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Tuberculosis in the San Diego-Tijuana Border Region:

Time for Bi-National Community-Based Solutions

Acknowledgements

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A workshop entitled, Tuberculosis in the San Diego-Baja California Border Region: Time for Bi-National Community-Based Solution, was held on November 10th, 2009 at the International Community Foundation's headquarters in National City, California. The participants of the workshop played an integral role in providing valuable input and feedback on our final report.

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Executive Summary

Tuberculosis (TB) in the San Diego – Tijuana Border Region: *Time for Bi-National Community-Based Solutions*

The close geographical proximity of San Diego and Tijuana, the stark contrast between their distinct economies and levels of socio-economic development, and the ease and magnitude of cross-border exchange between these two metropolitan areas, demand our undivided attention. According to the San Diego Association of Governments (SANDAG), over 60 million persons cross into San Diego from Tijuana at the San Ysidro border crossing each year. In fact, many have come to agree that the San Diego-Tijuana border region does not identify with one particular country, but rather has a broader identity of its own. The blending of economic, social and cultural activities in this region charges us to find bi-national solutions to the unique bi-national issues facing the region. One such regional issue we must confront is that of tuberculosis (TB). Both California and Baja California have TB incidence rates that are much higher than the national rates of their respective countries. Furthermore, Tijuana reports approximately 4 times as many new TB cases per year than does San Diego. There is an urgent need to confront this disparity, and address the issue of bi-national TB control in the San Diego-Tijuana border region to find sustainable, community-based solutions that will benefit both Mexico and the United States. Importantly, as an air-borne infection, successful models of TB control will have applicability to other emerging diseases threats that require cross-border solutions, such as H1N1.

Likely an underestimate, over 600 cases of pulmonary TB were confirmed and reported annually in Tijuana in 2006 and 2007.

In the last decade, there has been an average of over 300 new TB cases per year in San Diego County, of which nearly 40% were born in Mexico.

TB is a subtle and complex chronic infectious disease that can remain dormant for years after the initial infection. Once active or re-activated, TB often takes weeks or months to be diagnosed correctly, allowing for ongoing exposure and transmission to others. The World Health Organization (WHO) estimates that 2 billion people, or one-third of the global population, are currently infected with the M. tuberculosis bacilli. Of those infected, it is estimated that 1 in 10 will develop the active, contagious form of disease at some time in their lives, and those with active TB will infect an average of 10 to 15 people per year if they are not treated. Likely an underestimate, over 600 cases of pulmonary TB were confirmed and reported annually in Tijuana in 2006 and 2007 with an overall rate of 46 per 100,000 inhabitants, which is substantially higher than rates in neighboring Mexican states. In the last decade, there has been an average of over 300 new TB cases per year in San Diego County, of which nearly 40% were born in Mexico. This estimate is likely to understate the influence of Mexico on the TB case load in San Diego, since US-born, Hispanic TB cases are not identified in

TB surveillance data as being of Mexican origin. Nevertheless, these cases have significant interaction with Mexico when they, or their contacts, cross the border for social, cultural and economic reasons. Prior to the discovery in 1946 that streptomycin cured TB, the disease claimed the lives of half its victims. Hopes of eradicating TB grew when a 6-month course of daily drug treatment was found to be highly effective for curing TB and rates of disease began to drop worldwide. However, interrupted or inconsistent treatment, combined with the AIDS epidemic, led to the emergence of drug resistant strains of TB bacteria that could no longer be cured with first-line antibiotics, and rates of TB began to increase in the 1980s. To date, the WHO and other agencies have documented cases of TB that are resistant to standard first-line antibiotics and second-line antibiotics in all regions of the world, including the US-Mexico border region. This reverses years of progress in TB control as successful management of drug resistance requires more sophisticated laboratory capacity, educated personnel and access to significantly more expensive drugs. Importantly, drug resistance is completely preventable with appropriate diagnosis that includes drug sensitivity testing and programs like directly observed therapy (DOT) that ensure patients are on proper treatment regimens and do not interrupt therapy or miss doses. Until a vaccine or single-dose treatment is discovered, our best hope for preventing TB from returning to an untreatable disease depends on accurately diagnosing and completely treating patients with TB.

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Like the disease itself, the costs of TB are complex and difficult to quantify. The direct costs can be described in terms of infrastructure - diagnostic laboratories and equipment, clinic and hospital units appropriately designed for infection control, and surveillance systems; personnel - trained laboratory technicians, informed healthcare providers, DOT workers, contact investigators, and surveillance system managers; and *consumables* - laboratory reagents, anti-TB medications, infection control supplies, and educational materials. Indirect costs include lost wages for those infected, decreased productivity by employers, and disruption to the community affected by contact tracing activities. We estimate that TB costs in San Diego amount to be at least **$21.3 million** annually, which includes approximately **$12.7 million** in lost earnings for patients due to their disease. Beyond the loss of earned wages is the loss by San Diego employers in productivity. Workforce productivity is impacted in several ways by TB. Most significant is that TB symptoms are slow to develop and many infected individuals continue day-to-day activities for weeks or months before their disease is detected, potentially exposing large numbers of contacts at work, home and in the community to TB. This results in additional

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infections in the workplace and disruptions due to the extensive contact tracing activities that need to take place after a workplace infection. The costs presented here include the major measurable factors and costs to San Diego, but, while high, are certainly an underestimate of total costs. They do not include the substantial hidden costs of lost productivity to employers or other more subtle losses like loss of income to school districts due to scheduled absences for children with TB; nor do they account for other social costs related to stigmatization or infected individuals and their contacts.

While the San Diego-Tijuana region is impacted by the growing challenges of TB, this is a preventable and treatable disease and there is tremendous potential to contribute and participate in an international mobilization of public health, clinical personnel, business leaders and communities to effectively combat the disease.

Importantly, there is consensus for what constitutes a comprehensive TB control program: the WHO DOTS program. This strategy includes early detection of cases, contact tracing, accurate diagnosis through bacterial culture and drug sensitivity testing, uninterrupted access to effective drugs, and DOT. Although incidence rates are declining globally and domestically, the number of cases worldwide is increasing due to population growth and the emergence of resistance threatens to reverse the advances to date. Thus, there is an urgent call by multiple political and professional organizations for a coordinated global response. While the San Diego-Tijuana region is impacted by the growing challenges of TB, this is a preventable and treatable disease and there is tremendous potential to contribute and participate in an international mobilization of public health, clinical personnel, business leaders and communities to effectively combat the disease.

Economic analyses clearly indicate that US investment in TB control in Mexico can be a cost-effective means of controlling TB in the United States. Given the epidemiology of TB in the San Diego-Tijuana border such economic benefits are likely to be true for this bi-national region. While this is so, the active involvement of both private businesses and governmental agencies will be required to make this a reality. Successful working models in which businesses located in high TB-incidence areas have taken a lead role in TB control programs already exist through the work of member companies of the Global Business Coalition for HIV, Tuberculosis and Malaria (GBC). This novel approach to address emerging high impact threats through private-public partnerships provides a promising model that can be adopted in the US-Mexico border region.

Smear microscopy is currently the standard diagnostic method for active TB in Baja California, yet this method fails to detect up to half of the cases with active pulmonary TB.

This report highlights five key areas of tuberculosis control in the San Diego-Tijuana border region that demand our combined and immediate attention: laboratory diagnostics, case management, prevention, infection control and surveillance.

1: Laboratory Diagnostics

For accurate diagnosis and appropriate therapy, bacterial culture for all suspected cases and access to drug susceptibility testing are imperative. These services are currently lacking in both the public and private sector health systems in Tijuana and

Mexicali. Smear microscopy is currently the standard diagnostic method for active TB in Baja California, yet this method fails to detect up to half of the cases with active pulmonary TB. Consequently, many individuals with active TB are misdiagnosed, allowing their disease to progress and more contacts to be exposed to infection. The WHO Global Stop TB Partnership currently recommends the use of rapid and sensitive TB diagnostic techniques including cultures to maximize case detection and to optimize therapy through drug susceptibility testing. Drug resistant strains of TB are found in Baja California, including Tijuana, and there is evidence of their transmission within the community. Yet, due to lack of routine drug susceptibility testing of TB isolates, these strains are not identified in a timely or standardized manner. Lack of early identification allows amplification of drug resistance to occur leading to emergence of multiply resistant strains. Although capacity to conduct first line drug susceptibility testing exists to a limited extent in Baja California laboratories, its use is severely limited by the system's or the patient's inability to pay for the tests. Conservative estimates indicate that approximately $122,400 in supplies and $90,000 for personnel, per year, are needed to accurately identify, detect and diagnose tuberculosis using cultures and drug susceptibility testing in Baja California.

Drug resistant strains of TB are found in Baja California, including Tijuana, and there is evidence of their transmission within the community. Yet, due to lack of routine drug susceptibility testing of TB isolates, these strains are not identified in a timely or standardized manner.

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2: Case management

Because most people find it difficult to adhere to a prolonged and exacting treatment course, the WHO, the US Centers for Disease Control and Prevention (CDC), and the Mexican National TB Program all endorse DOT for TB patients. However, in Baja California, as elsewhere, the allocation of resources to assure appropriate delivery of DOT services is decided by local health jurisdictions. Baja California has over 1000 active TB patients diagnosed each year. Despite an excellent system of decentralized health care and a history of using promotores (community health workers) to attend to community health needs, currently available resources are inadequate to support the DOT strategy in Baja California at this time. Lack of DOT for TB treatment increases the likelihood of inconsistent or abandoned drug therapy and subsequently results in drug resistance. Employer-supported programs that enable employees to receive DOT in the workplace, is one way of augmenting the jurisdictional DOT service network and improving access for workers.

Despite an excellent system of decentralized health care and a history of using promotores to attend to community health needs, currently available resources cannot fully realize the DOT strategy in Baja California at this time.

An uninterrupted supply of first and second line drugs is critical to successful TB case

Employers could potentially support DOT-in-the-workplace for employees who are returning to work, thereby augmenting the jurisdictional DOT service network and improving access for workers.

management and preventing drug resistance. Ad hoc regimens are used when the medications for standard regimens are not available and may lead to poor outcomes, including drug resistance and relapse. Standard first line tuberculosis drugs are generally available in Baja California; however, second line drugs are controlled by the National TB Program and require a lengthy and cumbersome process that can take up to 6 months for the approval and release of the needed drugs from Mexico City. A model is in place for the receipt of second line drugs in Baja California. What is needed is control and monitoring of the process to ensure future drug shipments will continue in a timely manner. Providers need a rapid and acceptable process for securing complete and appropriate medications for their patients who have failed a previous treatment course. Limited national resources require strict and often prohibitive controls; thus, alternative strategies for drug delivery are needed to increase the availability of drugs.

3: Prevention

The most effective method of TB prevention is rapid diagnosis and cure of TB cases. Beyond the technical and resource limitations impacting this strategy, patient awareness and reluctance to be diagnosed with TB can delay their diagnosis and treatment. There remains a great deal of misinformation about TB among the general public. This misinformation causes undue anxiety and fear for individuals when confronted with someone who has a TB diagnosis and often places the patient in a position of shame and ostracism. Fear of stigmatization, whether perceived or real, leads patients to hide their diagnosis potentially complicating treatment adherence and contact tracing efforts. It may also prevent infected persons from seeking care, thus prolonging the period of infectiousness. The facts about TB, when well communicated, can change perceptions, leading to cooperation and support in the control of TB at many levels; patient, provider, family, workplace, and community. The Mexican government has recently stepped-up attention toward tuberculosis. Tuberculosis health education is needed on both sides of the border for providers, patients, family contacts, and the general public - including business - to ensure an accurate understanding of disease transmission and prevention and to reduce stigma and stereotypes about the disease. This is perhaps the most feasible and least costly manner in which business can contribute to the control of TB-by adding tuberculosis education to the agenda.

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The facts about TB, when well communicated, can change perceptions, leading to cooperation and support in the control of TB at many levels.

