

Cost-Effective Syphilis Screening in Military Recruit Applicants

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A cost-effectiveness analysis of syphilis screening was performed. Strategies included no screening, universal testing at military entrance processing stations, universal testing at basic training centers, and contracting centralized screening. Probabilities derived from data retained on recruit applicants from 1989 through 1991 ($N = 1,588,143$) and from the published literature were used. Cost estimates were derived from costs incurred by the military and costs projected from implementing new strategies. Sensitivity analyses were performed. Modifying the existing contract for human immunodeficiency virus screening to include syphilis screening would maximize the effectiveness of screening at a cost to the Department of Defense of \$9.52 per additional year of service received. The no-screening option was significantly more cost-saving than the current method of testing. Syphilis is rare and treatable, and individuals with syphilis will be identified by other means in many cases. Syphilis screening of recruit applicants at the military entrance processing stations should cease, saving the military \$2,541,000 per year.

Introduction

Syphilis is a disease caused by the spirochete *Treponema pallidum*. It is usually spread by sexual contact. Infection can manifest itself in three stages, each with its typical symptoms: primary (chancre), secondary (rash, condyloma lata, oral mucous patches), or tertiary (gummata, neurosyphilis, and tabes dorsalis).¹ Screening and appropriate antibiotic treatment will prevent these manifestations.

In the early 1930s, the U.S. Public Health Service estimated that 1 in 10 Americans was infected with *T. pallidum*.² During World War II, after the Public Health Service Surgeon General Thomas Parran's campaign against syphilis, which included prenatal and premarital laws as well as the public health novelty of case-finding, prevalence decreased from 10% to 4.8% in the first 2 million men drafted.² There was an increase in the prevalence during the late 1980s, which has been attributed to crack cocaine use, but syphilis has been declining since then. In 1995, the incidence of syphilis was 0.006%, with the fewest cases reported since 1960.³

In the military, testing the serum of enlisted recruit applicants to detect syphilis is routinely conducted before allowing applicants into the service to prevent the time lost to treatment and the costs of the sequelae. When military screening was

instituted, syphilis was common and untreatable. Now it is rare and treatable. The rapid plasma reagin test (RPR) is used initially. The RPR measures a nontreponeme-specific antigen in the organism's membrane. If this test is positive, the applicant then gets a confirmatory fluorescent treponemal antibody absorption test (FTA), which is more specific, time-consuming, and expensive than the RPR.¹ A positive FTA disqualifies an individual from entering active military service unless the individual can provide proof of previous adequate treatment.

In fiscal year 1995, the Clinical Laboratory Improvement Act (CLIA) was instituted within the Department of Defense (DOD). Screening of enlisted recruits continued, but new questions were raised concerning the practice. Under CLIA, the RPR is the only laboratory test conducted at the military entrance processing stations (MEPS) that is classified as moderate; the others are of a minimal degree of complexity. Moderate procedures must be conducted by a trained laboratory technician who otherwise could be used elsewhere. Maintaining a technician at every MEPS solely to perform this moderate-complexity-level test was estimated to cost the military syphilis screening effort an additional \$2 million per year. Elimination of the RPR was then considered by the Military Entrance Processing Command (MEPCOM), and this investigation was performed.

In contrast, because of the low prevalence of syphilis in military officer applicants, the Department of Defense Medical Review Board discontinued RPR screening as a part of the accession medical examination for military academy and Reserve Officer Training Corps applicants in 1987 [L.E. Mullen, Department of Defense Medical Review Board, personal communication, 1997].

Methods

Data from 1,588,143 military recruit applicants passing through the 65 nationwide MEPS from 1989 through 1991 were the source of prevalence rates of positive FTAs, probabilities of medical disqualification for service for other than a positive FTA, probabilities of being granted a waiver for a disqualifying medical condition other than syphilis, pregnancy rates, and attrition rates.

