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# NOSOCOMIAL TUBERCULOSIS INFECTION IN INDIA: A REVIEW

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**Abstract**

This review aims to evaluate the commonness of nosocomial contamination among tuberculosis patients. Risen as a most serious risk to India TB undermined the health of a large number of individuals. Since TB is omnipresent and infectious, hospital staff and others in close contact with tuberculosis patients run the most elevated risk of contamination. This hazard is to a great extent preventable by utilization of basic cheap measures to keep away from the disease to spread by means of droplets. Despite the fact that healthcare workers are very much aware of the method of spread of tuberculosis, they don't take prudent steps while managing TB patients. Patients also are non-compliant with doctor's recommendation of wearing masks for their safety. In this manner, broad utilization of masks will enormously decrease the transmission of tuberculosis. This might be accomplished if expendable masks are made accessible free of cost from allocators under a national program thus tackle the disease. In the wake of evaluating the disease prevalence, risk factors, and resources, India must implement effective strategies to diminish nosocomial transmission. Existing evidences accentuate the need to design and execute basic, successful and reasonable TB contamination control programs in healthcare facilities in India. With its vast human and intellectual capital in India, nearly countrywide DOTS coverage, and a large, well-funded, successful national TB control program, is well placed to tackle this problem and set an example for other high prevalence countries.

**Key words:** Latent Tuberculosis; Prevalence; Incidence; Nosocomial Infections, Healthcare workers

## INTRODUCTION

Tuberculosis (TB) is one of the guideline reasons for mortality on the world today, is a disease caused by Mycobacterium tuberculosis (Mtb), where one individual per second is infected by the bacillus.[1] TB is a noteworthy disease since it taints 33% of the total population, causing around 8 million new cases and 3 million deaths in each year.[2] Recent reports of episodes of multidrug-safe tuberculosis (MDRTB) uncovered the hazard for nosocomial transmission of multidrug-safe tuberculosis to patients and laborers in medical facilities.[3]

As indicated by the most recent national survey, 5.7% of new TB cases and 26% of retreated cases in the public health system were MDRTB. This information far outperforms the worldwide average where around 3.5% of new cases and 20.5% of the retreated cases are MDRTB. The hazard that Mycobacterium tuberculosis can be transmitted from patients with dynamic tuberculosis (TB) to other patients and healthcare workers has been recognized for a long time. The degree of hazard changes by occupation, patient population, setting and adequacy of TB disease control measures yet the rate is higher in facilities overseeing tremendous quantities of positive smear TB patients who does not get quick isolation, diagnosis, and treatment, especially without other infection control measures.[4,5]

Nosocomial TB hazard has been decreased by a chain of control measures, including authoritative, designing, natural controls and personal protection measures[6] by healthcare facilities in high-income countries,[7] yet because of their surprising expense and restricted facilities, low-income countries can't bear to execute them. Furthermore, consequently, nosocomial transmission is disregarded in nations with couple of assets, however a few variables stressed the requirement for nosocomial TB to be tended to, even in such areas.[8]

To start with, nosocomial transmission is of concern since it influences patients who are exposed as well as the healthcare workforce, which could unfavorably influence healthcare services over time.[9] Second, transmission of TB can have genuine outcomes, especially with multidrug-safe TB (MDRTB). A few episodes in the US showed the role that hospitals can play as central points of MDRTB transmission,[10] a marvel likewise found in Europe, South America, South Africa, and Russia.[11] These flare-ups can be dangerous and related with high death rates on the grounds that hospitalized patients are regularly immunocompromised.[12] Third, nosocomial TB must be tended to in light of the fact that it can help the healthcare framework, especially the private health sector, improve TB diagnosis and treatment and better adjust practices with the DOTS system. For instance, distinguishing smear-positive TB with microscopy is a key part of the DOTS strategy and a significant regulatory disease control measure. In any case, a few examinations have demonstrated that private practitioners in India tend to underutilize microscopy and depend more on chest radiographs for TB diagnosis.[13] Fourth, despite the fact that low-income nations have less assets, overlooking a potential risk contrary to the standards of ensuring human wellbeing, the foundation of health care in any nation. At long last, the issue of controlling TB in medical clinics isn't an issue with TB alone yet reflects an issue with infection control by and large, which, whenever improved, could likewise prevent various infectious diseases (e.g., severe acute respiratory disorder and avian flu) that might be nosocomially transmitted. In this way, TB disease control projects can have optional advantages. At last, averting

flare-ups and ensuring patients and staff are in the interest of healthcare facilities. TB infection control is a good stage for such efforts.[14,15]

**NOSOCOMIAL TUBERCULOSIS IN INDIA**

Most high income countries execute tuberculosis contamination control programs to decrease the hazard for nosocomial transmission, however such control measures are not implemented in India, a nation which has one of the highest number of TB flare-ups and announced cases around the world. In spite of the higher prevalence joined by greater likelihood of nosocomial transmission, more individuals are unconscious about the nosocomial and occupational TB. Likewise, just less number of studies tended to the issue. In this review we concentrated on the incidence, prevalence, factors encouraging nosocomial TB transmission, preventive measures by considering the achievability and appropriateness of various contamination control mediation with respect to the same.[16]