Mexico's TB control efforts emphasize detection and treatment of active TB cases, but as suggested by the WHO, comprehensive programs for prevention of reactivation of latent TB infection (LTBI) are necessary to control TB. The cost of a 9-month regimen of preventative therapy for LTBI (not disease) is minimal. Although there are policies in place

to treat LTBI among persons with HIV co-infection, this group represents a small proportion of those at high risk of TB reactivation, which also includes diabetics, persons with chronic illness and children < 5 years old. In addition to expanding LTBI treatment to individuals at increased risk of TB reactivation, adequately funded programs are needed to expeditiously track all contacts of newly diagnosed TB cases to determine their need for treatment of the active or latent form of the disease. This includes cross-border communication between health departments for notification of potential exposures because of patients who work, live, or travel on both sides of the border. Exposures within worksites can be prioritized and pilot projects to have employers assist with worksite testing and treatment can be initiated.

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4: Infection Control

The TB bacterium becomes airborne when persons with pulmonary TB cough, sneeze, spit or speak allowing TB to spread easily to others in closed spaces, such as hospitals and clinics and thus poses a significant risk to health care workers and patients. TB transmissions in clinics and hospitals have been documented affecting individuals as well as multiple persons during outbreaks. In Tijuana specifically, a well conducted study at a major hospital over a 4 year period concluded that health care workers (HCWs) were 11 times more likely to be infected than the general population. Infected HCWs are particularly problematic because until they are treated, they may infect co-workers and patients with other health conditions such as diabetes mellitus or AIDS that predispose them to active TB. Thus, routine HCW screening and education is a critical part of infection control.

While effective infection control guidelines for health care settings have been published by international and domestic agencies, local-level assessments are needed to tailor such recommendations according to the needs and resources in each region. An initiative, funded by the US Agency for International Development (USAID), is underway to strengthen the infection control policies for Mexico, including Baja California. In order to effectively respond to the resulting recommendations, Baja California must be prepared and enabled to provide HCW education, renovate hospital wards to include isolation rooms and air handling systems, and purchase the equipment and supplies necessary to implement the guidelines. TB screening programs and personal protective equipment, such as N95 masks, will be needed as well. As an additional benefit, improvements in respiratory infection control will help prevent transmission of other respiratory illnesses, such as H1N1 influenza.

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5: Surveillance

Disease surveillance allows health officials,

policy makers, and healthcare providers to assess the magnitude of a disease, monitor the effectiveness of interventions to reduce the incidence of the disease, detect outbreaks so that appropriate public health responses can be taken to bring he disease under control, and ideally to track progress toward elimination of the disease. Although Mexico has a technically sophisticated national TB surveillance system, there are a number of ways in which this system could be enhanced to minimize under-reporting of cases and improve follow-up data to better document treatment outcomes. The responsibility for entering cases into Mexico's TB surveillance system varies across institutions and is frequently avoided by private providers even though these providers diagnose and manage TB cases. Hard copy paper reports require administrative time to complete and couriers to deliver. In some cases, physicians must travel to a designated office with their patient follow-up reports and dictate them while a health official enters the data into an electronic database system. Tijuana's TB Control Program has a reporting requirement prior to releasing government subsidized TB medications as a way to promote case reporting. However, this may not provide any incentive for patients of private providers that can afford unsubsidized medications.

Harmonizing TB reporting responsibilities across institutions and moving towards an accessible electronic method of reporting would greatly improve the quality of data and the possibility for greater patient follow up.

Harmonizing TB reporting responsibilities across institutions and moving towards an accessible electronic method of reporting would greatly improve the quality of data and the possibility for greater patient follow up. Complete surveillance data is essential for monitoring TB trends at both the local and national level in order to inform policy, implement and evaluate TB control practices, and effectively allocate precious healthcare resources. High quality surveillance data can also be used to justify requests for additional resources in areas of greatest need.

Role of Business in Tuberculosis Control

Cross border collaboration among critical public health authorities, academia and private business is essential for the development and implementation of an effective TB health education, diagnosis and treatment program in the San Diego-Tijuana region. Local businesses can and must contribute to solutions in TB control across the border region.

Because of the unparalleled level of bidirectional border crossings and growing number of cross-border residences and businesses, binational partnerships must also evolve to address the growing number of TB cases that continue to go unreported early on which increase the risk and societal cost of workplace infection. The report highlights several recent examples of TB cases in San Diego that have involved broad spectrums of businesses in nurseries, bio tech firms, manufacturers, nail salons, hotels and casinos. s an increased incidence of TB will have a growing negative impact on a broad spectrum of businesses on both sides of the border, there is a pressing need

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for more pro-active steps to be taken by the private sector on both sides of the border. Steps that could be taken include in the San Diego-Tijuana border region include workplace based TB education programs, paid sick leave for infected workers and improved reporting of TB cases managed by private physicians in Mexico.

The report also highlights the cutting edge work of the Global Business Coalition for HIV/AIDS, Tuberculosis and Malaria (GBC), a membership organization established in 2001 to bring together major multinational corporations to respond to the risk of infectious disease in the countries and communities where member companies do business. Yet, to date, the emphasis of GBC's work has been in Africa and South Asia where the risk of TB is greatest. Among the over 300 GBC members, there are 12 corporations with a presence in the San Diego-Tijuana border region. Given the growing cross-border risk of TB transmission, pro-active steps should be taken by initiate a GBC pilot program in the San Diego-Tijuana border region.

Conclusions & Next Steps

On November 10th, 2009, a bi-national workshop entitled, Tuberculosis in the San Diego-Baja California Region: Time for Bi-national Community-Based Solutions was convened at the International Community Foundation's headquarters in National City, California. The workshop included representatives from academia, non-profit organizations, the private sector and governmental agencies at the federal, state and local levels from both Mexico and the United States. The workshop began with a plenary session to provide an overview of the current status of tuberculosis on both sides of the border, with an emphasis on identifying ways that private businesses could pioneer novel solutions to the existing challenges in TB control. The workshop also included four break-out sessions that addressed the following topics: 1) diagnosis and screening, 2) data collection, sharing and new technologies, 3) coordination of care, and 4) stigma, awareness and education. The break-out sessions provided an opportunity for representatives across different sectors to brainstorm possible solutions, next steps and pilot projects that could begin to alleviate the problems that the border region faces with regards to TB. The potential role of philanthropy and expanded cross-border public-private partnerships was also further explored.

In addition to galvanizing partners along the U.S.-Mexico border to begin to prioritize possible solutions for TB control in the region, the workshop also provided a forum for important feedback and input on this document. Several of the key solutions and recommendations identified to respond to San Diego-Tijuana's cross-border TB challenges, will required changes in public policy, increased public sector funding and/or the expanded commitment and involvement of the business communities of San Diego-Tijuana as well as the philanthropic sector. These recommendations are summarized below:

TB Cost Analysis

- A detailed cost-analysis of TB in San Diego and Tijuana could provide a more accurate estimate of costs, including trends, as well as opportunities for cost-savings that could be realized with bi-national interventions. Much work remains to be done in better quantifying the cost of TB in the Mexican border region and its resulting impacts on U.S. border communities such as San Diego.

Diagnosis and Screening

- Improve detection of active TB through routine TB screening by supplementing the current standard acid fast bacilli (AFB) smear microscopy with specimen concentration, fluorescence microscopy and TB culture.

- Expedite the introduction of drug susceptibility testing (DST) throughout Tijuana and Baja California with the ultimate goal of making DST routinely available to all local hospitals and clinics in the public and private sector. To facilitate this process, laboratories should utilize existing and evolving technologies rather than imposing strict criteria on tests to be used.

- Remove barriers to treating latent TB infection for contacts and high-risk groups by using assays that are insensitive to BCG vaccination, such as interferon gamma release assays (i.e., QuantiFERON TB Gold or T.Spot TB), to detect candidates for treatment. Prioritization should include high risk groups (e.g., diabetics, HIV co-infection) and contacts of recently diagnosed active TB cases.

- Conduct a pilot program within a business, such as a large maquiladora, to perform QuantiFERON screening for latent TB with a pilot TB prophylaxis program for employees identified as TB infected who are at high risk of progressing to active disease (e.g., diabetics).

Data Collection, Sharing and New Technologies

- Simplify the process of including TB cases in local and national (SINAVE) surveillance systems in Tijuana, with technologies such as electronic transfer of case information (e.g., email, fax, websites). This would require the placement of computers with internet access in all healthcare facilities that manage TB cases. The computers should be made available for multipurpose use to attain secondary benefits from their placement. Future funding would be used for systems analysis, equipment and training to enhance the existing systems.

- Improve methods for monitoring DOT initiation and completion through the existing surveillance system. Also, explore the feasibility and cost-effectiveness of novel technologies (e.g., wirelessly monitored pill dispensers) to facilitate and track DOT.

- Develop procedures and systems for sharing TB data between Mexico and the US.

Coordination of Care

- Assure that the cost to patients of laboratory tests, such as repeat TB smear microscopy, imaging studies and monitoring of medications, do not contribute to abandonment of TB therapy.

- Provide strict DOT for all new pulmonary TB patients. In areas where this is not being routinely accomplished, stakeholders including providers, administrators, employers, patients and nurses should be convened to develop and implement DOT pilot initiatives (e.g., workplace DOT, virtual DOT, inter-institutional agreements, home-based DOT).

- Initiate policies for patients who relapse or fail TB treatment such that review

and oversight of retreatment regimens is performed by experts in drug resistant TB.

- Training in TB surveillance and management should be implemented for three key populations: 1) first and second level providers to assure new TB patients are reported and managed in accordance with approved standards; 2) case management/DOT staff to assure quality outreach services and infection control practices; and 3) patients and family members to engage them as participants in successful treatment and to limit ongoing community transmission.

Stigma, Awareness and Education

- Launch a mass media campaign to educate the public regarding TB, with an emphasis on reducing stigma, encouraging early detection, limiting the period of contagiousness, and heightening awareness of the availability of curative medications.

- Implement a pilot program within a Mexican private or government business that would conduct a KAP survey (Knowledge, Attitudes, Practices) from which draft health education materials could be developed and tested. Ultimately finalized materials could be incorporated into existing occupational health programs at the business sites.

- Explore possible ways for Mexican workers to receive full salary versus partial salary compensation on completion of successful TB therapy.

I. Introduction:
Tuberculosis as an Emerging Pathogen

Tuberculosis (TB) remains a significant health burden throughout the world with an unacceptably high annual rate of new TB infections and >2 million deaths from TB per year. The World Health Organization (WHO) estimates that 2 billion people, or one third of the global population, are currently infected with tuberculosis bacilli. Of those infected, it is estimated that 1 in 10 will develop the active, contagious form of disease at some time in their lives, and those with active TB will infect an average of 10 to 15 people per year if they are not treated (1). Due to the large number of potentially infectious individuals worldwide and the non-discriminatory airborne transmission of tuberculosis bacilli, it is clear that TB is both a current and re-emergent global threat to the public's health. It is especially threatening to the most productive members of society, as it mainly affects the working population (1) and is spread by close contact which can occur in the work place.

A major contributor to the escalating TB threat is drug resistance to standard first-line antibiotics (multi-drug resistant TB or MDR-TB) and to standard second-line antibiotics (extremely drug resistant TB or XDR-TB) that has been documented by the WHO in all regions of the world. Additionally, TB that is resistant to all TB medications (totally drug resistant TB or TDR-TB) was recorded in several countries for the first time in 2009. This is reversing years of progress in TB control as successful management of drug resistance requires more sophisticated laboratory capacity, educated personnel and access to significantly more expensive second-line drugs. From a public health standpoint, drug resistance is important because: 1) individuals with drug resistant TB remain infectious for longer periods of time, potentially spreading TB to a larger number of contacts, and 2) fewer treatment options will be available to those who become infected. Of particular concern is the appearance of XDR-TB with multiple cases now documented in the US, a mortality rate of >80%, and treatment that can require a combination of surgery and injection drugs for effective therapy (2). Importantly, drug resistance is completely preventable with appropriate diagnosis that includes drug sensitivity testing and programs like directly observed therapy (DOT) that ensure patients are on proper treatment regimens and improve patient compliance.

