceding prenatal blood-testing legislation. In all of these States the trend in infant mortality due to syphilis continued downward in the years immediately following legislation, in 7 at a faster pace than expected; in 6 at approximately the pace expected; and in 13 at a slower pace than expected.

As an example of the enactment of a prenatal blood-testing law resulting in decreased infant mortality due to syphilis, the observed rates in relation to expected trend are shown in figure 3 for the State of New Mexico. The significant decrease noted during the years 1950–53, following the passage of the law in 1949, is even more remarkable in view of the fact that New Mexico has for some years had the highest rate of infant mortality from all causes in the United States.

It might be asked if the accelerated decrease in infant mortality due to syphilis was confined to States with required prenatal blood-testing legislation or if States without such legislation experienced a comparable reduction in infant mortality rates. Since there is no date of law enactment to use as a point of reference in establishing an expected trend of infant mortality from syphilis in States without prenatal or premarital blood-testing laws, the selection of a year from which to project such a trend becomes fairly subjective. However, the observed trend line for areas without such legislation shows a gradual reduction in infant mortality from syphilis from 1936 to 1950, but how much more of a reduction would have occurred during these years if blood-testing legislation had been in operation is a matter of conjecture.

In addition to the reduction in infant mortality due to syphilis there is evidence to indicate that prenatal blood testing makes a definite contribution to the control of infant mortality from all causes. Presumably this is accomplished by bringing many expectant mothers to prenatal

Figure 2. Composite rate of infant mortality due to syphilis in 40 States before and after enactment of premarital blood-testing law.