Consistently, TB develops in about 2 million individuals in India, and almost 1 million cases are smear positive; an expected 40% of the Indian population is latently contaminated with M. tuberculosis.[17] India's Revised National TB Control Program (RNTCP) presently gives access to DOTS to >85% of the population.[18] This program is the quickest growing DOTS program in the world and the biggest in the world in terms of patients getting starting treatment.[17] Outside of the RNTCP, India has an enormous private health sector that is effectively associated with providing TB care;[12,19] practically 50% of patients with TB in India initially seek care from the private sector.[18] In this way, since large number of TB patients are hospitalized, the hazard for nosocomial exposure is substantial.[20]

In a study conducted by Rao *et al.*,[21] a tertiary care hospital in Chandigarh, evaluated the occurrence of active TB among resident physicians. Among residents already working in the hospital, TB developed in 9 (2%) of 470, for an incidence of 11.2 new cases per 1,000 persons per year of exposure. Extra pulmonary disease developed in 66% of the residents. In this manner, the investigation concluded a high pace of TB (overwhelmingly extra pulmonary) among the individuals who worked in medical subspecialties. However, most cases were recognized by utilizing clinical criteria, and few were bacteriologically confirmed.[21]

Another study conducted by Pai *et al.*,[22] in a rural medical school hospital in Sevagram, the tuberculin skin test (TST) and an entire blood interferon-γ release assay (IGRA) for 726 healthcare workers was performed. Past BCG vaccination and NTM presentation won't influence IGRAs since they are very specific. Half of results were positive by either TST or IGRA. Almost 70% of the participants reported direct contact with sputum smear–positive TB patients. Exposure was high among attending physicians, physicians in training and nurses. Length of work and increasing age were hazard factors for latent TB disease. Nurses, nursing students, orderlies, and laboratory staff had higher prevalence of latent infection.[21] A recurrent survey of 216 medical and nursing students in this cohort enabled estimation of the yearly risk for latent infection by utilizing TST and IGRA, when this two tests were utilized, the yearly hazard for latent TB infection was estimated to be 5%.[22] The assessed community based yearly hazard for contamination in India is 1.5%,[24] so the overabundance danger of 3.5% might be owing to nosocomial exposure.[23]

In a retrospective review, healthcare workers who experienced anti-TB treatment in a tertiary care hospital in Vellore, Gopinath *et al.*,[25] identified 125 healthcare workers who had been treated for active TB somewhere in the range of 1992 and 2001. The yearly occurrence of pulmonary TB was 0.35–1.80 per 1,000 people during this period. The yearly incidence of extra pulmonary TB was 0.34–1.57 per 1,000. These rates have been underestimated because only healthcare workers who experienced TB treatment were checked. In this hospital, a case-control study demonstrated that low body mass index and work in medicinal wards were hazard factors for TB disease among healthcare workers.[26]

**PREVALENCE OF LTBI (LATENT TUBERCULOSIS INFECTION) AND RISK FACTORS FOR LTBI**

The prevalence of occupational LTBI have been over-estimated as it depended on TST. The TST identifies lifetime aggregate occupational and non occupational presentation to M. tuberculosis, as well as the impacts of NTM (Non Tuberculous Mycobacterium) exposure and BCG inoculation. Prevalence of NTM and its impact on TST is hard to evaluate in light of the fact that reviews from a few nations were incorporated, and there are no information on NTM pervasiveness in each setting.[27]

The practice, timing, and frequency of BCG immunization fluctuate across countries, which complicates the investigations as BCG, which can be a significant reason for false-positive TST. The results of TST are likewise affected by the type of test material, purified protein derivative (PPD), technique of reading, and definition of a positive test.[28] Additionally, prevalence studies lack data on LTBI prevalence in the population. The prevalence of LTBI was lower among young medical or nursing students recently entering the healthcare profession in a study conducted by Silva *et al.*,[29] however expanded with every year of training (an index of cumulative exposure). Likewise, the prevalence of LTBI among different HCWs (Health care workers) expanded with duration of employment, again reflecting cumulative exposure. HCWs whose are in nearer contact, (for example, nurses) with patient likewise had higher LTBI prevalence. These outcomes by implication propose that nosocomial TB adds to the weight of LTBI among HCWs.[27,29]

A study from India,[22] revealed a four-fold higher prevalence in medical students who were older than 23 years than in medical students aged 18–20 years (comparing to an extra 3–5 years spent in training). The all out pooled prevalence of LTBI was 12% (95% confidence interval [CI] 10 to 13) among medical or nursing students, excluding the study by Levy *et al.*,[30] where every medical student had recieved BCG vaccination within the past 6 months, and 70% of them were TST-positive. [30]

The presence of a BCG scar was not altogether connected with LTBI in people immunized with BCG during their childhood. The prevalence of LTBI in all HCWs ranged from 33% (95% CI 23 to 45)[31] to 79% (95% CI 75 to 82)[32] in different investigations, with a pooled prevalence eztimate of 54% (95% CI 53 to 55). Age and employment duration in the human care facility (indicating longer cumulative exposure), were related with higher commonness of LTBI in many studies. The prevalence of LTBI in HCWs expanded by 1.04 times (95% CI 1.02 to 1.07) with each extra year of increment in age,[33] and by 1.5 (95% CI 1.0 to 2.2) to 2.4 (95% CI 1.1 to 5.0) times with employment span of over 1 year. The prevalence of LTBI was 3-fold higher with 10 years of employment.[22]