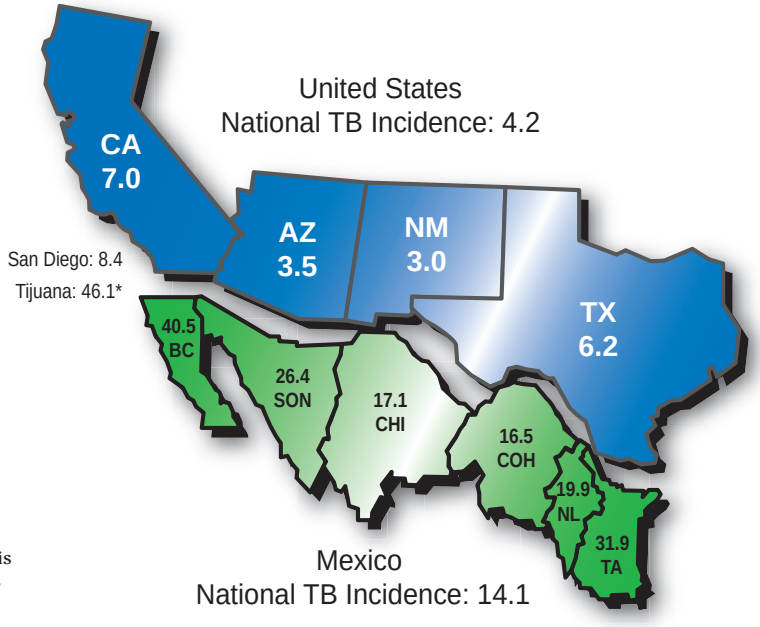
Currently, there is no effective preventive vaccine for TB. The BCG vaccine, which is routinely administered to newborns in Mexico, protects children who acquire TB infection from developing more serious or fatal disease; however it does not prevent transmission or progression from infection to active pulmonary disease, which is the main source for dissemination of disease in the community. Therefore, prevention is dependent upon identifying and treating cases before they transmit tuberculosis bacilli to their contacts, and the prophylactic treatment of contacts with latent infections before the disease state

develops. Despite the lack of an effective vaccine, TB therapy and control for individual patients, even those with multi-drug resistant TB, are well-established. However, because TB treatment typically requires combinations of medications and up to a year or more to complete, stable, sustainable programs are necessary to control and ideally eradicate TB.

On a population scale, there is consensus for what constitutes a comprehensive TB control program (WHO DOTS program). Strategies include early detection of cases, contact tracing, accurate diagnosis through bacterial culture and sensitivity testing, uninterrupted access to effective drugs, and DOT. Although incidence rates have started to decline globally and domestically, with continued high rates and the emergence of resistance there is an urgent call by multiple political and professional organizations for a coordinated global response. While the San Diego-Tijuana region is impacted by the growing challenges of TB, tremendous potential also exists to contribute and participate in the international mobilization of public health and clinical personnel, business leaders and communities to effectively combat the disease.

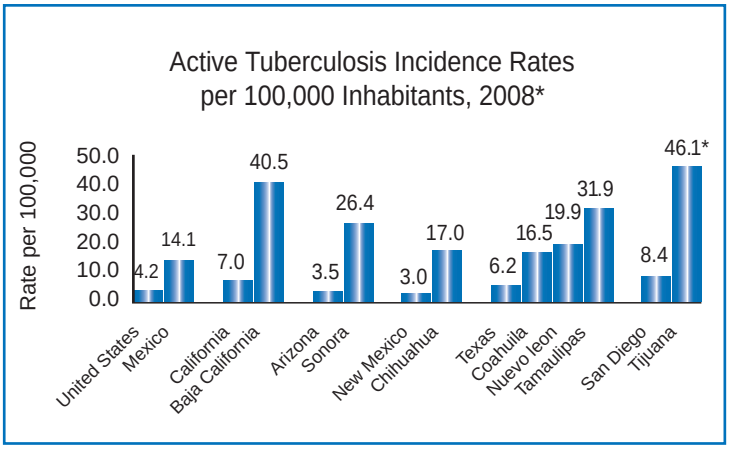
San Diego and Tijuana share a number of challenges in health and emerging infectious diseases, including an excessive burden of TB. Both California and Baja California are approaching or exceeding TB rates double those of their respective nations. In 2008, the rate of TB in California (7.0 per 100,000 population) was almost double the U.S. national rate (4.2 per 100,000), and the rate of pulmonary TB in Baja California was more than double that of the national rate in Mexico (40.5 per 100,000 versus 14.1 per 100,000) (3, 4). TB rates are even higher in San Diego (8.4 per 100,000) and Tijuana (over 45 per 100,000) (3,5,6). Evidence of the shared impact of TB along the US-Mexico border is not surprising given the unparalleled bidirectional border crossings, and growing cross-border residencies and businesses being established in both populations. In fact, the San Diego County Tuberculosis Control Branch reported that in 2008, over 70% of TB cases were foreign born individuals and over one third of all TB cases were born in Mexico.

Figure 1.
Tuberculosis Incidence in US/Mexico Border States Relative to National Incidence (per 100,000 inhabitants), 2008*



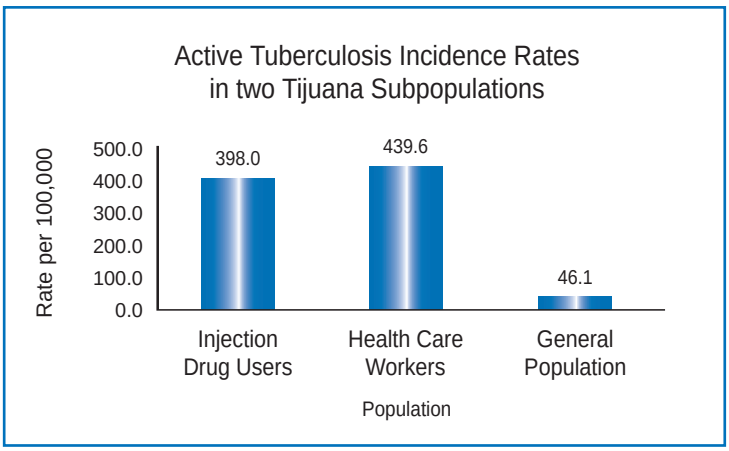
Source: CDC, 2008; CDPH, 2008; DGEPI Mexico, 2008; INEGI, 2005; SINAVE, 2007.
*Based on 2007 data. **All United States data is based on all types of TB and all Mexico data is based on pulmonary TB only.

Figure 2.
Active Tuberculosis Incidence Rates per 100,000 Inhabitants, 2008*



Source: CDC, 2008; CDPH, 2008; DGEPI Mexico, 2008; INEGI, 2005; SINAVE, 2007. *Based on 2007 data. **All United States data is based on all types of TB and all Mexico data is based on pulmonary TB only.

Figure 3.
Active Tuberculosis Incidence Rates per 100,000 Inhabitants in Two Tijuana Subpopulations



Source: Garfein, R., 2008; INEGI, 2005; Laniado-Laborín, R. & Cabrales-Vargas, N., 2006; SINAVE, 2007.

The United States-Mexico Border Health Commission recently released an important report, Tuberculosis Along the United States-Mexico Border White Paper, which delineates both successful strides and deficiencies in tuberculosis control along the entire US-Mexico border. In the San Diego-Tijuana region, notable programs such as the CureTB bi-national health cards and the Puentes de Esperanza program are confronting the specific needs of the border population (additional information about the CureTB program is available at http://www.sdcounty.ca.gov/hhsa/programs/phs/cure_tb/). However, the report also highlights the fact that significant challenges still exist in Mexico, such as insufficient laboratory diagnostics including mycobacterium culture and drug sensitivity testing, limited DOT programs, and poor access to second-line drugs (7). In the United States, ways in which to reach, educate and treat vulnerable populations for TB, including those who did not enter the United States legally, must also be addressed and implemented.

Economic analyses have clearly demonstrated that US investment in TB control in Mexico is a cost-effective means of controlling TB in the US (8). Given the epidemiology of TB in the San Diego-Tijuana border region this is especially likely to be true; but major involvement by private

businesses and governmental agencies will be required to make this a reality. Two important organizations, the Global Business Coalition for HIV/AIDS, Tuberculosis, and Malaria (GBC) and the Global Health Initiative (GHI) of the World Economic Forum have successful working models in which businesses located in high TB-incidence areas have taken a lead role in TB control programs. This has led to health benefits for employees and the community at large, and has boosted employee morale and productivity. Positive outcomes of early TB detection and effective therapy include a reduction in absenteeism and turnover and reduced transmission of TB to other workers and family members. Specific strategies include providing TB health education to employees, implementing diagnosis and onsite treatment programs, and reducing stigma and fear by developing non-discriminatory policies. Some companies have built local TB control capacity by investment in local hospitals, labs or clinics providing TB care. This is a novel approach to address emerging high impact threats through private-public partnerships, and provides a promising model that can be adopted in the US-Mexico border region. The San Diego-Tijuana region, with active local and regional coalitions and a substantial private and government business presence, is a perfect area in which to demonstrate the validity of this model, which could then be translated to the rest of the US-Mexico border region.

This document opens with a description of the pattern and impact of TB in the San Diego-Tijuana border region, including estimated costs associated with TB disease. Subsequent chapters are organized by the five strategies that have been identified as cornerstones of TB prevention and control. These include:

- Laboratory Diagnostics
- TB Case Management
- TB Prevention
- TB Infection Control
- TB Surveillance

Each chapter includes background information relevant to this region, identified needs with suggested approaches to reducing them, and the anticipated costs and benefits of addressing them. Finally, the document closes with a chapter on the role of businesses in tuberculosis control. It is hoped that this document will serve as a resource guide and 'roadmap' for stakeholders on both sides of the border that are committed to improving TB control.

References:

1. World Health Organization, *2008 Tuberculosis Facts (rev. April 2008)*. Retrieved on June 2, 2009 from http://www.who.int/tb/publications/factsheets/en/index.html
2. Hamilton CD, Sterling TR, Blumberg HM, et al. Extensively Drug-Resistant Tuberculosis: Are We Learning from History or Repeating It? *Clinical Infectious Diseases* 45:338-342. 2007
3. County of San Diego Health and Human Services Agency, TB Control Branch. *2001-2008 Comparative Data*. Retrieved on February 17, 2010 from http://www.sdcounty.ca.gov/hhsa/programs/phs/tuberculosis_control_program/statistics.html
4. Secretaria de Salud, México, Dirección General de Epidemiología. *Anuarios de Morbilidad 1984-2008.* Retrieved on February 17, 2010 from http://www.dgepi.salud.gob.mx/anuario/html/anuarios.html
5. SINAVE Plataforma Única de Información Módulo Tuberculosis 2007.
6. Instituto Nacional de Estadistica Geografica e Informatica (INEGI*). Conteo de Poblacion y Vivienda 2005.* Retrieved on July 13, 2009 from http://www.inegi.org.mx/inegi/default.aspx?c=10202&s=est
7. The United States-Mexico Border Health Commission. *Tuberculosis Along the United States-Mexico Border White Paper (2009).* Retrieved on June 2, 2009 from http://borderhealth.org/reports.php?curr=about_us
8. Schwartzman, K., Oxlade, O., Barr, R. G., Grimard, F., Acosta, I., Baez, J., Ferreira, E., Melgen, R. E., Morose, W., Salgado, A. C., Jacquet, V., Maloney, S., Laserson, K., Mendez, A. P., and Menzies, D. "Domestic returns from investment in the control of tuberculosis in other countries," New England Journal of Medicine 353 (2005): 1008-1020.
9. Global Business Coalition on HIV/AIDS, Tuberculosis and Malaria. *The State of Business and HIV/AIDS, Tuberculosis and Malaria (2008).* Retrieved on June 2, 2009 from http://www.gbcimpact.org/soba
10. Center for Disease Control and Prevention. Tuberculosis. Retrieved on June 2, 2009 from http://www.cdc.gov/tb/
11. Center for Disease Control and Prevention. *Reported tuberculosis in the United States, 2008.* Retrieved on February 17, 2010 from http://www.cdc.gov/tb/statistics/default.htm
12. Garfein, R, Prevalence of latent tuberculosis infection (LTBI) and active TB among hidden populations at risk for HIV infection in Tijuana, Mexico: Project PreveTB. Public Health Without Borders Conference, October 28, 2008 (San Diego, CA) http://apha.confex.com/apha/136am/techprogram/paper_186931.htm
13. Laniado-Laborín, R., & Cabrales-Vargas, N. (2006). Tuberculosis in healthcare workers at a general hospital in Mexico. Infection Control and Hospital Epidemiology: The Official Journal of the Society of Hospital Epidemiologists of America, 27(5), 449-452.