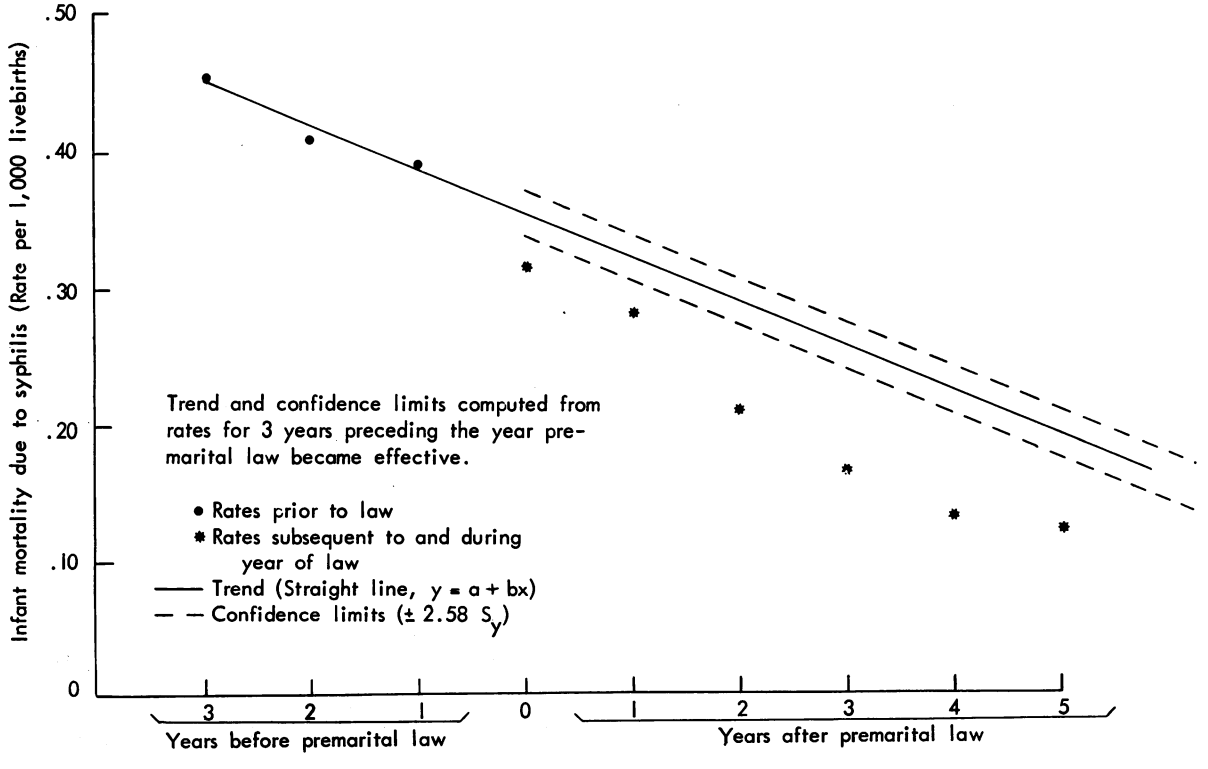
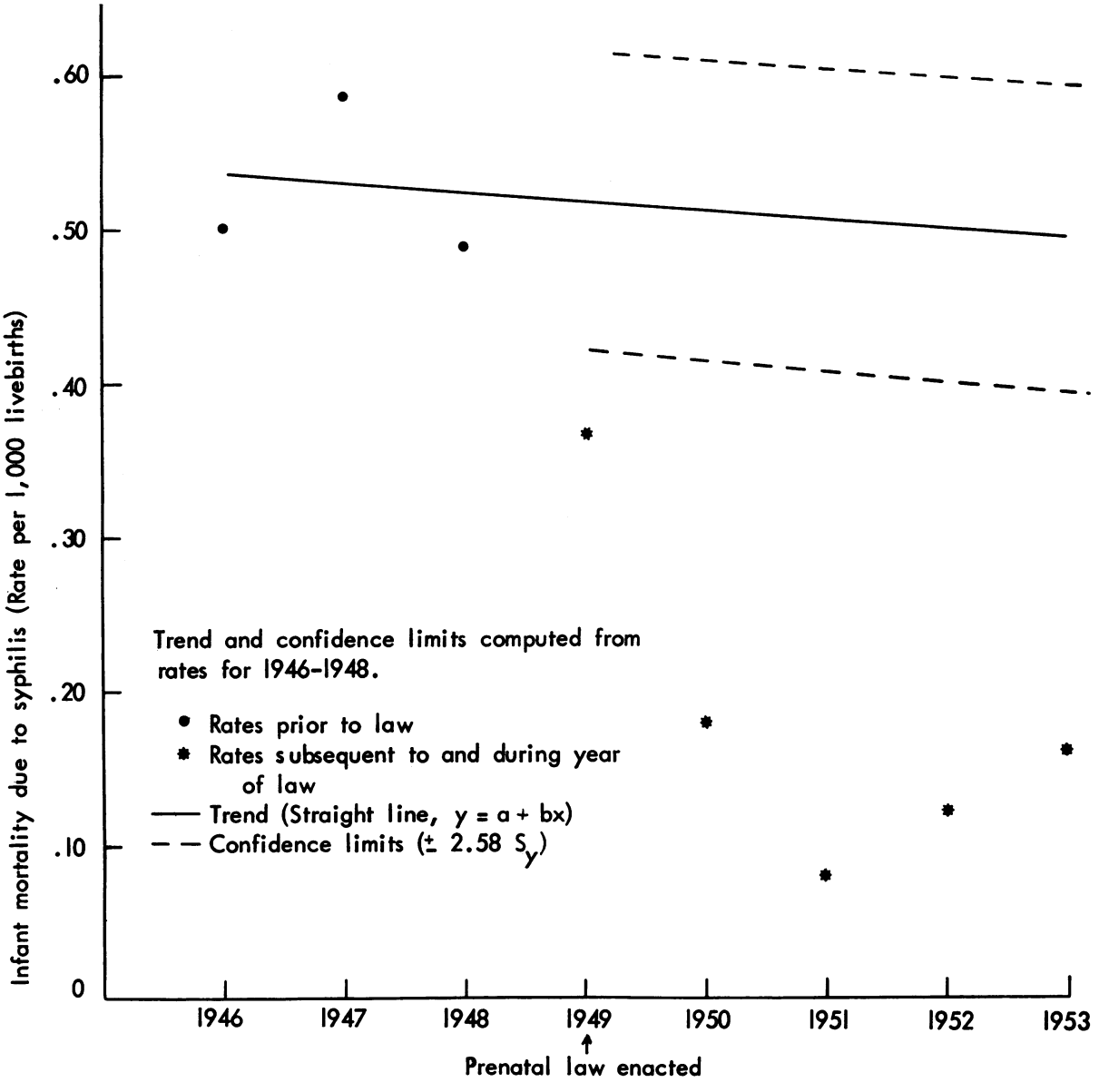


Figure 3. Rate of infant mortality due to syphilis in New Mexico before and after enactment of prenatal blood-testing law.



care which they probably would not obtain otherwise.

For the years 1951–53 the total infant mortality rates were significantly lower in the group of States with prenatal blood-testing laws. Since the States without these laws are not those with unreasonably high infant mortality from causes other than syphilis, it seems reasonable to assume that the lower infant mortality in States with prenatal blood-testing laws may have been due at least in part to increased prenatal care incident to the required blood-testing program.