A decision tree (DecTree version 0.38, Henry M. Jackson Foundation, Rockville, Maryland) was used to assess the relative cost-effectiveness of four programmatic strategies for a syphilis screening program in military recruits. Figure 1 illustrates a summary of the approach to the initial portion of the model. The four strategies compared were (1) no screening, (2) the current MEPS policy of universal testing of all recruit applicants at the MEPS with MEPS processing of the RPRs and resultant disqualification for service based on a positive follow-up FTA, (3) universal testing of all applicants at the MEPS with contractual commercial laboratory processing of the RPRs

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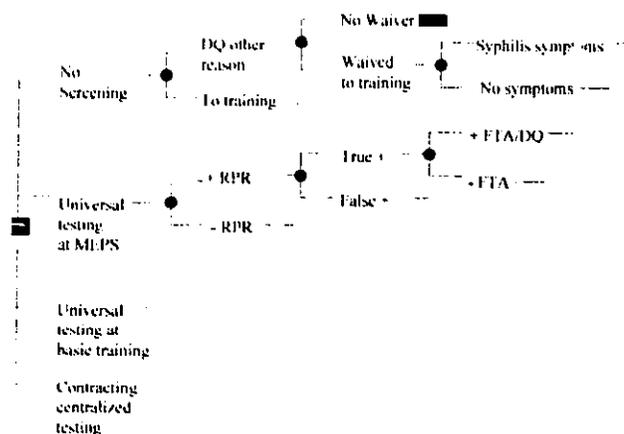


Fig. 1. Decision tree. DQ, Disqualified.

and resultant disqualification for a positive follow-up FTA, and (4) universal testing of all recruits at basic training with contractual commercial laboratory processing of the RPRs and treating without disqualification or discharge. There were more than 500 terminal branches in the decision tree model.

The effectiveness of a strategy was measured in terms of years of service. This militarily functional outcome incorporated decreases in years of service provided to the military because of discharges for conditions that existed before service, such as syphilis, and decreases in years of service provided by individuals who would have been discharged for other reasons before their syphilis would have affected the military system. Weighting by rank using preferences defined by the 1996 pay scale was performed to represent the higher value of a higher-ranking individual with more years of service to the military than a lower-ranking individual with less experience. This was done to reflect the DOD investment in training. A discharge for a condition existing prior to service (EPTS) results in a loss of time and money already invested in recruiting, assessing, and training that individual. Because of its strongly negative connotation within the DOD, an EPTS discharge was taken as -0.40 weighted years of service. Less than 1 year of service was assigned 0.00. The weighted effectiveness assigned to completion of year 1 of service was 0.98, year 2 was 2.06, year 3 was 3.38, and year 4 was 4.76.

The dates of any losses from the service for all 1,588,143 applicants were retrieved from the Defense Manpower Data Center. Years of service were calculated using the active duty start date from MEPCOM and the date the individual left the service from Defense Manpower Data Center.

The source of the costs, all expressed in 1996 U.S. dollars, was actual U.S. military expenditures for performing the RPR at the MEPS and the estimated cost of contractual commercial laboratory processing of the RPR and FTA. Actual treatment costs incurred by the military were obtained from the Medical Expense and Performance Reporting System from October through June 1996 and the 1996 military pay scale for the cost of time off from work for medical visits or sick days. The cost of death included the \$200,000 life insurance payment paid by the military. The cost of a syphilis infection EPTS discharge included administrative personnel time and applicant travel and

did not incorporate opportunity costs, e.g., the cost of bringing another applicant to the training level of the individual being discharged.

A 4-year analytic horizon was used. Future costs were not discounted. The analysis was approached from a DOD perspective, and transmission was not modeled. A sensitivity analysis was conducted to assess the effect of uncertainty around many model parameters.

Some assumptions were made. Some people delay entry into the military for up to 2 years after the medical examination at the MEPS. Before these people go to basic training, they undergo a cursory examination for any obvious changes in their health. It was assumed that in this examination, no signs of syphilis would be noted. Because there are no data on which individuals initially had positive FTAs, were disqualified, and then returned after treatment, it was assumed that they were demographically similar to individuals with positive FTAs who did not return. Last, it was assumed that the screening effort itself would not influence the risk of acquiring new infection.