II. *The Scale and Cost of Tuberculosis in San Diego County*

Tuberculosis Trends in San Diego County

In the last decade, there has been an average of over 300 new Tuberculosis (TB) cases per year in San Diego County (1). In 2008, there were over 8 new TB cases for every hundred thousand people in the county (2), which is double the national average of 4 new TB cases per 100,000 people (3). While the number of new TB cases in the both the US and San Diego have been decreasing steadily over the last decade (1,3), the incidence of TB in San Diego has remained approximately double that of the national average since 1993 (Figure 1). While TB trends are complex and multivariate, much of the discrepancy with national incidence is likely due to the large number of foreign-born TB cases in San Diego. While foreign-born individuals from high prevalence TB countries have contributed an increasing proportion of TB

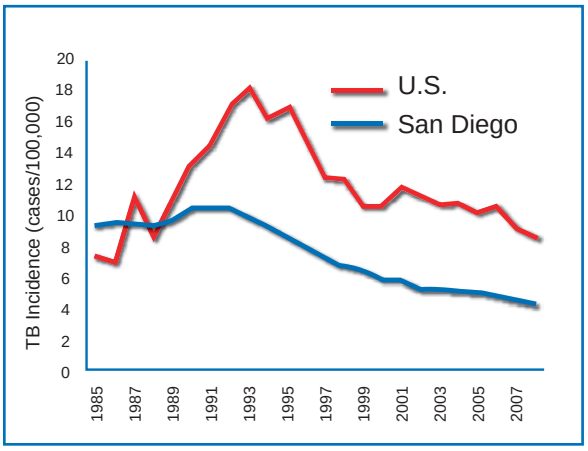
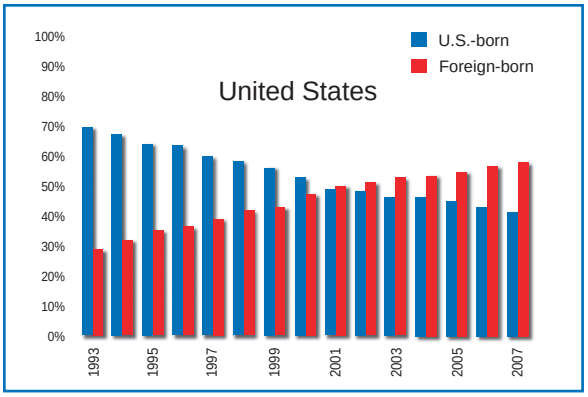
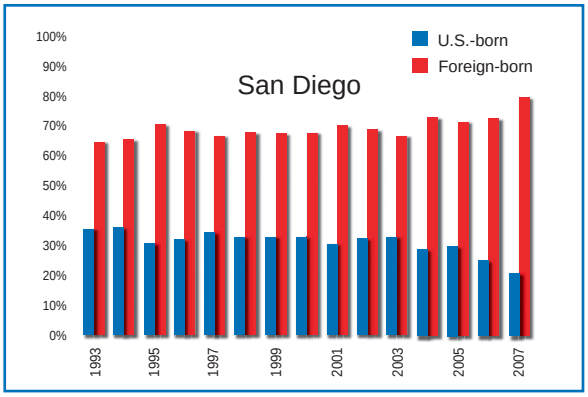


Figure 1.
Trends in Tuberculosis Incidence, 1985-2007

Figure 2a & b.
Trends foreign-born vs. US-born TB cases in the United States and San Diego





cases to the US totals since 2001 (Figure 2a), in San Diego, foreign-born individuals have always made up at least 60% of the TB cases, and that proportion has continued to increase since the 1990's (Figure 2b). In 2007, 80% of new TB cases in San Diego were in individuals born outside the US.

The San Ysidro border crossing between San Diego and Tijuana is one of the busiest land border-crossings in the world, with over 60 million crossings annually and 90% of all trips either starting or finishing in San Diego or Tijuana (4). Over the last decade almost half (45%) of the foreign-born TB cases in San Diego were born in Mexico, with Mexican immigrants making up 36% of all San Diego TB cases in 2007 (1). This is likely an underestimate of the influence of Mexico on the TB case load in San Diego as the majority of US-born, Hispanic TB cases (which are not identified in TB surveillance data as of Mexican origin) are of also of Mexican descent and are being exposed to Mexican TB risk factors when they cross into Mexico for social, cultural and economic reasons.

Table 1.
Examples of Direct and Indirect Costs of Tuberculosis in San Diego

Type of Cost	Examples
Direct Costs	
Prevention Diagnosis	Education, surveillance, contact tracing Tuberculin skin testing, chest radiography, TB microscopy, TB culture, TB drug sensitivity testing
Treatment	Inpatient/outpatient costs, antibiotics, DOT
Indirect Costs	
Lost Wages Lost Potential	Unable to work during infectious period Disabilities and mortalities

It has been clearly demonstrated that US investment in TB control in Mexico is a cost-effective and efficient manner of reducing TB incidence in the US (5). This is likely to be especially true in San Diego where many of the residents being treated for TB were probably exposed to TB risks factors in Mexico where the TB prevalence is much higher than in the US (see section II, Figure 1). What this means for San Diego is that the prevention and treatment of TB, and control of TB costs have to be managed in collaboration with other public health, non-profit and business partners inTijuana.

Estimating TB Costs in San Diego

TB is a subtle and complex chronic infectious disease that can remain dormant for years after an individual has been infected. Once an infection becomes active, TB disease often takes weeks or months to be diagnosed correctly and takes a minimum of 6 months of daily medication to treat effectively. Treatment can extend to multiple years if the infecting TB strain is drug-resistant. The costs of TB are complex and difficult to quantify. Costs include direct cost such as TB surveillance, diagnostic equipment, and the cost of treatment; as well as indirect costs including lost wages for those infected (Table1) (6). In order to estimate the true cost of TB in San Diego we need to understand both the epidemiology of TB cases in the county and the direct and indirect costs of supplies and services needed for preventing, diagnosing and treating tuberculosis. While the epidemiology of TB is well understood in San Diego, data on the local costs of TB are limited. In order to make an estimate of the costs of TB for this report we have used local cost estimates from public and private sources when available, but have had to rely heavily on estimates from comparable national and international studies to supplement regional data. While the cost estimates we included

are likely the major variables driving TB costs in San Diego, our estimates should be considered an underestimate of the true cost of TB to San Diego County.

Direct Costs

Diagnosis and Treatment
Depending on the severity of the symptoms and stage at which the disease is diagnosed, TB treatment can be initiated in an inpatient setting with extensive costs, or if symptoms are less severe, in an outpatient setting with lower costs. Most TB patients in San Diego are treated with a combination of outpatient and inpatient care through the course of the disease. Direct TB costs are most sensitive to the number of days a patient is hospitalized. In order to estimate the direct cost of TB treatment we have assumed each patient has both inpatient and outpatient costs. Treatment costs include all direct costs of diagnosing and treating TB patients and are based on the specific studies and reports referenced below.

Inpatient Treatment Costs

Hospitalization for TB Treatment
Between 1985 and 2008, there was an average incidence of 315 new TB cases per year in San Diego. In 2008, 46% of the new TB cases were initially diagnosed and treated in the hospital (pers. comm. Marisa Moore, San Diego TB Control, HHSA). Additionally, according to previous studies (7), 8% of TB patients were also hospitalized again sometime during treatment, and some patients were hospitalized several times (7). For this analysis we combined these estimates and assumed that at least 54% of all new TB patients (approximately 140 TB patients per year) are hospitalized at least once during their TB treatment. Drug-resistant TB cases were not included in this estimate and were handled separately (see below).

Length of Hospital Stay for TB Treatment
A 2006 study of hospital stays for TB in US hospitals indicated that stays were on average three times longer than for other medical hospitalizations, with a national mean of 15 days hospital stay when the TB was the primary diagnosis (8). This is consistent with a previous San Diego study which showed the average length of stay in the hospital for TB treatment was 12.5 days (7). We took the mean of these two estimates (**13.8 days**) as our estimate of the mean number of days TB patients are hospitalized in San Diego.

Costs of Hospital Care
Average daily costs for hospitalized TB patients were not available for San Diego. These values were estimated based on average national costs for TB hospitalizations and adjusted for inflation. The median daily cost of a TB hospitalization in the US in 2006 was $1,300 per day (8). Adjusted for inflation using Bureau of Labor Statistics-Medical Care Tables (9) that cost was estimated to be **$1,459 per day** in 2009. Physician charges (inpatient provider costs) were not included in that estimate, and were an additional cost equivalent to 9.59% of hospital costs (Table 2) (8,10).

Mortalities
As a TB diagnosis can take up to two weeks, approximately 2% of TB patients die before they are actually diagnosed. These patients were included in initial hospital costs, but were excluded from continuing inpatient and outpatient care costs. Based on San Diego County TB data, an additional 6% of new TB patients die during treatment. As most of these patients die in a hospital we included them in total hospital costs but we discounted their outpatient costs by 50%, assuming most of them died before receiving full treatment.

Outpatient Treatment Costs

While the specific costs of outpatient TB treatment were not available for San Diego, these costs have been estimated at a national level. We assumed for this analysis that the national estimates are similar to San Diego. Direct outpatient treatment costs of drug-susceptible TB in the US, which include antibiotics, provider costs, diagnostics and patient compliance monitoring, was estimated to be $2,300 per patient in 1991 (10). Adjusted for inflation, this would be **$4,968** in 2009. We are confident this is accurate as our inflation adjusted estimate is consistent with the estimate of $4,831 which was the average cost per outpatient TB case in Oregon in 2008 (11).

Costs of Drug-Resistant TB
Drug-resistant TB (DR-TB) and Multidrug-resistant TB (MDR-TB) cases need to be treated with more expensive medications and require longer and more complicated inpatient and outpatient treatment periods. For this reason we have estimated DR-TB and MDR-TB direct costs separately. These cost estimates were not available for San Diego and were based on a study of 13 DR-TB patients chosen from across the US in 1994 (12).

Based on San Diego County data between 1993 and 2007, approximately 9% of all new TB cases in San Diego have been infected with TB bacteria that were resistant to at least one anti-tuberculous antibiotic (DR-TB), and about 1% was resistant to two of the most effective TB antibiotics; isoniazid and rifampin (MDR-TB). The average outpatient cost of treating mono-resistant TB cases in 1991 was $5,000 per patient (6), which was **$10,800 per patient** in 2009 adjusted dollars. MDR-TB cases were estimated to cost on average $44,881 per patient in 1995/96 (12), which was **$76,746 per patient** in 2009 after correcting for inflation.

Costs of Treating TB Suspects
In 1991, a study of TB costs in the US estimated that for every TB case correctly diagnosed and treated, there are an additional 3.22 cases that go through the diagnosis process and take TB medications that don't have TB (6). These cases are considered “TB suspects”, and as the TB diagnostic process can take months to complete, TB suspects take on average three months of TB medications before TB is ruled out. This “precautionary” therapy cost (including diagnosis, treatment and follow up) was estimated to be $1,400 per TB suspect in 1991(6), or **$3,024 per suspec**t in 2009 inflation adjusted dollars.