Race Distribution

Race distribution is, of course, a very real factor in measuring infant mortality. To determine the results of prenatal blood testing, specific for race, we have prepared some comparative material on areas with and without the law with varying percentages of white population. The 7 areas without prenatal

laws (6 States and the District of Columbia) happen to cluster in 3 geographic areas where white births comprise the following percentages of total births: 63 percent in Alabama, Tennessee, and Mississippi; 75 percent in the District of Columbia and Maryland; and 98 percent in Minnesota and Wisconsin. Total infant mortality in neighboring States with a prenatal blood-testing law and of a comparable proportion of white births was compared with the total infant mortality in these three areas. In every case, regardless of race distribution, the infant mortality rate among the white population was lower in 1953 in States with the prenatal blood-testing law than in States without such a law. Conversely, in all instances, the nonwhite infant mortality rate was higher in States with the prenatal blood-testing law than in States without this law, with the differential becoming greater as the number of nonwhites in the population decreased.

There may, of course, be a number of factors contributing to this paradox among nonwhites. One factor is the administration of the law. This was borne out by a study of New York City birth certificates which asked whether a prenatal blood test had been made (see table).

Results of a study on prenatal care in New York City, 1951

Race	Number of births	Late or no prenatal STS	
		Number	Percent
White	4, 905	639	13. 0
Puerto Rican	521	228	43. 8
Nonwhite	1, 138	441	38. 8

From birth certificate data it was found that in 13 percent of the white births studied, the mother either had no serologic test for syphilis (STS) or had had an STS only during the last trimester of pregnancy, as compared with 44 percent among Puerto Rican and 39 percent among nonwhite pregnant women. If only 60 percent of nonwhite pregnant women are being adequately tested for syphilis in New York City, where a prenatal law has been in effect since 1938 and where medical facilities are known to be available, there is reason to believe that administration of the prenatal law is even less effective in areas where prenatal care is less adequate. With higher percentages of nonwhites in an area, the administration of the law becomes less effective for this group.

Penicillin Therapy

Another factor which adds to the difficulty of evaluating prenatal blood testing is penicillin therapy. This has undoubtedly affected, even to the point of destroying trend comparability, the two measures we use to estimate the incidence of congenital syphilis, namely, reported number of cases and infant mortality due to syphilis. With penicillin readily available and carrying little therapeutic risk, many physicians have adopted the policy, in cases of doubtful diagnosis, of treating infants on a prophylactic basis. Since these cases are not diagnosed, they are not included in the congenital syphilis case rate. On the other hand, treatment of syphilitic babies with penicillin has been so successful that infant mortality due to syphilis is no longer comparable to this rate during the arsenical-bismuth era. Thus, the reductions in the incidence of congenital syphilis may be due, for the most part, to therapy rather than to the actual prevention of cases. Very recently, with the alarm aroused by increased reactions to penicillin, this therapy is in many cases being withheld, which complicates the trend pictures even more, but at the same time points up the need for prenatal screening.

Congenital Syphilis

Another facet of the evaluation of required blood-testing programs centers on the difficulty of diagnosing congenital syphilis. In infants, there may be no physical signs of the disease, and the serologic test is sometimes negative until 3 or 4 months of age. In present-day venereal disease control programs, many years pass before it is certain that all children at risk have been screened for congenital syphilis. Mass blood-testing programs are designed for those who have reached early adulthood, and we know from experience that very few cases of congenital syphilis are found in blood-testing surveys. Hence, the child with congenital syphilis often remains undiscovered and un-

treated until he enters school, applies for a job, enters military service, or plans to marry. An effective prenatal blood-testing law will protect him from infection before birth. For instance, in the fiscal year 1955, 4.8 percent of the reported cases of congenital syphilis were in infants less than 1 year old at time of discovery of syphilis, 2.2 percent in children aged 1–4 years, 8.1 percent in children aged 5–9, and 85 percent were in children 10 years old or older. In numbers, this means that 4,700 of the 5,515 patients with congenital syphilis reported in fiscal year 1955 were approaching or had reached adulthood before detection of the disease. This number, added to the undiscovered reservoir of cases still in the population, represents, in a measure, the past failures of prenatal blood testing and points up the need for more effective administration of the law.

Premarital Testing

Reactivity rates in premarital blood testing have not declined in the period 1951–54, the only period for which we have data available. This maintained level of reactivity indicates that whatever reasons there may have been for the original enactment of the laws, these reasons may still be valid. The argument may be raised that premarital blood testing has not discovered an appreciable number of cases of early syphilis; however, it must be kept in mind that premarital blood testing was not expected to find much lesion syphilis. Conservative estimates indicate that 12,000 to 13,000 previously untreated syphilitic persons are found annually through premarital blood testing. Because of the age-interval of candidates for premarital blood testing, most of the cases of syphilis detected are early latent. Our current epidemiological indexes indicate that each person diagnosed with early latent syphilis names, on the average, 2 contacts, and that 115 cases of syphilis per 1,000 of these contacts examined are found as a result of contact interviewing.