Probabilities

The overall prevalence of positive FTAs in this population was 0.021%. This prevalence includes only those individuals with a positive FTA who did not return after treatment. Individuals who returned after treatment had the disqualification erased from their record at MEPCOM. The overall prevalence of 0.021% was used in the base case, but prevalence was varied upward substantially in the sensitivity analysis.

The probability of being disqualified for military service at the MEPS for a medical reason other than a positive FTA was 7.4% overall, and of those individuals, 15% obtained a medical waiver for their condition and were allowed to enter basic training. Data were unavailable on the number of individuals disqualified for syphilis who returned to the MEPS with proof of treatment and then qualified. Chief physicians at the MEPS estimated that 95% of individuals disqualified for a positive FTA would later return and qualify (MEPS chief medical officers, personal communication, 1996).

The sensitivity and specificity of the RPR and FTA were obtained from the medical literature.⁴ The sensitivity and specificity of the RPR were 97% and 98%, respectively. The sensitivity and specificity of the FTA were 97% and 100%, respectively.

The probability of treatment failure in an individual with early syphilis was estimated as 3%.⁵ The chance that any individual has a documented allergy to penicillin and thus would not receive penicillin treatment is 12.5%.^{6,7} Among individuals without known penicillin allergy, the probability of a new allergic reaction was 2.5%.⁷⁻¹⁰ Of those individuals, 0.6% would have anaphylaxis and 0.03% would die.^{7,9-11} If infected and untreated, 75% would become symptomatic with secondary syphilis.¹

To estimate birth rates, all females in the population were matched by social security number to Defense Medical Information System data for hospitalization during childbirth using diagnostic related group codes 370 to 375. Approximately 2% of all females gave birth within the first year of military service and we assumed, in accordance with the guidelines of the American College of Obstetrics and Gynecology, to have received prenatal syphilis screening and treatment if necessary.

TABLE II
REFERENCE CASE RESULTS BASED ON 350,000 RECRUIT APPLICANTS PER YEAR

Intervention	Cost (1996 dollars)	Effectiveness (years of service)	Incremental Cost	Incremental Effectiveness (years of service)	Cost/Effectiveness (Incremental cost/Incremental years of service)
No screening	\$ 3,500	1,354,500	-	-	
Test all at basic training	\$ 630,000	1,430,800	626,500	76,300	\$8.21
Test all by commercial contract	\$ 770,000	1,445,500	\$140,000	14,700	\$9.52
Test all at MEPS	\$2,544,500	1,445,500			Dominated by another option

years of 0.70 did not alter the results. The inability of these variations to change the results illustrate the robustness of the model.

The only variation from the base-case model parameters that had an impact on the results was the cost of the testing in the screen-at-basic-training-and-treat option. By using the costs quoted for modification of the MEPS human immunodeficiency virus contract, the annual cost based on 350,000 recruit applicants per year was \$630,000, providing 1,430,800 years of military service (Table II). If the RPR could be obtained via commercial contract at the basic training centers for \$1 and the FTA for \$1.99, the cost decreased to \$315,000, with no loss in the years of service provided. This would result in 76,300 additional years of service over the no-screening option at \$4.08 per year provided. If the RPR could be obtained for no less than \$3 and the FTA for \$3.99, the cost increased to \$945,000 with the same years of service provided, making this option dominated by the test-all-by-commercial-contract option.

Discussion

With CLIA prompting a review of syphilis screening policies, we found that the current method of screening all applicants and processing the specimens at the MEPS was not cost-effective. The most cost-saving program would be no screening for syphilis. The most effective program would be to test everyone at the MEPS while contracting centralized commercial RPRs and FTAs at an incremental cost of \$766,500 per year to the DOD over no screening. Sensitivity analysis proved the robustness of the model, with changes in the cost of obtaining the RPR moderately affecting the results. This is not surprising because the RPR applied to all applicants and the other parameters applied to small percentages of applicants.