Individuals working in medical wards, those occupied with procedures, for example, sputum collection and post-mortem examinations, and a background of contact with TB patients were independent occupational hazard factors for LTBI. More predominance of LTBI in nurses was reported in various examinations, a subgroup with a high level of patient contact, and in this way potential presentation to TB cases. The prevalence of LTBI among nurses ranged from 43% to 87%. It was likewise announced in eight studies that the prevalence of LTBI in nurses was higher than that in other HCWs ranging from being 1.3% higher to 35.6% higher.[34] In another study by Orrett *et al.*,[35] reported a lower predominance in nurses, compared with other HCWs.[35]

**INCIDENCE OF LTBI AND RISK FACTORS**

Practically all investigations that assessed the incidence of new TB diseases, utilized a sequential tuberculin skin testing (TST). Notwithstanding the known confinements of TST, serial TST has extra issues, for example, boosting, choice between a single step or a two-step baseline protocol, and the definitions utilized for conversion. Most investigations pursued the two-step testing protocol so as not to overestimate true LTBI rate due to boosting. Just one study utilized an IGRA for assessing the rate of new TB infection.[24] This study found a higher conversion rate when an IGRA was used, which increase the likelihood that IGRAs are more sensitive for recent infection than the TST yet this hypothesis requires further study.[24]

Beyond the above limitations, the outcomes demonstrated that HCWs have a higher danger of TB disease than in the overall public. The high attributable risk estimates for LTBI incidence rate give the most persuading proof to nosocomial transmission of TB in healthcare settings. In these studies, more years of clinical training and more prominent exposure to TB patients were hazard factors for new disease, and this gives extra help for nosocomial transmission.[36] There was a marked, in spite non significant, relationship between the occurrence of LTBI and TB hospital admissions per year (R ¼ 0.86, p ¼ 0.13). A larger amount of clinical training (odds ratio [OR] ¼ 4.77, 95% CI 1.01 to 22.46), BCG vaccination after baseline TST (OR 2.9, 95% CI 1.1 to 7.6), nursing occupation (OR 1.7, 95% CI 1.1 to 2.7), and recent exposure to TB (OR 1.6, 95% CI 1.0 to 2.6) were independent hazard factors for TST.[29,36]

**INCIDENCE OF TB DISEASE**

The hazard to nosocomial exposure ranged from 25 to 5,361 for each 100,000 every year in HCWs to TB infection. In facilities with less HCWs, for each TB patient seen (HCW-to-patient proportion less than 50 for each 100 TB patients), had a higher rate of TB infection in HCWs (R¼ 0.45, p ¼ 0.18).[37] However, the estimates of relative and attributable hazard were not particularly extraordinary when the studies were analyzed WHO data, or utilizing local estimates given by the authors of the study concerned. Regardless of the above limitations, most studies reported higher appraisals of TB ailment among HCWs than in general populations, and this is suggestive of nosocomial transmission. The expanded rates of TB infection among young HCWs involves concern. A portion of this might be clarified by coinfection with HIV-especially in nations with a high prevalence of HIV.[38]

The rate of TB ailment in HCWs was commonly higher than the evaluated TB rates in the overall public. Although, a few methodological issues may influence the interpretation of these examinations, HCWs might be bound to look for therapeutic consideration, and thus case-recognition rates might be higher than in the overall public. Additionally, then again HCWs are more averse to create TB on the grounds that HCWs have a higher normal financial status, and are younger and beneficial, than general population in low and middle income country (LMIC).[39] WHO estimates for the incidence of TB in the relevant country was utilized to guarantee the comparability of results across studies. Utilizing information from a solitary source guarantees consistency in deciding attributable risk for various investigations. There might be considerable territorial variety of rate of TB within nations, no doubt provincial assessments of TB frequency would be increasingly legitimate to compare the rates of TB in a specific institution.[40]

**WORK LOCATION AND JOB CATEGORIES ASSOCIATION WITH TB RISK**

The incidence rate ratios (IRRs) was determined by utilizing an estimated general population incidence rate for all TB cases in the country as a comparison. Compared with the general population, workers in TB inpatient facilities (IRR extended from 14.6 to 99.0) like emergency rooms (IRR 26.6 to 31.9), general medicine wards (IRR 3.9 to 36.6) and laboratories (IRR 35.9 to 78.6) had a higher hazard for TB ailment, workers in outpatient medical facilities had a moderate risk (IRR went from 4.2 to 11.6), and workers in surgery, obstetrics and gynecology, administration and operation theaters had a lower chance. There was a considerable danger of TB infection between various occupations: radiology technicians, patient attendants, nurses, ward attendants, paramedics, clinical officers, laboratory personnel, and physicians had a high rate of TB ailment, while the frequency of TB illness was least in authoritative staff.[37,41]

