tuberculosis had probably occurred in their household (3 clusters of 2 case-patients each). Nosocomial transmission was possible for the other 5 individuals: 3 case-patients had received long-term follow-up care at the same HIV outpatient clinic and 2 had concurrent visits to the HIV day care unit.

DISCUSSION

The cluster rate observed in this study (32.1%) supports the hypothesis of recently transmitted TB among HIV-infected patients.[5] In the United States, hospital-based studies among HIV and non-HIV patients have found higher cluster rates, between 43% and 54%.[6-8] In Brazil, previous studies performed in two metropolitan areas showed clustering rates of 38% among HIV-infected patients seeking care at an outpatient care facility in São Paulo and 19% among hospitalized patients in Rio de Janeiro.[9,10]

Several risk factors for clustering observed in other studies, such as illicit drug use and institutionalization in correctional and residential facilities, were not related to clustering in our study population. It is possible that this finding is related to characteristics of the study group. Our study also demonstrated that follow-up at the hospital was associated with clustering. We speculate that this may be an indirect indicator of nosocomial exposure to infectious TB patients as a result of inadequate adherence to the recommended airborne precautions.

Epidemiologic links could be demonstrated in 11 (31.4%) of 35 case-patients in this study. As shown by other authors, there was a poor association between conventional contact tracing and molecular methods.[7,10] Our data reinforce the need for more extensive contact tracing and more detailed prospective evaluation. Some authors have suggested that this poor association may be related to undetectable exposure circumstances, such as those occurring in waiting rooms or other public areas.[7]

In the current study, retrospective epidemiologic investigation detected five TB cases probably acquired within the confines of the hospital. Although no association between delayed adoption of airborne precautions and clustering was demonstrated, this delay was frequently reported among recently admitted patients with infectious pulmonary TB. These data reinforce the need for continued education to encourage adherence to airborne precautions.

Drug susceptibility tests were not systematically performed in the current study, preventing comparisons among groups. In previous studies, multidrug resistance was associated with recent TB transmission and outbreaks.[1,2] In Brazil, prospective population-based studies are needed to better characterize the risk factors for TB transmission in HIV and non-HIV patients, with special focus on multidrug resistance.

Nosocomial transmission of TB probably occurs in developing countries and is likely underestimated. Our results suggest that hospital infection control precautions, in addition to community TB control programs, are needed to prevent TB transmission in HIV-infected patients.

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Booster Effect of Two-Step Tuberculin Skin Testing Among Hospital Employees From Areas With a High Prevalence of Tuberculosis

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ABSTRACT

During a baseline survey of TST, 236 nurses underwent a two-step TST. Overall, 29 (12%) showed boosting. All age groups showed boosting; the rate was 9.7% in those younger than 35 years. Subjects older than 45 years were more likely to have a booster effect than younger individuals (29% vs 10.1%) (*Infect Control Hosp Epidemiol* 2004;25:1117-1120).

TABLE 1
CHARACTERISTICS OF THE SUBJECTS PARTICIPATING IN TWO-STEP TESTING (N = 236)

Characteristic	
Age, y	
Mean	40.8
Range	25 to 56
Female:male ratio	12:1
Country of origin (TB prevalence per 100,000 population)	
Philippines (297)	163 (69%)
India (178)	50 (21%)
Ghana (201)	6 (2.5%)
United Kingdom (12)	5 (2.1%)
Pakistan (171)	3 (1.3%)
Other	9 (3.8%)
BCG scar	
Present	177 (75%)
Absent	53 (22.5%)
Unknown	6 (2.5%)
Work area	
Inpatient	179 (75.8%)
Outpatient	46 (19.5%)
Administration	11 (4.7%)
First PPD	
0 to < 5 mm	198 (84%)
5 to < 10 mm	38 (16%)

TB = tuberculosis; BCG = bacille Calmette–Guérin; PPD = purified protein derivative.