Total Annual Direct Costs of TB Diagnosis in San Diego

Table 2 shows the combined estimate of total direct inpatient and outpatient costs of TB in San Diego is over eight million dollars per year, or about **$27,000 per confirmed TB case**. Approximately 30% of the total direct TB costs ($2.7 million) are due to TB cases from Mexico. Economic studies have shown that these costs can be significantly decreased if the US invests in the detection and treatment of TB in Mexico where treatment and management of the disease is more cost-effective (5).

Indirect Costs
TB is a chronic infectious disease with a slow disease course, long diagnosis times and treatment cycles that can stretch from a minimum of six months to multiple years for complicated or drug-resistant cases. Consideration of the true costs of TB to San Diego has to include an estimate of indirect costs paid by the patients. We estimated these costs in terms of lost wages due to work days lost to the diagnosis, treatment and follow up requirements of TB disease. As TB causes significant mortalities in working-age adults we also included estimates of the

Table 2.
Summary of Annual Direct Inpatient and Outpatient TB Costs in San Diego

Inpatient Costs	
Total TB cases	315
Non MDR-TB cases	312
MDR-TB cases	3
Cases initially hospitalized (not MDR-TB)	144
Mortalities (dead at diagnosis)	6
Cases hospitalized later (not MDR-TB)	24
Cost of initial hospitalizations	$2,899,325
Cost of later hospitalizations	$483,221
Inpatient provider costs	$324,724
Total MDR-TB costs (input and output)	$230,238
SubTotal	**$3,937,508**
Outpatient Costs (non MDR-TB)	
Total outpatient cases starting treatment	303
Mortalities (died during treatment)	18
Total outpatients ending treatment	288
Drug susceptible cases	262
Mono-Resistant cases	26
Cost of drug-sensitive cases	$1,302,013
Costs of mono-resistant cases	$279,936
Cost of susceptible cases that died during treatment	$40,688
Cost of mono-resistant cases that died during treatment	$8,748
SubTotal	**$1,631,385**
TB Suspects Costs	
TB Suspects	1,014
Cost of treating TB Suspects	$3,067,243
SubTotal	**$3,067,243**
Total Inpatient & Outpatient Costs	**$8,636,137**

average cost of salaries permanently lost to those that died from TB. These estimates are broad averages based on national and international estimates of days lost to TB, local estimates of the number of working-age adults affected by TB and county estimates of median salaries for men and women in San Diego.

Social Demographics of TB in San Diego
For the years 1993 through 2007, 61% of the TB cases were male and 69% of cases were considered of working age, between 18 and 65 years old (Table 3). As noted in Figure 2b, most of these cases were in foreign-born individuals. Half of these foreign-born TB

Table 3.
Sociodemographics of TB Patients, 1993-2007. n=5172

	Cases	%
Age		
<18 yrs	638	12%
18-35 yrs	1515	29%
36-65 yrs	2064	40%
>65 yrs	955	18%
Sex		
Male	3161	61%
Female	2011	39%
Ethnicity		
Hispanic	2448	47%
Not Hispanic	2724	53%
Country of Origin		
U.S.	1584	31%
Mexico	1601	31%
Philippines	981	19%
Vietnam	303	6%
Other Foreign Country	703	14%
Homeless		
No	4624	89%
Yes	376	7%
Unknown	172	3%
Correctional Facility		
No	4867	94%
Yes	296	6%
Unknown	9	0.2%

cases came from Mexico and the Philippines (Table 3). Most TB cases were working individuals with a permanent residence, with only a small number from correctional facilities (6%).

Wages Lost to TB Morbidity

Working Days Lost to TB
There is no data available on the number of days a person with TB loses from work in San Diego. It was estimated that on average a person loses 3-4 weeks of work time in the initial infectious phase of the disease (pers. comm. Kathleen Moser, San Diego TB Control, HHSA) but that does not include the extensive follow up and outpatient treatment time taken away from work. The most recent study of indirect costs of TB was in 2009 in the Netherlands where the sociodemographics of TB cases and TB treatment options are similar to the US (13). In that study the average time away from work (including diagnosis, inpatient and outpatient treatment and follow up) was **80.7 days**.

San Diego Wages Lost to TB
A 2007 San Diego study estimated the median annual income for males to be $47,955 and that for females to be $38,680. With an average of 260 working days per year we estimated a median daily income of $184 for men and $149 for women (salaries not adjusted for inflation). Total lost wages were calculated by multiplying the total number of cases by the average days lost by the median daily income (Table 4). We estimated that a total of **$2.8 million** of earnings are lost annually to TB morbidity in San Diego.

Wages Lost to TB Mortality
From 1993 through 2007, there were 442 deaths amongst the TB cases in San Diego. Forty eight percent of the total mortalities occurred in working-age individuals (18-65) at an average age of 47 years. This means that on average TB patients that died lost 18 years of earnings. We applied these average mortality figures to the mean annual number of TB cases in Table 5 and calculated earnings losses using 2007 median salaries in San Diego (not adjusted for inflation). We estimate that on average TB mortalities are causing **$9.8 million of lost earnings** in San Diego annually. As this estimate is a projection of future earnings and does not include inflation it is most certainly an underestimate.

Table 4.
Annual Wages Lost to TB Morbidity

Total TB cases	315
TB cases in 18-65 yr age group	206
Working age TB cases - males	130
Working age TB cases - females	76
Mean total work days lost to TB	80.7
Mean wages lost - males	$1,934,984
Mean wages lost - females	$912,431
Total wages lost to TB morbidity	**$2,847,416**

Table 5.
Annual Wages Lost to TB Mortality

Annual working age morts	12
Male Working Morts	9
Female Working Morts	3
Mean age of working age morts	47
Mean working years lost	18
Male lost wages	$7,768,710
Female lost wages	$2,088,720
Total wages lost to TB mortality	**$9,857,430**

Total Annual Indirect Costs of TB in San Diego

Combining the lost earnings from the morbidity and mortality of TB in San Diego, we estimate that San Diego TB patients are losing approximately **$12.7 million** of earnings per year due to their disease. Beyond the loss of earned wages and tax revenues is the loss by San Diego employers in productivity. Workforce productivity is impacted in several ways by TB. Most significant is that TB symptoms are slow to develop and many individuals infected and infectious with TB continue day to day activities for several weeks before their disease is detected. This can result in significant workplace infections and disruptions due to the extensive contact tracing activities that need to take place after a workplace infection. According to the Center for Worklife Law, this "presenteeism" (workers continuing to work when they are ill) accounts for over $180 billion annually in lost productivity for businesses nationally, whereas absenteeism accounts for only $70 billion (14). These substantial, but hidden costs are difficult to estimate in San Diego where TB prevalence is one of the highest in the nation but could be significantly reduced by business involvement in TB management in both Mexico and San Diego.

Total Direct and Indirect Costs of TB in San Diego

Adding direct costs (Table 2) to indirect costs (Table 3, Table 4), we estimate that TB is costing a minimum of **$21.3 millio**n in San Diego annually. These costs include the major measurable factors and costs in San Diego, but, while high, are certainly an underestimate of total costs. They do not include the substantial hidden costs of lost productivity to employers or other more subtle losses like losses to schools that have had to undergo substantial costs and disruptions resulting from multiple TB case investigations in recent years (15-17). As over 50% of these TB cases are occurring in foreign-born individuals, and over a third of cases are in individuals from Mexico (Table 3), it is critical that San Diego take proactive steps to work with our international TB control partners to reduce these costs.

Recommendations

While we were able to generate a rough estimate of the costs of TB in San Diego, it is important to recognize that this falls short of the kind of cost analysis or cost-benefit analysis that could help us determine not only an accurate estimate of costs, but also trends in costs and opportunities for cost-savings. As described in the chapter above, this is particularly relevant in the US/Mexico bi-national region where cost savings will likely require an understanding of costs on both sides of the border as well as interventions in both Mexico and the US to achieve savings.

Cost analyses such as these are driven by data. While we were able to find much of the data necessary for a cost estimate in San Diego, such data was not readily available for Tijuana, Mexico. We recommend a formal cost analysis of TB in San Diego and Tijuana to determine the dynamics and potential cost-savings that might be realized with the types of bi-national interventions described in the remainder of this document.

References:

1. San Diego Health and Human Service Agency (HHSA). Comparative Data: County of San Diego tuberculosis statistics, 2000_2007. Available at: http://www2.sdcounty.ca.gov/hhsa/documents/fctshttables2007V2.pdf (accessed January 14, 2009).
2. San Diego Health and Human Service Agency (HHSA). County of San Diego tuberculosis control program 2008 fact sheet. Available at: http://www.sdcounty.ca.gov/hhsa/programs/phs/documents/Factsheet2008V1.pdf (accessed January 15, 2010).
3. CDC. Trends in tuberculosis–United States, 2008. *MMWR Morb Mortal Wkly Rep.* 2009;58(10):249-253.
4. San Diego Association of Governments (SANDAG). Economic impacts of wait times at the San Diego-Baja California border. Available at: http://www.sandag.org/programs/borders/binational/projects/2006_border_wait_impacts_execsum.pdf (accessed 2010, February 18).
5. Schwartzman K, Oxlade O, Barr RG, Grimard F, Acosta I, Baez J, Ferreira E, Melgen RE, Morose W, Salgado AC, Jacquet V, Maloney S, Laserson K, Mendez AP, Menzies D. Domestic returns from investment in the control of tuberculosis in other countries. New England Journal of Medicine. 2005;353(10):1008-1020.
6. Brown RE, Miller B, Taylor WR, Palmer C, Bosco L, Nicola RM, Zelinger J, Simpson K. Health-care expenditures for tuberculosis in the United States. *Arch Intern Med.* 1995;155:1595-1600.
7. Taylor Z, Marks SM, Rios Burrows NM, Weis SE, Stricof RL, Miller B. Causes and costs of hospitalization of tuberculosis patients in the United States. *International Journal of Tuberculosis and Lung Disease.* 2000;4(10):931-939.
8. Tuberculosis stays in U.S. hospitals, 2006. Available at: http://www.hcup-us.ahrq.gov/reports/statbriefs/sb60.pdf (accessed September 24, 2009).
9. Bureau of Labor Statistics. Overview of BLS Statistics on Inflation and Prices. Available at: http://www.bls.gov/bls/inflation.htm (accessed September 15, 2009).
10. Brown RE, Miller B, Taylor WR, Palmer C, Bosco L, Nicola RM, Zelinger J, Simpson K. Health-care expenditures for tuberculosis in the United States. *Archives of Internal Medicine.* 1995;155:1595-1600.
11. Rubado DJ, Choi D, Becker T, Winthrop K, Schafer S. Determining the cost of tuberculosis case management in a low-incidence state. *International Journal of Tuberculosis and Lung Disease.* 2008;12(3):301-307.
12. Rajbhandary SS, Marks SM, Bock NN. Costs of patients hospitalized for multidrug-resistant tuberculosis. *International Journal of Tuberculosis and Lung Disease.* 2004;8(8):1012-1016.
13. Kik SV, Olthof SPJ, de Vries JTN, Menzies D, Kincler N, van Loenhout-Rooyakkers J, Burdo C, Verver S. Direct and indirect costs of tuberculosis among immigrant patients in the Netherlands. *Bmc Public Health.* 2009;9.