**INFECTION-CONTROL STRATEGIES IMPACT ON TB INCIDENCE**

Most authors reported that no particular TB infection control programs were being utilized in the healthcare facilities in which the investigations was done. Just three studies assessed the effect of different infection control techniques on the danger of TB disease or infection. Another two studies[42] analyzed whether an absence of personal-protection measures was related with a danger of TB infection. One study assessed the knowledge, attitude and utilization of TB disease control measures by HCWs. The presentation of numerous managerial, individual, and designing controls in a single emergency clinic in Thailand[34] brought about a noteworthy drop in the yearly occurrence of LTBI in HCWs from 9.3% to 2.2%. Be that as it may, the rate of TB illness in HCWs demonstrated a non-critical increment (from 179 to 252 for each 100,000) 1–2 years after inception of these control measures.[43]

In another study, a cross-sectional tuberculin survey determined the baseline LTBI prevalence in four hospitals. Hospital A began managerial controls and gave N95 respirators to all HCWs required to go into a TB-isolation room. Hospital B had started managerial controls 3 months before the baseline TST testing and, at the beginning of the investigation, had presented N95 respirators and started development of negative-pressure isolation rooms. Hospital C and hospital D does not have TB-control measures set up all through the examination. Baseline TST positivity was altogether unique in the four medical clinics (46.7%, 69.6%, 65.8%, and 62.2% hospitals A, B, C,

and D, individually). Following 1 year, the frequency of LTBI (in at first tuberculin-negative workers) was significantly lower in Hospitals A and B, which had actualized various contamination control measures, in contrast with the other two hospitals.[36]

Limited accessible proof proposes that a decrease in the danger of TB contamination is conceivable with simple managerial controls, yet this should be assessed in bigger, better-controlled studies. Consequently, there is a predictable epidemiologic proof that TB is a significant work related ailment in HCWs. Additionally, if there is a substantial exposure, with little or no infection control measures set up, it isn't astounding that there is reliable proof of overabundance prevalence and incidence of TB contamination, just as a higher frequency of TB ailment among HCWs than in the general populations in the equivalent LMICs. This epidemiological proof infers that a significant proportion of LTBI and TB illness in the HCWs in LMICs is the consequence of nosocomial TB transmission.[33]

**HEALTH SERVICES, TREATMENT RELATED FACTORS AND ATTITUDE OF HEALTH CARE PROVIDERS**

There were dissimilar perspectives among patients with respect to the boundaries prompting TB default, particularly the health services and treatment related variables (side effects of medications, hindrances identified with health center for DOTS program, and health professional mentality).

**THE TREATMENT FACTORS**

About 63% of defaulted patients were not on DOTS program. They referenced that DOTS with day by day supervision of treatment for the initial two months (introductory stage) was a test to them particularly during this phase.[44] During the initial stage, numerous patients were sick, weak and experienced the seriousness of the ailment. This implied, they expected to visit the TB clinic with a relative. The DOTS program was intensified by a few challenges: geographical distance, transportation cost and day by day participation, particularly for ladies and those from villages.[45] The individuals who had no vehicles utilized public transportation, bikes, riding camels and donkeys or even by walking. The health care providers communicated their well awareness of TB treatment and underlined the accessibility of health services at DOTS health centers. Simultaneously they conceded the lack of adequate health staff, and absence of training. All health care providers expressed that DOTS program is a significant factor for treatment adherence and cure. However, some revealed that coming every day to the TB facility particularly in the intensive period of treatment was physically and monetarily demanding for TB patients.[46]

**SIDE EFFECTS TO TREATMENT**

Over 77% of defaulted patients experienced side effects to TB medicine and referenced the burden of TB medications and their side effects being the significant difficulties on concomitant treatment. The primary side effects noted by the patients and health care providers included head ache, rash, nightmares, burning abdomen, feeling of hunger, vomiting and fatigue. Other health care providers reported that a few patients look for

restorative treatment when they feel sick, and stop treatment when feeling much improved. Also, they indicated that side effects were a main source of default (75%).[47,48]

**THE ATTITUDE OF HEALTH CARE PROVIDERS**

Most of defaulted patients in the study were disturbed about attitude and approach of health care providers (81.5%). The participants told that the health provider ought to be responsive, friendly, and pursue a warm approach when counselling patients. The health care provider mentioned that their primary jobs are diagnosis and treatment of the ailment, yet in addition they used to furnish their patients with some additional information regarding disease.[49] Every one of them pursued friendly approach with patients and expanded cooperation with them to upgrade continuation of treatment. They all emphasized the significance of having a health care provider at every health unit. The health care providers referenced that they attempt to help their patients and families, at the same time a few patients can't acknowledge their infection with TB and may conceal it even from their close relatives, and eventually stop the treatment.[50]

**FACTORS FACILITATING NOSOCOMIAL TRANSMISSION**

Various factors may encourage nosocomial transmission in Indian hospitals. The mind-boggling number of TB patients and multiple exposures to smear positive TB patients are principle factors. Inability to isolate and segregate patients with smear-positive TB from other patients and delayed diagnosis and inception of treatment also add to transmission risk. Poor adherence to treatment, absence of consistent medication supply, utilization of sub optimal treatment regimens, and insufficient treatment period have been known to prolong infectiousness of TB patients and in this manner encourage nosocomial transmission. Episodes of drug resistant tuberculosis have been reported in regions with high prevalence of HIV infection.[51]