The recent resurgence of tuberculosis (TB) and the increased risk of nosocomial TB have made TB control in healthcare facilities a priority.[1,2] Periodic tuberculin skin testing (TST) of high-risk healthcare workers (HCWs) has been recommended to discover recent converters and to institute appropriate measures.[1] Baseline two-step TST has been advocated to identify individuals with latent infection who otherwise would be classified on their next test as recent converters.[1,3,4]

Two-step TST involves administering a second test to those individuals whose initial test yields negative results prior to finalizing their status. Individuals whose delayed hypersensitivity to tuberculin may have waned over the years would show an enhanced (booster) reaction to the second test due to an anamnestic response stimulated by the first test. Without a two-step TST, such individuals may be misclassified as recent converters if tested later.[3-8]

The booster phenomenon has been described in individuals with latent TB infection as well as in those with previous exposure to other mycobacteria or bacille Calmette–Guérin (BCG) vaccine.[3,6,8-11]

In Saudi Arabia, most nursing staff in hospitals have come from areas with a high prevalence of TB (ie, > 100 per 100,000 population) and most have previously received BCG vaccine. In 1998, a program of baseline TST for HCWs was initiated at King Khalid University Hospital in Riyadh. We used its results to study the utility of two-step TST in this setting, the factors associated with the booster phenomenon, and whether a two-step TST was useful for employees younger than 35 years.

METHODS

The study was conducted at King Khalid University Hospital in Riyadh, Saudi Arabia. This is a tertiary-care center with 660 beds. Approximately 25 smear-positive patients with TB are seen at the hospital annually. As part of the enhancement of the TB control program at the hospital, a baseline TST of all nurses was initiated in 1998.

Nurses whose TST had been documented to have yielded positive results previously were excluded from testing. The initial TST was applied using 5 IU in 0.1 mL of commercially prepared (Biocine Test–PPD, Chiron Vaccines, Oxford, United Kingdom) purified protein derivative (PPD) injected intradermally. All TSTs were applied by two infection control nurses who had received training in proper injection techniques. Reading was by experienced staff at the employee health clinic after 48 to 72 hours. Nurses whose initial test yielded negative results were scheduled for a second test 1 to 3 weeks later. The dose, administration, and reading were identical to those of the first test.

A positive result on the initial test was defined as an induration of 10 mm or greater in the transverse diameter using the palpation method. A positive result on the second test was defined as an increase of at least 6 mm of induration from a negative result on the first test (< 10 mm) to a total induration of 10 mm or greater.[4-7,9-14] Data collected included age, gender, nationality, work area, and previous PPD testing. BCG status was determined by the presence or absence of a BCG scar. The data were analyzed using StatPac Gold (Walonick Associates, Inc., Minneapolis, MN), a statistical analysis package. Chi-square was used to compare proportions and Student's *t* test was used to compare means. A *P* value of less than .05 was considered significant.

RESULTS

Three hundred sixty-seven nurses whose PPD status prior to employment was either negative or unknown were tested initially. One hundred twenty-eight (35%) were found to have positive results (≥ 10 mm) and were excluded from further testing. Of the remaining 239 subjects, 3 failed to complete the two tests and were excluded. The characteristics of the remaining 236 subjects who completed the two-step testing are listed in Table 1. A BCG scar was present in 177 subjects (75%). The size of the first PPD reaction was 4 mm or less in 198 (84%) of the subjects.

The mean age of the subjects was 41 ± 5.2 years; 15% were 35 years or younger. Twenty-nine (12%) of the subjects fulfilled the definition of a booster reaction. The median increase in the size of the boosted TST was 11 mm and the mean was 12.6 ± 3.7 mm.

The mean age as well as the median age of those who boosted was 42 years (range, 30 to 55 years). The rate of boosting in relation to age is detailed in Table 2. Subjects older than 45 years were threefold more likely to boost than were younger individuals (29% vs 10.1%; $P = .008$). Those with an initial PPD induration of 5 to 9 mm were twice as likely as those with a reaction size of less than 5 mm to show a booster effect (21% vs 10.6%; $P > .05$). There was no difference between those with a BCG scar and those without in terms of the rate of boosting (11.9% vs 13.2%) or the mean increase in the size of induration (12.7 vs 12.6 mm).

TABLE 2
RATE OF BOOSTING ACCORDING TO AGE GROUP*

Age Group (y)	Total No.	No. Boosted (%)
25 to 34	31	3 (9.7)
35 to 40	75	9 (12)
41 to 45	91	8 (8.8)
> 45	31	9 (29)

*Chi-square, 8,989; $P = .029$.