14. Paid Sick Days Is Smart Business. Available at: http://www.hartfordbusiness.com/news9089.html (accessed September 30, 2009).
15. Local High School Possibly Exposed To TB. Available at: http://www.10news.com/news/13298219/detail.html (accessed September 30, 2009).
16. High School Student Diagnosed With TB. Available at: http://www.10news.com/news/16192832/detail.html (accessed September 30, 2009).
17. Chula Vista Student Tests Positive For TB. Available at: http://www.10news.com/news/19650943/detail.html (accessed September 30, 2009)

III. *Status of Tuberculosis Control in the San Diego – Tijuana Border Region*

a. Laboratory Diagnostics

Background: For active TB, it is imperative that physicians seek to isolate the *M. tuberculosis* (Mtb) bacterium from patients displaying symptoms that suggest the presence of active TB. Bacterial isolation is not only important for confirming the diagnosis of TB, testing the bacterium for resistance to anti-TB medications is critical for determining which medications the patient should be prescribed. Latent TB infection (LTBI) is diagnosed by detecting immunologic responses either directly in the patient (i.e., tuberculin skin testing) or in blood samples tested in a lab (i.e., QuantiFERON-TB Gold or T.Spot TB assays) indicative of prior infection, plus an absence of signs, symptoms and bacteriologic evidence of active TB. Use of these tests is critical for effective TB surveillance, prevention and control; however, available resources ultimately dictate which tests are performed.

While *Mtb* can infect most organs of the body, with limited exception only patients with TB in the lungs or throat can spread their infections. Thus, sputum is the most commonly tested sample for *Mtb*. The detection of acid-fast bacilli (AFB) in stained sputum smears examined microscopically is the easiest and quickest procedure, and provides the physician with a preliminary confirmation of a TB diagnosis. It also gives a quantitative estimation of the number of bacilli being excreted, which makes it important clinically and epidemiologically for assessing the patient's infectiousness. The sensitivity of AFB smear microscopy can be improved relatively inexpensively through the use of fluorochrome staining and microscopy. In addition, centrifuging and concentrating the sample can increase the likelihood of detecting *Mtb*. Negative smears, however, do not preclude tuberculosis disease. Various studies have indicated that only 50% to 80% of patients with pulmonary tuberculosis will have positive sputum smears. Detection of *Mtb* can be significantly improved by placing the sputum sample into a growth medium and allowing the bacteria to multiply before examining the sample for Mtb. In general, the sensitivity of culture is 80-85% with a specificity of approximately 98% (6, 7). Relative infectiousness has been associated with positive sputum culture results and is highest when the AFB smear results are also positive (8).


Mtb bacteria

With the exception of Tijuana General Hospital, Baja California laboratories currently use smear microscopy as the standard diagnostic test for TB. Additionally, because few laboratories are equipped to safely concentrate sputum samples, public and private laboratories process sputum smears using a non-centrifuged, non-

concentrated specimen (direct technique). Microscopy using fluorochrome staining can increase the sensitivity; however, due to cost, few laboratories have this capability. Since smear microscopy fails to detect up to half of the cases with active pulmonary TB, many individuals with active TB are not diagnosed and remain in the community able to transmit the disease. Justification given for this approach is that patients who excrete the highest quantities of bacteria, and thus most infectious, are being detected. Consequently, TB-infected patients remain infectious, and are often treated for other suspected causes of respiratory illness involving treatments with potential for causing the bacteria they harbor to become resistant to antibiotics. Mycobacteriology cultures are performed only in limited circumstances as outlined in the Mexican norms (9); generally after two relapses or failed courses of therapy. The laboratory in the Tijuana General Hospital has the basic equipment and staff to perform cultures, but lacking resources for reagents and other supplies these tests are rarely performed.


Mycobacteriology Culture

The Global Stop TB Partnership currently recommends the use of rapid and sensitive TB diagnostic techniques including cultures to maximize case detection and to optimize therapy through drug susceptibility testing.

Drug susceptibility testing (DST) is performed by introducing patient samples into bacteria culture media with and without individual anti-TB medications and observing whether the bacteria continue to grow. Medications that inhibit bacterial growth are subsequently prescribed to the patient with the knowledge that they will be effective. Using standard culture methods, this process takes about *one-two months* to provide results, during which time physicians must presumptively treat the patient with multiple drugs to avoid producing new resistance.


Drug Susceptibility Testing for *Mtb*

Enhanced techniques, using liquid culture systems (e.g., Bactec MGIT), reduce this time by about half. Drug resistant strains of TB are found in Baja California, including Tijuana, and there is evidence of their transmission within the community. Yet, due to lack of routine DST, patients with these strains are not identified in a timely or standardized manner. Lack of early identification allows amplification of drug resistance to occur leading to the emergence of multiply resistant strains. Limited drug susceptibility testing for first line drugs (isoniazid, rifampin, ethambutol, streptomycin, and pyrazinamide) can be performed in Baja California laboratories, when reagents are available and patients are willing to pay for the test.

Susceptibility testing is provided by the National Institute for Epidemiology and Diagnostics (INDRE) in Mexico City. The jurisdictional health departments are able to send sputum samples for first-line drug susceptibility testing. However, slow turnaround times, contamination issues, and

shipping costs limit the use of this service. Tijuana General Hospital (part of ISESALUD) is equipped with a Bactec MGIT 960 system and staff trained to conduct rapid first-line susceptibility testing. All institutions in Baja California know of the availability of cultures and susceptibilities at the Tijuana General Hospital. They also are aware that routine problems with supplies limit the availability of the service. When supplies are not available, the samples are sent to San Diego County HHS laboratory for DST. Because of the expense borne by the patient (~USD $100 per culture if the samples are sent to San Diego County HHS and up to $350 per culture if tested in private laboratories) even in these "public" clinics, cultures are rarely ordered. Consequently, of all the TB cases diagnosed through ISESALUD in 2007 and 2008, 23 (7.3%) and 4 (1.6%), respectively, were cultured and tested for drug susceptibility at the General Hospital lab (10). Failing to utilize these resources represents a missed opportunity to provide appropriate care and prevent ongoing transmission of potentially drug resistant strains of *Mtb* in Mexico. Despite the availability of lab equipment and trained technicians, the cost of testing TB specimens prohibits providers from using these services. Resources are needed to provide a consistent supply of DST reagents at affordable prices, as well as changing the culture among physicians to so that they make DST a routine part of their diagnostic work-up for TB.

Public labs in Baja California also lack resources to definitively identify the species of mycobacteria in TB patients, creating the possibility that some TB cases are misclassified as being due to *Mtb*. For example, a recent study from San Diego found that *M. bovis*, a strain of mycobacterium common in cows, accounted for 45% (62/138) of all culture-positive TB cases in children (<15 years of age) and 6% (203/3,153) of adult cases (11). Almost all of the cases were among Hispanics who were born in Mexico. Since *M. bovis* responds to most but not all medications used to treat *Mtb* infection, species identification should be routine in endemic regions such as Baja California. Species identification, as well as DST, can lead to spurious results if the testing is not done correctly. Therefore, outside quality assurance programs are an essential feature to ensure accuracy of laboratory results. Currently, such programs are inadequate in Mexico, and resources are needed to build them up.

Screening tests for LTBI are used in contact tracing to determine whether contacts of TB patients have been infected. Since those who test positive have a 5% chance of developing active TB in the first two years and an additional 5% chance of developing active TB over the remainder of their lifetime, preventive treatment is recommended depending upon additional risk factors such as age, HIV infection, diabetes, and other conditions that suppress the immune system. Treatment of LTBI reduces the risk of reactivation by 65%-75% after 6-9 months of therapy with isoniazid (INH) (1). The most significant advance in TB diagnosis in decades is the in vitro IFN-_ release assays (IGRAs): QuantiFERON TB® Gold and T-SPOT.TB. IGRAs are rapidly replacing century-old tuberculin skin testing (TST), for the detection of TB infection (2, 3, 4). The TST requires two patient visits; one to administer the test on the patient's forearm, and another to read the test 2-3 days later; a labor-intensive process prone to missed visits (5). Further limiting its potential as a predictive indicator, the TST has been plagued with problems of inter-rater reliability and false-positive results in people who have received bacille Calmette-Guerin (BCG) vaccination, which is ubiquitous in high TB prevalence countries such as Mexico. The commercially available IGRAs are designed to provide a qualitative

(positive/negative) indicator of *Mtb* infection, similar to tuberculin skin test (TST), but do not cross-react with the BCG vaccine, making them better suited for Mexico. Screening and preventive treatment are an essential component of TB control. A limitation of the IGRAs is their increased cost, which is about ten times that of the TST, although studies show that after factoring in administrative costs, failure to have results read, and decreased accuracy, the costs of the two tests to detect cases of TB are comparable (12, 13).

Needs: Capacity for reliable, timely, and high quality culture and drug susceptibility testing is currently lacking in Baja California. These services need to be available to the public sector, as well as the private sector, and providers in both Tijuana and Mexicali. Given the public health importance of drug resistance and ongoing disease transmission, testing should not be dependent on patients' willingness or ability to pay.

Approach: As recommended by the American Thoracic Society and the US Centers for Disease Control and Prevention (14), "All clinical specimens suspected of containing mycobacteria should be inoculated (after appropriate digestion and decontamination, if required) onto culture media for four reasons: 1) culture is much more sensitive than microscopy, being able to detect as few as 10 bacteria/ml of material (8), 2) growth of the organisms is necessary for precise species identification, 3) drug susceptibility testing requires culture of the organisms, and 4) genotyping of cultured organisms may be useful to identify epidemiological links between patients or to detect laboratory cross-contamination." Creating laboratories via a public-private partnership and addressing supply chain issues of reagents and laboratory supplies will address this goal. Already, there is interest in the creation of this type of laboratory from the private sector. Training of physicians and laboratory staff would also need to be included. Given that Tijuana General Hospital already has an automated liquid culture system (Bactec MGIT 960) that is currently operating at less than 20% capacity, this laboratory could easily accept samples for testing from other institutions. With firm commitments of private investment and public support, such a laboratory could be functional within six months. Public entities, as well as private practitioners would have access to these services.

Benefits: The availability of TB cultures and species identification assays, will allow physicians to identify TB patients earlier and with more accuracy. The establishment of a lab capable of providing TB cultures and drug susceptibility testing in a timely and cost-effective manner would ensure early diagnosis and appropriate drug therapy. This has the additional benefits of minimizing disease severity, development of new drug resistant strains, and decreasing the period of infectiousness. This lab would also permit lab-based surveillance through which jurisdictional authorities would receive data to identify unreported cases and to monitor drug resistance.

Approximate Costs: To achieve the goal of improving laboratory capacity in Baja California to handle diagnostic testing for the state's 1100-1200 annual TB cases, resources are needed for laboratory space and equipment, testing supplies and reagents, technicians and training. Tijuana General Hospital already possesses a Bactec MGIT 960 system (valued at $78,000) for conducting drug susceptibility testing. Purchasing a second system for Mexicali would allow samples from both cities and the outlying communities that feed into them to be tested efficiently. All AFB(+) sputum samples should be sent to the TGH laboratory for TB cultures ($2/each),

identification of *M. tuberculosis* complex by GenProbe Amplicor method ($12/each) or other method to rule out growth of non-*Mtb* bacterium, and first line DST by MGIT ($88/each). The annual supply cost to culture, identify and test all isolates for drug susceptibility in Baja California are estimated to be $112,200-$122,400. Three full time laboratory technicians (USD <$10,000/year each) will be needed to conduct the testing. Training of laboratory staff and physicians through continuing education courses and certification of laboratory facilities will significantly enhance capacity and acceptability of universal testing. Electronic data management systems that link providers with laboratories will facilitate rapid transmittal of laboratory results and enhance surveillance capabilities. Through a grant funded by USAID (15), Tijuana General Hospital was the first laboratory in Mexico equipped to conduct QuantiFERON TB Gold testing (valued at $10,589). QuantiFERON testing can be added to contact tracing and screening of high risk populations (e.g., health care workers, institutionalized persons, and substance abusers) for the cost of reagents and technician time (approximately $30/sample).

Recommendations:

- Improve detection of active TB through routine TB screening by supplementing the current standard acid fast bacilli (AFB) smear microscopy with specimen concentration, fluorescence microscopy and TB culture.

- Expedite the introduction of drug susceptibility testing (DST) throughout Tijuana and Baja California with the ultimate goal of making DST routinely available to all local hospitals and clinics in the public and private sector. To facilitate this process, laboratories should utilize existing and evolving technologies rather than imposing strict criteria on tests to be used.