Only small number of hospitals in India have built up disease control measures. Hospitals, particularly public hospitals, will be crowded, inadequately ventilated, and have constrained or no facilities for respiratory isolation. Most respiratory care procedures (including sputum collection) are routinely carried out in a general ward setting, as opposed to in respiratory isolation rooms. Further, few of these hospitals offer routine screening programs to distinguish and treat TB among health care workers. As practically a large portion of the Indian population is affected, health care workers don't see latent TB contamination as an issue. Subsequently, latent infection is infrequently treated.[52]

**IMPLEMENTING TB INFECTION CONTROL IN INDIA**

Successful TB disease control in medicinal services settings relies upon early detection, segregating contaminated people, and quickly and viably treating people with TB. Subsequent to evaluating the disease prevalence, chance variables, and assets, India must execute powerful procedures to decrease nosocomial transmission. In all health care settings, a fundamental TB contamination control program ought to be executed, as suggested by WHO and different organizations. Building up a infection control plan alongside instructing health care workers and patients on improving sputum collection practices, assessment of suspected TB patients in outpatient settings and performing triage will diminish exposure in the laboratory.[3,17]

The World Health Organization (WHO) has proposed handy and minimal cost interventions to decrease nosocomial transmission in settings where assets are limited.[3] These proposals emphasized prompt diagnosis and fast treatment of TB as opposed to costly innovations, for example, isolation rooms and respirators. In any case, regardless of the boundless execution of the DOTS short cost strategy, which is universally prescribed, in consistence with these more straightforward rules is commonly poor in low-income countries.[9]

Actualizing a significant number of the recommended engineering controls isn't practical in most health care facilities in view of the surprising expenses of such measures (e.g., negative-pressure isolation rooms). However, isolation of smear-positive TB patients in rooms with simple mechanical exhaust ventilation (e.g., window fans) could be feasible in some settings.[3] At such focuses, patients with infectious TB, particularly XDR and MDR-TB, must not be admitted to the same wards as patients with HIV contamination. Individual respiratory protection measures (e.g., N95 respirators) are most likely not attainable in view of the surprising expense. Respirators might be generally costly to execute and of restricted viability in high-incidence, resource limited settings. In any case, the N 95 respirators ought to be utilized while overseeing XDR and MDR TB patients.[53]

Efforts should be made to improve the quality of TB care in the private division through better coordination between the RNTCP and the private sector. By improving TB diagnosis and treatment practices, smear-positive TB patients are bound to get fast diagnosis and treatment, thereby directly and indirectly diminishing the general transmission in the community and in the nosocomial setting. DOTS PLUS strategy needs to be extended and all patients with XDR-TB and MDR-TB should be identified and treated in the hospital in isolation to prevent contaminated people from potentially spreading disease to others.[54]

**RECOMMENDATIONS**

Managerial measures, for example, FAST are the present concentration in such manner, especially given the pressures for decentralized care to oversee MDR TB. Ventilations should be appropriate to building plan in hospitals and district or primary health care services as well as on exceptional areas, for example, laboratories. Studies of "upstream" or health framework factors which may decide the effective utilization of facility level control measures, for example, political commitment, authority, financing, or information systems are absent from the literature.[55]

To fortify the quality and introduction of such research, studies with more unequivocal methodological quality than those inspected are required. Although randomized control trials are desirable for diminishing selection bias and confounding, controlled before and after studies must be relied upon, yet with more noteworthy attention regarding the timespans being compared. An alternative approach is the investigation of quality improvement interventions for intermediate processes, the means that make up FAST.[56]

The effectiveness in anticipating TB infection in HCWS should be at ultimately tried by utilization of incident tuberculosis as the result which should be obliged by variability in susceptibility to its progress to dynamic illness.

Predisposition evaluation should be unequivocal, utilizing an accepted scenario. Indeed, even before-after examinations are strategically requesting which require establishment of an exact baseline rate of transformation, proper implementation of the intervention, and consequent follow up periods of measurement. Continued and exact record-keeping, consistency of testing practice, evaluation of co-intervention and confounding over this period all increase the asset and staffing necessities of such research.[57]

**PREVENTION**

So as to viably lessen the danger of transmission, it is significant that we embrace a progressively proactive methodology. One such measure includes the utilization of HIGH QUALITY LOW COST MASKS. Masks should be made accessible more widely and effectively in all parts of the hospital and not simply in drug stores, and at a cost affordable to all. This will upgrade its use among each one of those associated with treating tuberculosis patients, just as patient's themselves.[58]

In numerous tertiary care centers, dispensers which store condoms are presently being made accessible to guarantee their more extensive use as an undertaking to diminish the danger of transmission of HIV and other sexually transmitted ailments. So why not have dispensers putting away disposable masks? Or on the other hand even better, a DUAL approach could be taken to handle TB along with HIV. These condom dispensers should be made to have another compartment to store and administer disposable masks. This measure would be cost effective and can be executed at a national level. This additionally manages the serious issue of TB affecting and prompting an exceptionally high mortality among HIV positive patients.[59]

**CONCLUSION**

In the wake of assessing the disease prevalence, risk factors and resources, India must actualize compelling systems to lessen nosocomial transmission. Existing proof obviously underscores the need to structure and actualize effective, moderate and straightforward TB infection control programs in health care facilities. Along these lines, the requirement for executing interventions must be made more desperately due to another risk identified recently 'extensively drug resistant tuberculosis'. In view of the XDR-TB danger, the WHO and the Stop TB Partnership are starting to feature the need to execute TB infection control measures in hospitals in poor countries.