Required blood testing has general health educational value. The very fact that it is required by law is convincing proof to many of the efficacy of such a procedure. Very few people submit to premarital or prenatal blood testing without some notion of why they are being tested. Premarital blood testing, which in most States is incorporated as part of a physical examination, offers the physician opportunities to find lesion syphilis, to do effective case finding of other diseases, and, in some cases, to provide sex education and marriage counseling. Premarital and prenatal blood testing in the control of syphilis are analogous to preventive medicine in other diseases. Since preventive medicine is the very essence of public health, blood-testing legislation is desirable.

As an index of prevalence of syphilis, the need for required blood testing continues. Perhaps of greater importance than as a statistical measure of control, required blood testing screens a segment of the population in which the incidence of early syphilis must be kept at a minimum if venereal disease control is to be maintained. Furthermore, the value of prenatal and premarital blood-testing laws must be measured against the number of cases of syphilis prevented by the existence of these laws as well as in terms of the cases found by their operation.

As a possible example of this dual evaluation of blood-testing laws, 100 cases of early syphilis detected among 100,000 persons examined premaritally would result in an infection rate of only 1 case per 1,000 examined. However, in terms of prevention, the 100 additional new infections which could have developed in prospective marital partners, plus the likely congenital infections in offspring of these marital unions, increase this rate to new proportions. By adding to these infections the previous contacts from which the initial 100 infections were acquired, 1 case actually detected among each 1,000 premarital examinees should be increased to perhaps 5 cases (assuming 2 offspring to each union) to measure more accurately the efficiency of premarital epidemiology and case finding.

Summary

Premarital and prenatal blood-testing legislation, when properly administered, contributes to venereal disease control by (*a*) detecting and bringing or returning to treatment persons with syphilis, (*b*) preventing the transmission of syphilis to marital partners, (*c*) protecting un-

born children from congenital infection, (*d*) reducing morbidity and mortality due to syphilis and to other causes among infants by encouraging prenatal care, and (*e*) providing opportunities for general health education, sex education, and marriage counseling. Despite the accomplishments of required blood-testing programs during recent years, there remains much to be done toward the prevention and control of congenital syphilis. As long as cases of congenital syphilitic infection continue to be found in our population, there is a definite need for strict enforcement of blood-testing legislation.

Revised Statement of Rheumatic Fever Prevention

Revised recommendations for preventing first and repeat attacks of rheumatic fever are incorporated in a new edition of the American Heart Association's statement on Prevention of Rheumatic Fever and Bacterial Endocarditis Through Control of Streptococcal Infections.

This is the second revision of the statement, prepared by the AHA Committee on Prevention of Rheumatic Fever and Bacterial Endocarditis to keep pace with the progressively growing body of knowledge and experience in this field. The committee points out that no recommendations can be considered final at this time. Revisions and changes will be made as new knowledge may indicate.

Principal Changes

Following are the principal changes in the recommendations:

1. Greater emphasis is placed on the value of throat cultures in diagnosing streptococcal infections with a view to stimulating an increased use of cultures, particularly when clinical manifestations alone are inconclusive.

2. The recommended duration of prophylaxis has been qualified. The committee reaffirms its view that continuous prophylaxis should be maintained indefinitely for known rheumatic subjects, but it recognizes that some physicians may wish to make exceptions in certain of their adult patients, particularly those without heart disease who have had no rheumatic attacks for many years.

3. Monthly injection of 1,200,000 units of benzathine penicillin G intramuscularly is now listed first among prophylactic methods. The committee also indicates that it is preferable, if oral penicillin is chosen as the method of prophylaxis, to prescribe 200,000–250,000 units twice daily, rather than once, providing an additional safeguard against breakthroughs which have been reported with the smaller dosage.

Bacterial Endocarditis Prophylaxis

Also revised in the statement are the recommended dosages for prophylaxis against bacterial endocarditis in patients with rheumatic or congenital heart disease who are obliged to undergo such surgical procedures as dental extractions and tonsillectomies. Emphasizing that the dosage regimens used for long-term prophylaxis of streptococcal infections are inadequate for this purpose, the committee recommends that high blood levels of penicillin be maintained for several days (rather than, as previously stated, on the day of operation alone) to prevent organisms from lodging in the heart valves during the period of transient bacteremia.

In general, the combined oral and parenteral route of administration is preferred, as follows: oral penicillin (200,000–250,000 units four times a day) for the 2 days before and the 2 days after surgery; the same dosage of oral penicillin on the day of surgery plus 600,000 units of aqueous penicillin with 600,000 units of procaine penicillin shortly before operation. Alternative recommendations are included for situations in which injection is not feasible or penicillin is contraindicated.

The revised statement appears in the December 1956 issue of *Modern Concepts of Cardiovascular Disease* and in the January 1957 issue of *Circulation*. An outline of a recommended method for culturing beta hemolytic streptococci from the throat is also being made available by the association and may be obtained from local heart associations or the American Heart Association, 44 East 23d Street, New York 10, N. Y.