- Remove barriers to treating latent TB infection for contacts and high-risk groups by using assays that are insensitive to BCG vaccination, such as interferon gamma release assays (i.e., QuantiFERON TB Gold or T.Spot TB), to detect candidates for treatment. Prioritization should include high risk groups (e.g., diabetics, HIV co-infection) and contacts of recently diagnosed active TB cases.

- Introduce laboratory-based reporting to enhance TB surveillance.

References:

1. Jasmer RM, Nahid P, Hopewell PC. Latent Tuberculosis Infection. *N Engl J Me*d 2002,347:1860-1866.
2. Lalvani A. Diagnosing tuberculosis infection in the 21st century - New tools to tackle an old enemy. *Chest* 2007,131:1898-1906.
3. Dinnes J, Deeks J, Kunst H, Gibson A, Cummins E, Waugh N, et al. A systematic review of rapid diagnostic tests for the detection of tuberculosis infection. *Health Technol Assess* 2007,11:1-+.
4. Pai M, Riley LW, Colford JM. Interferonn assays-gamma in the immunodiagnosis of tuberculosis: a systematic review. *Lancet Infectious Disease*s 2004,4:761-776
5. Menzies D, Pai M, Comstock G. Meta-analysis: New tests for the diagnosis of latent tuberculosis infection: Areas of uncertainty and recommendations for research. *Ann Intern Med* 2007,146:340-354.
6. Morgan, M. A., C. D. Horstmeier, D. R. DeYoung, and G. D. Robers. Comparison of a radiometric method (BACTEC) and conventional culture media for recovery of mycobacteria from smear-negative specimens. J. Clin. Microbial. 1983;18:384-388.
7. Ichiyama, S., K. Shimokata, J. Takeuchi, and the AMR Group. Comparative study of a biphasic culture system (Roche MB check system) with a conventional egg medium for recovery of mycobacteria. Tuberc. Lung Dis. 1993;74:338-341.
8. Yeager, H. J., Jr., J. Lacy, L. Smith, and C. LeMaistre. Quantitative studies of mycobacterial populations in sputum and saliva. Am. Rev. Respir. Dis. 1967;95:998-1004.
9. SDS. Modificación a la Norma Oficial Mexicana NOM-006-SSA2-1993, Para la prevención y control de la tuberculosis en la atención primaria a la salud. http://www.salud.gob.mx/unidades/cdi/nom/m006ssa23.html. Accessed January 21, 2008.
10. SINAVE Plataforma Única de Información Módulo Tuberculosis 2007
11. Rodwell TC, Moore M, Moser KS, Brodine SK, Strathdee SA. Tuberculosis from Mycobacterium bovis in binational communities, United States. Emerging infectious diseases. 2008;14(6):909-16.
12. Lambert L, Rajbhandary S, Qualls N, et.al. Costs of Implementing and Maintaining a Tuberculin Skin Test Program in Hospitals and Health Departments. Infect Control Hosp Epidemiol. 2003; 24: 814-820.
13. Nienhaus A, Schablon A, Le Bâcle C, Siano B, Diel R. Evaluation of the interferon-release assay in healthcare workers. Int Arch Occup Environ Health 2007; Jun 29; (Epub ahead of print).
14. American Thoracic Society. Diagnostic Standards and Classification of Tuberculosis in Adults and Children. Crit Care Med. 2000;161:1376-l 395.
15. Garfein RS. Screening and diagnosis for TB among populations at risk for HIV infection in Tijuana, Mexico. *12th Annual Meeting of the International Union Against Tuberculosis and Lung Disease-North American Region*. San Diego, CA, February 28-March 1 2008.

b. Tuberculosis Case Management

i. Patient Management and Directly Observed Therapy

Background: After the diagnosis of TB is made, the next step is to assure that each patient receives an appropriate course of treatment. A patient registry will be crucial to successfully treating and following patients. The correct medications must be used, in the correct dose, for the correct number of months, and adherence and side effect monitoring procedures need to be in place. Failure of any of these elements increases the risk of treatment failure, relapse and emergence of drug resistance.

Mexico follows WHO guidelines for TB treatment. Patients are treated with two months of DOT-BAL (a combination preparation of INH, rifampin, ethambutol, pyrazinamide) followed by four months of DOT-BAL-S (a combination preparation of INH and rifampin). Because most people find it difficult to adhere to a prolonged and exacting treatment course, the WHO, the US CDC, and the Mexican NTP all endorse directly observed therapy (DOT) for TB patients. However, in Baja California, as elsewhere in Mexico, the allocation of resources to assure that DOT services are adequate is left to local jurisdictions. Because of competing priorities, jurisdictions often find it challenging to create and maintain well-functioning DOT programs. Furthermore, because of resource limitations these services often can only reach more stable, easy to manage patients, leaving the most challenging patients inadequately served. Baja California has over 1000 active TB patients diagnosed each year. Despite an excellent system of decentralized health care and a history of using promotores (community health workers) to attend to community health needs, currently available resources cannot fully realize the DOT strategy in Baja California at this time.

Strict DOT may be used in some cases, but medications are more often issued in weekly or longer intervals based on provider assessment of patient reliability, specific barriers to DOT (e.g., need to return to work, distance from health center, unaccounted costs of TB treatment etc.), and resources (1). Therefore, many TB patients are on de facto self-administered treatment (SAT).

For patients who fail treatment (i.e., remain smear positive) or relapse, standardized re-treatment regimens are recommended in accordance with WHO guidelines. Often, however, re-treatment drugs are not readily available and patients may be temporized with partial regimens. The regimens are empiric, thus re-treatment may magnify drug resistance in some cases. Moreover, the practice of allowing SAT extends to re-treatment patients.

Patient monitoring, to minimize side effects and prevent serious adverse reactions, reduces the likelihood of patient abandonment and increases overall success of treatment. However, some monitoring tests (e.g., thyroid-stimulating hormone testing, vision screening, etc.) are not covered under current Mexican norms and so are not readily available to patients.

Needs: Assurance of strict DOT for all patients with TB is needed. The system needs to be patient-centered with enough flexibility to allow access. Centralized and decentralized strategies can be developed. Treatment support should include assistance with housing, food, and similar needs when required to maintain patient adherence.

Drug susceptibility testing (DST) and base line tests should be built into the standard diagnostic workup, to assure the best regimen can be selected the first time a

Varying Patient Experiences with TB Treatment

Patient One

- First diagnosis in 2000 with TB; Treatment through SAT with 1st line drugs; "Cured"
- Second diagnosis in 2006 with TB; Treated as new TB infection through SAT with 1st line drugs; Treatment failure
- Third diagnosis in 2007 with MDR-TB; Treatment through DOT with 2nd line drugs through Puentes de Esperanza program; Continues on treatment

Patient Two

- First (incorrect) diagnosis in early April 2009 with a lung condition; Treatment with antibiotics for 2 weeks; Treatment failure
- Second (incorrect) diagnosis in late April 2009 with pneumonia; Treatment with antibiotics and injections for 2 weeks; Treatment failure
- Third diagnosis in May 2009 with TB; Treatment through SAT with 1st line (improper) drugs; No improvement
- Fourth diagnosis pending drug susceptibility testing in August 2009; New treatment regimen through DOT with 1st line drugs; Continues on treatment

Patient Three

- First diagnosis with a lung condition in April 2009; Treatment through SAT with unknown drugs; abandoned treatment
- Second diagnosis with MDR-TB in May 2009; Treatment through DOT; Abandoned program in August 2009

Patient Four

- First diagnosis with TB in August 2004; Treatment through SAT with 1st line drugs; Treatment intolerance and failure
- Second diagnosis with MDR-TB in March 2006; Treatment through DOT with 2nd line drugs; Treatment failure followed by no treatment due to pregnancy
- Third diagnosis with MDR-TB in May 2009; Treatment through Puentes de Esperanza DOT program with 2nd line drugs; Continues on treatment

patient is treated. At a minimum, treatment failure and relapse should require DSTs prior to initiation of a second course of treatment. Monthly monitoring schedules, attendance to infection control and routine laboratory testing should be added to standard policies to provide guidance to treating physicians and to enhance access to recommended monitoring tools. Training for providers and support personnel should be developed to reinforce treatment standards and expectations. The Global STOP -TB Partnership's Standards of Care and Patient Rights documents should be folded into patient care and provider training initiatives.

Approach: DOT strategies should be created that are specific to the geography, social norms, patient demographics, and institutional structures that exist in Baja California. Supervision, training and support of DOT and infection control staff are critical as they are a vital link to understanding the barriers confronting patients. Written inter-institutional agreements to cooperate in DOT coverage and resource sharing could be an

important strategic element.

Employers can support DOT-in-the-workplace for employees who are returning to work, thereby augmenting the jurisdictional DOT service network and improving access for workers. Partnerships between IMSS (which currently provides DOT for its patients), private sector, ISESALUD health centers and others health institutions can be forged to offer DOT at the closest health center to the patient's work or residence. Investment in transportation for health workers could expand outreach capacity by enabling one promotora to serve 15 or more patients per day (especially in central urban regions). Cell phone technology and the internet can be used which would allow DOT workers to observe patients taking their medications without on-site observation generating significant savings in terms of transportation and staff salary costs.

A strategy suggested by the Global Stop TB Partnership is to establish, for each geographical area, a group of TB specialists who can review and strengthen policies, assist in training and provide consultation for individual patients. Review of non-standard treatment regimens should be accomplished by an inter-institutional group to identify repeated problems in patient management and to develop and implement corrective strategies. Baja California currently has such a group, the State Committee for Drug Resistance (COEFAR), which should be supported and used as a model for other regions of Mexico.

Benefits: TB patients often fail treatment and develop drug resistance, because they cannot adhere to their DOT schedules. In addition, government entities are often unable to accommodate the work schedules of the TB patients that they serve, and therefore, do not require strict DOT for employed TB patients. Thus, patients may abandon or take partial therapy, creating circumstances where drug resistant TB strains may flourish. Expanded access to DOT will likely increase patient adherence to medications and decrease the development of drug resistance. Within the workplace, businesses are likely to have patients with TB who return partially treated and who become infectious again in the workplace. Businesses may currently lose workers who must choose between getting their DOT and returning to work. By implementing DOT at the worksite, businesses can avoid these situations.

DOT Program has Benefits that Extend Beyond Curing TB

While sick with MDR-TB and receiving DOT every day at his home from a community health worker (promotora), a patient who formerly worked as a doctor said he formed strong “links of friendship” with the person who gave him his daily TB medicine. So strong was the link that he viewed his promotora as a true “angel” and the program, Puentes de Esperanza, which is one of the only programs in Mexico that provides treatment for MDR-TB, his “savior”. He said, “You cannot imagine the gratitude you have when someone returns your life to you”. After months of treatment, testing negative and release by his doctor, he now volunteers as a community health worker for Puentes de Esperanza and has become an angel to other patients in his same situation.

Recommendations:

- Provide strict DOT for all new pulmonary TB patients. In areas where this is not being routinely accomplished, stakeholders including providers, administrators, employers, patients and nurses should be convened to develop and implement DOT pilot initiatives (e.g., workplace DOT, virtual DOT, inter-institutional agreements, home-based DOT).

- Ensure repeat sputum samples to confirm conversion to smear negative status, and response to therapy.

- Initiate policies for patients who relapse or fail TB treatment such that review and oversight of retreatment regimens is performed by experts in drug resistant TB.

- Training in TB surveillance and management should be implemented for three key populations: 1) first and second level providers to assure new TB patients are reported and managed in accordance with approved standards; 2) case management/DOT staff to assure quality outreach services and infection control practices; and 3) patients and family members to engage them as participants in successful treatment and to limit ongoing community transmission.