To mediate, we should realize what interventions will and won't work in India. Preliminaries are in this manner expected to assess generally basic, plausible interventions and their viability in decreasing nosocomial hazard. The lessons learned in such preliminaries will be material in other resource limited settings. Health care workers are essential in the battle against TB, and their wellbeing should be ensured. India, with its tremendous human and scholarly capital, countrywide DOTS coverage, and an enormous, well-subsidized, fruitful national TB control program, is all around set to handle this issue and set a model for other high prevalence nations.

**REFERENCES**


1. Jaggarajamma K, Sudha G, Chandrasekaran V, Nirupa C, Thomas A, Santha T, et al. Reasons for non-compliance among patients treated under revised national tuberculosis control programme (RNTCP), Tiruvallur district, South India. *Ind J Tuberc*. 2007; 54(3): 130-135.
2. Farley JE, Tudor C, Mphahlele M, Franz K, Perrin NA, Dorman S, et al. A national infection control evaluation of drug-resistant tuberculosis hospitals in South Africa. *Int J Tuberc Lung Dis*. 2012; 16(1): 82–89.
3. World Health Organization. Global tuberculosis control. Surveillance, planning, financing. WHO Report 2005. Geneva: The Organization; 2005.
4. Zignol M, van Gemert W, Falzon D, Sismanidis C, Glaziou P, Floyd K, et al. Surveillance of anti-tuberculosis drug resistance in the world: an updated analysis, 2007–2010. *Bull World Health Organ*. 2012; 90(2): 111–119.
5. Elisabeth SP, Themba D, Alexandra AS, Sabine RG, Zerihun DT, Philippe C, et al. High prevalence of multidrug-resistant tuberculosis, Swaziland, 2009–2010. *Emerg Infect Dis*. 2012; 18(1): 29–37.
6. Blumberg HM. Update on the treatment of tuberculosis and latent tuberculosis infection. 2005; 293(22): 2776–2784.
7. Sophie H, Thomas B, Vincent P, Siddhartha B, Madhukar P, Clara D. Knowledge about tuberculosis and infection prevention behavior: A nine city longitudinal study from India. *Plos One*. 2018; 10(1): 1-15.
8. Centers for Disease Control and Prevention. Guidelines for preventing the transmission of Mycobacterium tuberculosis in health-care settings, 2005. *MMWR Recommendations and Reports.* 2005; 54(1):1–141.
9. Joshi R, Reingold AL, Menzies D, Pai M. Tuberculosis among health care workers in low and middle income countries: A systematic Review. *Plos Med*. 2006; 3(12): e494.
10. Drobniewski F, Balabanova Y, Nikolayevsky V, Ruddy M, Kuznetzov S, Zakharova S, et al. Drug-resistant tuberculosis, clinical virulence, and the dominance of the Beijing strain family in Russia. *JAMA*. 2005; 293(22): 2726–2731.
11. Prasad R, Nautiyal RG, Mukherji PK, Jain A, Singh K, Ahuja RC. Diagnostic evaluation of pulmonary tuberculosis: what do doctors of modern medicine do in India? *Int J Tuberc Lung Dis*. 2003; 7(1): 52–57.
12. Rangan S. The public-private mix in India's Revised National Tuberculosis Control Programme–an update. *J Indian Med Assoc*. 2003; 101(3): 161–163.
13. Chadha VK, Kumar P, Jagannatha PS, Vaidyanathan PS, Unnikrishnan KP. Average annual risk of tuberculous infection in India. *Int J Tuberc Lung Dis*. 2005; 9(1): 116–118.
14. Ong A, Creasman J, Hopewell PC, Gonzalez LC, Wong M, Jasmer RM et al. A molecular epidemiological assessment of extrapulmonary tuberculosis in San Francisco. *Clin Infect Dis*. 2004; 38(1): 25–31.
15. Rajeswari R, Chandrasekaran V, Suhadev M, Sivasubramaniam S, Sudha G, Renu G. Factors associated with patient and health system delays in the diagnosis of tuberculosis in South India. *Int J Tuberc Lung Dis*. 2002; 6(9): 789–795.
16. Madhukar P, Shriprakash K , Ashutosh NA, Dick M, Henry MB. Nosocomial Tuberculosis in India. *Emerg Infect Dis*. 2006; 12(9): 1311-1318.
17. Central TB Division, Directorate General of Health Services. TB India 2005. RNTCP Status report. New Delhi, India: Ministry of Health and Family Welfare; 2005.