Screening only females, screening only African Americans, or screening only individuals from high-risk MEPS based on geographic prevalences, all with the testing being performed at the MEPS, are other options because the prevalences in these subsets of the recruit applicant pool were elevated. When looking at these strategies, effects incurred from individuals in the other groups who were not screened were considered. Screening only African Americans was dominated by screening only individuals from geographically high-risk MEPS. Screening only females, who had a higher prevalence of final positive FTAs, would provide 1,368,500 years of military service, 14,000 more than the no-screening option, with a increased cost of \$416,500, and screening individuals from geographically high-risk MEPS would provide 1,372,000 years of service at a cost of \$476,000

more than the no-screening option. Screening only females, African Americans, or individuals from high-risk MEPS based on geographic prevalences, all with the testing being performed at the MEPS, may be inappropriate policy options because of their inequitable or discriminatory nature.

One limitation of this study is that other potential sources of syphilis screening exist. Even though all applicants are currently tested for syphilis at the MEPS, as modeled in this study, all Navy basic trainees get tested again by RPR upon arrival at the Great Lakes Training Center, the only basic training site for the Navy. The Navy is currently identifying approximately five individuals with untreated, latent syphilis as a result of in-processing screening per year (M.M. Ryan, Great Lakes Naval Training Center, personal communication, 1997). If syphilis screening were abandoned at the MEPS but all Navy recruits were still tested upon arrival at basic training, the number of positive tests would remain extremely low. It is recommended that the Navy discontinue its separate testing at basic training, particularly if syphilis screening is continued at the MEPS using commercial contract testing.

Syphilis also may be detected through screening of blood donated during basic training on which an RPR or a Venereal Disease Research Laboratory test is done. Although recruits do not donate blood during Navy basic training, it is common at most Army basic training sites, with an estimated 10% to 15% of recruits donating, and at the sole Air Force basic training site, with approximately 60% of recruits donating (M.M. Ryan, Great Lakes Naval Training Center; W.P. Corr III, U.S. Army Medical Activity, Fort Benning; and J. Turner, Lackland Air Force Base, personal communications, 1997). Many recruits also will get screened for syphilis and treated if necessary when applying for a marriage license in the states of Georgia, Illinois, Massachusetts, Mississippi, Oklahoma, Pennsylvania, Rhode Island, and West Virginia (T. Mackay, Centers for Disease Control and Prevention, personal communication, 1997). It is likely that some individuals will be screened when presenting with another sexually transmitted disease or will be treated for other illnesses with antibiotics also effective against the syphilis spirochete. Prenatal syphilis screening, which was taken into account in our analysis, is another potential source of syphilis screening. These other opportunities for screening and treatment for syphilis further support the discontinuation of RPR screening in new military recruit applicants.

Another limitation of this study is that the costs used for medical care were not available in discrete form. Some overhead costs not directly related to syphilis screening and treatment may have been included, causing an overestimation of costs.

Because the likelihood of utilizing the health care system was varied in the sensitivity analysis without altering the model, this is not expected to affect the results.

The relatively few years of service provided in the no-screening option reflects the sensitivity of the results to the disutility of the EPTS discharge. This prompts one to examine the practice of EPTS discharge for syphilis. If no screening were implemented and individuals found to have syphilis after entering basic training were treated and returned to duty instead of given an EPTS discharge, the effectiveness of the no-screening option would increase substantially and any costs of the EPTS discharge would not be incurred.

Although it is relatively unusual to recommend doing nothing as an optimum medical policy for individuals, in this case we believe that from the DOD population perspective discontinuation of syphilis screening in military recruit applicants is indeed the best option. This finding is bolstered by the opportunity to reduce the disutility of EPTS discharge and by the other screening avenues and treatment effects inherent in today's medical system. MEPCOM ceased recruit applicant syphilis screening in June 1998. This policy change should save the military \$2,541,000 per year, and the \$2.5 million annual savings can be

reallocated to a disease with greater prevalence and population health impact than syphilis.

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