DISCUSSION

The rate of boosting in two-step TST varies widely between different studies, ranging from 0% to 31%.[4-7,9-19] Studies involving HCWs have reported rates of boosting ranging from 0% to 10%.[4-7,14,17,18] Studies involving residents of chronic care facilities reported boosting rates ranging between 6% and 19.2%.[12,13,15-17] Studies involving university students in Canada and in Chile reported boosting rates between 5.2% and 19.6%.[9-11]

The variation in the rate of boosting among the different studies reflects differences in the populations studied regarding age, BCG vaccination status, and previous exposure to *Mycobacterium tuberculosis* or environmental mycobacteria. The boosting rate reported in this study (12%) is higher than that of some of the studies of hospital employees[4-7,14,17,18]; however, it is similar to the rates reported by Simon et al. (13%)[15] and Welty et al. (11.3%).[16] The difference may be explained by the higher mean age of our study population (41 ± 5.2 years) compared with some of the studies of HCWs.[7,14,18]

The boosting rate in staff older than 45 years was almost threefold higher than that in the younger age groups (Table 2). Previous studies have documented a relationship between boosting and increasing age.[4,5,10,15] Some investigators have recommended restricting two-step TST to HCWs older than 35 years.[4,17] Our findings do not support this recommendation as the rate of boosting in those younger than 35 years was substantial (Table 2).

The fact that most of our study population came from countries with a high prevalence of TB also contributed to the high boosting rate. Similar findings were noted by other investigators.[9,18,19] Two studies involving university students and young adults in Quebec, Canada, found the two-step boosting rate to be 5.2% and 16% in the Canadian-born and foreign-born young adults, respectively.[9,10]

The positive results on second tests in this study probably did not reflect recent nosocomial TB infections because there was no clustering in any specific work area and the rate of boosting in the areas where patients with TB were housed was similar to that in other areas.

BCG vaccination was found by other investigators to be associated with an increasing rate of boosting.[8-11,17,18] In this study, no difference was found in the boosting rate between vaccinated and unvaccinated subjects. The lack of BCG effect in our study population could be related to the fact that most of our subjects came from countries with a high prevalence of TB. A previous study found that the augmenting effect of BCG vaccination on the booster effects was greater in subjects originating from countries with a low prevalence of TB than in those originating from countries with a higher prevalence.[9]

The size of the initial PPD induration was found to have an important effect on boosting.[10,13,15,16] The proportion of positive booster reactions increased with a larger size of the initial reaction. Menzies et al. reported a frequency of boosting of 3.7%, 17.1%, and 28.4% in those whose initial reactions measured 0 mm, 1 to 4 mm, and 5 to 9 mm, respectively.[10] Alvarez et al. found the boosting rate to be 12.7% and 35.5% in those with an initial reaction measuring 0 to 4 mm and 5 to 9 mm, respectively.[13] In our study, individuals with an initial reaction of 5 to 9 mm were twice as likely to show a booster effect compared with those with a reaction of 0 to 4 mm. The difference, however, was not statistically significant.

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Medical News

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Hygiene in Endoscopy: Data on the Quality of Reprocessing Flexible Endoscopes and Endoscopic Accessories in Hospitals and Private Practices

Guidelines for reprocessing flexible endoscopes have been published in many countries. Compliance with the German guidelines, published in 2002 by the Commission on Hospital Hygiene and Infection Prevention of the Robert Koch Institute, is mandatory in all endoscopic units, in hospitals as well as in private practices. Heudorf et al. conducted a survey of current reprocessing practices in an urban region in Germany that covered all hospitals and private practices in this region. In the summer of 2003, all endoscopic units in Frankfurt/Main, Germany—15 hospitals and 23 private practices—were visited by members of the public health service, using a checklist based on the recommendations of the German guidelines. In these institutions, more than 70,000 endoscopic examinations are performed per year. Eighty-seven percent (13 of 15) of the hospitals and 43% (10 of 23) of the private practices reported that they conducted more than 1,000 procedures per year. Great differences were found in hygienic quality on comparing endoscopic units in hospitals with those in private practices. In hospitals, compliance with the guidelines was satisfactory. Main problems in the practices were lack of facilities for ultrasonic cleaning (74%) and sterilization (43%), faults in reprocessing the bottle and tube for air/water-channel flushing (26%) that used non-sterile water (48%), storage of the endoscope where there was a risk of recontamination (48%), and omitting routine tests of the endoscopes after reprocessing (44%). Generally, hygienic conditions and procedures were worse in small units than in bigger ones.

The data from Frankfurt hospitals were satisfactory. In private practices, however, especially in smaller ones, improvements are needed. Improvements should cover the quality of structure and process (ie, specific education of the nurses and availability of ultrasonic cleaners and sterilizers and, preferably, automatic dishwashers) as well as implementation of a written protocol for hygiene in endoscopy, based on the German guidelines.

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