18. Puneet KD , Lal SS, Knut L, Fraser W , Mukund U, Suvanand S, et al. Improving tuberculosis control through public-private collaboration in India: literature review. *BMJ*. 2006; 332(7541): 574–578.
19. Zarir FU, Lancelot MP, Mukund WU. Tuberculosis management by private practitioners in Mumbai, India: Has anything changed in two decades? *Plos One*. 2010; 5(1): e12023.
20. Singh AA, Frieden TR, Khatri GR, Garg R. A survey of tuberculosis hospitals in India. *Int J Tuberc Lung Dis*. 2004; 8(10): 1255–1259.
21. Rao KG, Aggarwal AN, Behera D. Tuberculosis among physicians in training. *Int J Tuberc Lung Dis*. 2004; 8(1): 1392–1394.
22. Pai M, Gokhale K, Joshi R, Dogra S, Kalantri S, Mendiratta DK, et al. Mycobacterium tuberculosis infection in health care workers in rural India: comparison of a whole-blood interferon gamma assay with tuberculin skin testing. *JAMA*. 2005; 293(22): 2746–2755.
23. Chadha VK, Sarin R, Narang P, John KR, Chopra KK, Jitendra R, et al. Trends in the annual risk of tuberculosis infection in India. *Int J Tuberc Lung Dis*. 2013; 17(3): 312–319.
24. Madhukar P, Rajnish J, Sandeep D, Deepak KM, Pratibha N, Shriprakash K, et al. Serial testing of health care workers for tuberculosis using interferon gamma assay. *Am J Respir Crit Care Med*. 2006; 174(3): 349–355.
25. Gopinatha KG, Siddiqueb S , Kirubakaranb H , Shanmugame A , Mathaia E, Chandy GM. Tuberculosis among healthcare workers in a tertiary care hospital in South India. *J Hosp Infect*. 2004; 57(1): 339–342.
26. Mathew A, David T, Kuruvilla PJ, Jesudasan M, Thomas K. Risk factors for tuberculosis among health care workers in southern India. Presented at the 43rd Annual Meeting of the Infectious Diseases Society of America (IDSA); San Francisco; 2005.
27. Golchin M, Rostami M. Tuberculin test in nursing and human sciences students. *J Res Med Sci*. 2005; 10(3): 172–176.
28. Kayanja HK, Debanne S, King C, Whalen CC. Tuberculosis infection among health care workers in Kampala, Uganda. *Int J Tuberc Lung Dis*. 2005; 9(6): 686–688.
29. Silva VM, Cunha AJ, Oliveira JR, Figueira MM, Nunes ZB, DeRiemer K, et al. Medical students at risk of nosocomial transmission of Mycobacterium tuberculosis. *Int J Tuberc Lung Dis*. 2000; 4(5): 420–426.
30. Levy MZ, Medeiros EA, Shang N, Soares MC, Homenko AS, Almeida RM, et al. TST reversion in a BCG revaccinated population of nursing and medical students, Sao Paulo–2000. *Int J Tuberc Lung Dis*. 2005; 9(7): 771–776.
31. Naidoo S, Mahommed A. Knowledge, attitudes, behaviour and prevalence of TB infection among dentists in the Western Cape. *SADJ*. 2002; 57(11): 476–478.
32. Kassim S, Zuber P, Wiktor SZ, Diomande FV, Coulibaly IM, Coulibaly D, et al. Tuberculin skin testing to assess the occupational risk of Mycobacterium tuberculosis infection among health care workers in Abidjan, Cote d'Ivoire. *Int J Tuberc Lung Dis*. 2000; 4(4): 321–326.
33. Maria GG, Aida JC, Maria EJC, Leticia FR, Kenneth M, Blanca RC , et al. Factors associated with tuberculin reactivity in two general hospitals in Mexico. *Infect Cont & Hsptl Epid*. 2001; 22(2): 88–93.
34. Yanai H, Limpakarnjanarat K, Uthaivoravit W, Mastro TD, Mori T, Tappero JW. Risk of Mycobacterium tuberculosis infection and disease among health care workers, Chiang Rai, Thailand. *Int J Tuberc Lung Dis*. 2003; 7(1): 36–45.

35. Orrett FA. Prevalence of tuberculin skin test reactivity among health care workers at a teaching hospital in Trinidad. *Clin Microbiol Infect.* 2000; 6(1): 45–48.
36. Roth VR, Garrett DO, Laserson KF, Starling CE, Kritski AL, Medeiros EA, et al. A multicenter evaluation of tuberculin skin test positivity and conversion among health care workers in Brazilian hospitals. *Int J Tuberc Lung Dis.* 2005; 9(12): 1335–1342.
37. Dimitrova B, Hutchings A, Atun R, Drobniewski F, Marchenko G, Zakharova S, et al. Increased risk of tuberculosis among health care workers in Samara Oblast, Russia: Analysis of notification data. *Int J Tuberc Lung Dis*. 2005; 9(5): 43–48.
38. Kilinc O, Ucan ES, Cakan MD, Ellidokuz MD, Ozol MD, Sayiner A, et al. Risk of tuberculosis among healthcare workers: Can tuberculosis be considered as an occupational disease? *Resp Med.* 2002; 96(7): 506–510.
39. Li CY, Sung FC. A review of the healthy worker effect in occupational epidemiology. *Occup Med*. 2000; 49(4): 225–229.
40. Chadha VK, Kumar P, Jagannatha PS, Vaidyanathan PS, Unnikrishnan KP. Average annual risk of tuberculous infection in India. *Int J Tuberc Lung Dis.* 2005; 9(1): 116–118.
41. Cuhadaroglu C, Erelel M, Tabak L, Kilicaslan Z. Increased risk of tuberculosis in health care workers: A retrospective survey at a teaching hospital in Istanbul, Turkey. *BMC Infect Dis*. 2002; 2(1): 14.
42. Teixeira EG, Menzies D, Comstock GW, Cunha AJ, Kritski AL, Soares LC, et al. Latent tuberculosis infection among undergraduate medical students in Rio de Janeiro State, Brazil. *Int J Tuberc Lung Dis*. 2005; 9(8): 841–847.
43. Luksamijarulkul P, Supapvanit C, Loosereewanich P, Aiumlaor P. Risk assessment towards tuberculosis among hospital personnel: Administrative control, risk exposure, use of protective barriers and microbial air quality. *Southeast Asian J Trop Med Public Health*. 2004; 35(4): 1005–1011.
44. Ibrahim LM, Hadejia IS, Nguku P, Dankoli R, Waziri NE, Akhimien MO, et al. Factors Associated with interruption of Treatment among Pulmonary Tuberculosis Patients in Plateau State, Nigeria. *Pan Afr Med J*. 2014; 17(1): 78.
45. Jasmer RM, Seaman CB, Gonzalez LC, Kawamura LM, Osmond DH, Daley CL.. Tuberculosis treatment outcomes: directly observed therapy compared with self-administered therapy. *Am J Respir Crit Care Med*. 2004; 170(5): 561-566.
46. Ahmed AOA, Martin HP. Disease and treatment-related factors associated with tuberculosis treatment default in Khartoum State, Sudan: a case-control study. *EMHJ*. 2017; 23(6): 346-352.
47. Sanou A, Dembele M, Theobald S, Macq J. Access and adhering to tuberculosis treatment: Barriers faced by patients and communities in Burkina Faso. *Int J Tuberc Lung Dis*. 2004; 8(12): 1479-1483.
48. Ali AOA, Prins HM. Patient non adherence to tuberculosis treatment in Sudan: socio-demographic factors influencing non adherence to tuberculosis therapy in Khartoum State. *Pan Afr Med J*. 2016; 25(1): 80.
49. John GA, Anna HH, Janet AA, Walter M, Peter ON, Odylia M, et al. Care seeking and attitudes towards treatment compliance by newly enrolled tuberculosis patients in the district treatment programme in rural western Kenya: a qualitative study. *BMC Public Health*. 2011; 11(1): 515.

50. Ibrahim LM, Hadjia IS, Nguku P, Waziri NE, Akhimien MO, Patrobas P, et al. Health care workers knowledge and attitude towards TB patients under Direct Observation of Treatment in Plateau state Nigeria. *Pan Afr Med J*. 2014; 18(1): 1-8.
51. Central TB Division, Directorate General of Health Services. TB India 2005. RNTCP Status report. New Delhi, India: Ministry of Health and Family Welfare; 2005.
52. McLaughlin SI, Spradling P, Drociuk D, Ridzon R, Pozsik CJ, Onorato I. Extensive transmission of Mycobacterium tuberculosis among congregated, HIV-infected prison inmates in South Carolina, United States. *Int J Tuberc Lung Dis*. 2003; 7(7): 665-672.
53. Madhukar P, Shriprakash K, Ashutosh NA, Dick M, Henry MB. Nosocomial tuberculosis in India. *Emerg Infect Dis*. 2006; 12(9): 1311–1318.
54. Chen-Yuan C, Enarson DA, Fujiwara PI, Deun AV, Jen-Jyh L. Strategies of Extensively Drug-resistant TB Risk Management for Health Workers and Other Care Givers. *Exp Rev of Resp Med*. 2008; 2(1): 47-54.
55. Cutsem G, Isaakidis P, Farley J, Nardell E, Volchenkov G, Cox H. Infection control for drug-resistant tuberculosis: early diagnosis and treatment is the key. *Clin Infect Dis*. 2016; 62(3): S238–S243.
56. Nathavitharana RR, Daru P, Barrera AE, Mostofa SM, Islam S, Ul-Alam M, et al. FAST implementation in Bangladesh: high frequency of unsuspected tuberculosis justifies challenges of scale-up . *Int J Tuberc Lung Dis*. 2017; 21(9): 1020–1025.
57. Taylor JG, Yates TA, Mthethwa M, Tanser F, Abubakar I, Altamirano H. Plan beta for tuberculosis: it's time to think seriously about poorly ventilated congregate settings. *Int J Tuberc Lung Dis*. 2016; 20(1): 5–10.
58. Nader Ghotbi, Shuzo Nishimura, Naoyoshi Takatsuka. Japan's national tuberculosis control strategies with economic considerations. *Environ Health Prev Med*. 2005; 10(4): 213–218.
59. Thrupp L, Bradley S, Smith P, Simor A, Gantz N, Crossley K, et al. Tuberculosis prevention and control in long-term-care facilities for older adults. *Infect Control Hosp Epidemiol*. 2004; 25(12): 1097–108.