References:

1. Guzmán-Montes, GY., Ovalles, RH., Laniado-Laborín, R. (2009). Indirect patient expenses for antituberculosis treatment in Tijuana, Mexico: is treatment really free? The Journal of Infection in Developing Countries, 3 (10):778-782.

ii. Medication Supply

Background: An uninterrupted supply of first and second line drugs is critical to successful TB case management and control. Ad hoc regimens are used when the medications for standard regimens are not available and may lead to poor outcomes, including drug resistance and relapse. Availability of TB medications in pharmacies, when they can be obtained without prescription, is also a factor in poor outcomes.

First line medications are generally available in Baja California. However, because combination preparations are the official formulations, it can be difficult to get individual first-line medications when needed for individualized patient management. Standard re-treatment regimens for patients with treatment failure and relapse follow WHO standards, with a four drug regimen of PZA-ofloxacin-prothionamide-amikacin or kanamycin. The current process for obtaining these medications requires submitting treatment history documents and a specimen for first-line DSTs to Mexico City and awaiting a national-level decision on whether the patient is accepted. This process can take over six months and patients are not always approved. This situation leads to ad hoc regimens being used instead of or while awaiting approval from Mexico City.

Needs: Providers need a rapid and acceptable process for securing complete and appropriate medications for their patients who have failed a previous treatment course. Re-treatment regimens should be guided by DSTs to avoid unintentional magnification of drug resistance. Policies have to be created and implemented to assure that appropriate drugs and dosage schedules, and appropriate delivery methods, are available for every patient.

Approach: Second-line drug regimens are available from several sources and the Mexican National Program is currently updating treatment standards for re-treatment cases. These standards should be reviewed by local physicians who use any second-line drugs for treating TB patients. All re-treatment cases should be reviewed by the Baja California COEFAR in a timely manner to obtain a consensus on the appropriate treatment regimen. In addition, the need for individual first-line medications should be assessed by the state TB program, to develop strategies for supplying these when needed.

A model for local receipt of Green Light Committee-approved second line drugs is in place in Baja California. The Green Light Committee reviews applications from DOTS-Plus pilot projects and determines their eligibility for receiving low-priced second line drugs. To assure that future shipments of these medications will continue, Baja California's health sector needs to develop an internal oversight system to assure all aspects of patient selection, diagnosis, and medication use are strictly controlled and monitored.

Benefits: Expanded access to and consistent supply of first and second line TB drugs will help ensure that patients are treated with the proper drug regimens, which reduces the chance for the development of drug resistance and improves patient outcomes.

Recommendations:

- Assure that the cost to patients of laboratory tests, such as repeat TB smear microscopy, imaging studies and monitoring of medications, do not contribute to abandonment of TB therapy.

- Devise a mechanism for charitable organizations to contribute to the TB drug supply chain, further ensuring an ample supply.

c. Tuberculosis Prevention

i. Health Education

Background: There remains a great deal of misinformation about TB among the general public. This misinformation causes undue anxiety and fear for individuals when confronted with someone who has a TB diagnosis and often places the patient in a position of shame and ostracism. Fear of such stigma, whether perceived or real, leads patients to hide their diagnosis potentially complicating treatment adherence and contact tracing efforts. It may also prevent infected persons from seeking care, thus prolonging the period of infectiousness. The facts about TB, when well communicated, can change perceptions, leading to cooperation and support in the control of TB at many levels; patient, provider, family, workplace, and community.

Needs: Education to explain, de-stigmatize, and motivate is needed at all levels. For example, primary providers need to recognize TB, understand pitfalls in treatment, and know when and how to refer. Patients need to understand their disease, transmission, treatment, and their responsibilities and rights as a person with this illness. The public, family, and workmates need information to alleviate fear and allow for acceptance and support of the TB patient.

Approach: Various sectors should identify the populations that they need to educate. Goals, programs and evaluations should be developed for each initiative. The private sector is ideally positioned to develop pilot approaches to educating the general public, and can work with subject matter experts to create public and/or worksite campaigns.

Benefits: An aware public and workforce will become advocates for their own health and that of others. Employees who have TB will feel able to notify employers in order to test and/or inform their co-workers. Employees could return to work earlier and with less stress if supported and welcomed back to the worksite because employers and co-workers will understand how the disease is and is not transmitted. Employees can adhere to DOT easier because they would not feel the need to hide their medications or promotora visits from others.

Concern about Stigma, Discrimination & Confidentiality in the Workplace

A resident of San Diego for over 30 years and TB patient expressed differences in attitudes surrounding tuberculosis depending on which side of the border he was on. In Tijuana, he feels as if "people treat you the same no matter what", whereas he was unsure of how he would be treated upon returning to work in San Diego. He said, "Once I go back to work, I will be able to tell you more about discrimination." Though he did say that his employer, coworkers and customers have been extremely supportive of him during his illness, he also mentioned that someone at work had been spreading rumors about his condition and not adhering to confidentiality policies. Educating employees and managers about TB fosters understanding and can eliminate the fear of returning to work after a serious illness. In addition, strict workplace policies can be put in place to protect employee privacy.

The Value of Tuberculosis Education

Even though her husband had been recently diagnosed, treated and cured of a TB infection, 36 year old Maria did not know what TB was, how it was transmitted or how to prevent it - until she herself was diagnosed for the first time in 2004. After multiple treatment failures, relapses and painful symptoms, she was diagnosed with MDR-TB, a type of TB she did not even know existed. Now, after years of dealing with the illness, she can list the full names of all the drugs that she takes, various methods of prevention and can even explain what MDR-TB is. Had she been equipped with this knowledge beforehand, Maria may have been able to avert a debilitating and costly 5 years with the disease.

Another patient, Pedro, had already been on treatment for his TB disease for 2 months. He was still concerned that TB could be sexually transmitted, could not name any of his current medications, and did not know whether he was currently positive or negative for TB. There is a need to make sure TB patients fully understand their condition, giving them more control and responsibility for the prevention of the spread of disease and for their own successful recovery.

Renewed Dedication to Tuberculosis Education

One TB patient said that the Mexican government makes tuberculosis seem like it is "distant and unlikely" - downplaying the disease and foregoing important education about symptoms and methods of prevention. In December 2008, he says, this began to change for the better. The Mexican government has begun to take TB more seriously and now runs radio and television campaigns to educate the general public about TB. To strengthen this commitment, businesses can also pledge to make sure their workforce knows the facts about TB.

Recommendations:

- Launch a mass media campaign to educate the public regarding TB, with an emphasis on reducing stigma, encouraging early detection, limited period of contagiousness, and awareness of the availability of curative medications.
- Implement a pilot program within a Mexican private or government business that would conduct a KAP survey (Knowledge, Attitudes, Practices) from which draft health education materials could be developed and tested. Ultimately finalized materials could be incorporated into existing occupational health programs at the business sites.
- Explore possible ways for Mexican workers to receive full salary versus partial salary compensation on completion of successful TB therapy.

ii. Contact Tracing

Background: Each patient with pulmonary TB is estimated to infect at least 10 people depending on the duration and extent of their disease. In many countries, investigation of those who have been exposed is limited to finding secondary cases in the home, rather than screening and treating for latent

infection. As in most TB endemic regions, Mexico adheres to WHO guidelines that emphasize detection and treatment of active TB as the primary means of controlling further spread of TB. However, in order to accelerate the decline, the Stop TB Partnership now recommends preventive strategies such as prophylactic treatment of LTBI among HIV-infected persons. Testing and treating high risk contacts to infectious cases should be considered a standard prevention strategy where resources are available.

Needs: There is a need for systematic procedures to perform expeditious contact tracing with every infectious case of active pulmonary TB identified, to include testing for latent infection among those at higher risk of developing disease and appropriate therapy. This includes cross-border communication between health departments for notification of potential exposures because of patients who work, live, or travel on both sides of the border.

Approach: Policies and operational procedures for contact tracing should be reviewed in light of new, more specific diagnostic tests for latent TB infection. High risk contacts can be identified as priorities for targeted screening and treatment, such as children, immune-compromised, and those exposed to MDR disease. Case management should be expanded to assure review of the high risk contacts, with strategies developed to enhance LTBI treatment. Exposures within worksites can be similarly prioritized (health care settings, shelters, daycare, etc.) and pilot projects to have employers assist with worksite testing and treatment can be initiated.

Benefits: Recently infected individuals, such as the contacts from active cases, are most likely to develop active disease within the first year of infection - making this a cost-effective approach.

iii. Prophylaxis

Background: Up to 95% of healthy individuals who inhale TB and are infected will control the infection and have 'latent' or quiescent TB infection (LTBI). Ten percent will activate to disease over a lifetime, or more, if there is any underlying illness such as diabetes or HIV infection. Treatment of latent infection is a cornerstone to preventing the activation of TB disease in order to minimize the risk of spread of TB to others. In the United States, an estimated 9.6 to 14.9 million people are infected with latent TB (1). The number of people in Mexico living with LTBI is currently unknown, but a recent study in rural San Quintín, Baja California, showed that approximately 30% of the population was infected, and in the high risk group of injection drug users in Tijuana, Mexico, 67% had LTBI (2). Additionally, a TST study in Tijuana found a 57% prevalence of positive reactors in children, 46% of whom had never received the BCG vaccination (3).

Latent infection can be diagnosed through tuberculin skin testing (TST), however in countries where the BCG vaccine is used, such as Mexico, this test is not as reliable. The new QuantiFERON Gold TB test can accurately detect latent TB, even in individuals who have received the BCG vaccine. The CDC recommends that all latent TB infections are treated with the standard therapy of isoniazid for 9 months, under a directly observed therapy (DOTS) program to ensure treatment adherence and completion. Clinical trials have shown a 90% efficacy in persons compliant with INH standard therapy. Latent TB infection should only be treated if active TB disease is ruled out.

Needs: Latent TB is not routinely tested for in Tijuana. There is a need to target high risk groups such as those infected with HIV, injection drug users and those with diabetes for detection of latent TB.

Approach: High risk populations should be tested for latent TB infection. To detect latent TB, the TST should be performed, even if individuals have previously had a BCG vaccination (4). QuantiFERON testing could also be performed on high risk groups. Once latent infection is determined and active disease excluded, standard 9 month INH therapy should be administered through a DOTS program. In order to more effectively treat TB infection, the necessary lab equipment, reagents, supplies and drugs should be available and appropriately trained personnel should be a consistent component of Mexico's TB prevention and control program.

Benefits: A focused effort on detection and targeted treatment of latent TB with INH therapy prevents TB from progressing to active disease, and proves much more cost effective than complicated multi-drug regimens required to treat active disease.

Recommendations:

- Detection and treatment of latent TB infections in groups at high risk of progression to active disease.

- Conduct a pilot program within a business, such as a large maquiladora, to perform QuantiFERON screening for latent TB with a pilot TB prophylaxis program for employees identified as TB infected who are at high risk of progressing to active disease (e.g., diabetes).

References:

1. American Thoracic Society/Centers for Disease Control and Prevention/ Infectious Diseases Society of America. Controlling tuberculosis in the United States. American Journal of Respiratory and Critical Care Medicine. 2005: 172: 1169-1227.
2. Garfein, R. S., Lozada, R., Liu, L., Laniado-Laborin, R., Rodwell, T. C., Deiss, R., et al. (2009). High prevalence of latent tuberculosis infection among injection drug users in Tijuana, Mexico. The International Journal of Tuberculosis and Lung Disease: The Official Journal of the International Union Against Tuberculosis and Lung Disease, 13(5), 626-632.
3. Laniado-Laborín, R., Cabrales-Vargas, N., López-Espinoza, G., Lepe-Zuñiga, J.L., Quiñónez-Moreno, S., Rico-Vargas, C.E. (1998). Prevalencia de infección tuberculosa en escolares de la ciudad de Tijuana, México. Salud Publica de México, 40(1).
4. American Thoracic Society, Centers for Disease Control and Prevention. Targeted tuberculin testing and treatment of latent tuberculosis infection. Am J Respir Crit Care Med. 2000;161(4 pt 2):S221-S247.

d. Infection Control

Background: It is estimated that approximately 60% of patients in Mexico, similar to other countries, with active TB disease are hospitalized (1). As TB is an airborne pathogen and infection is possible with inhalation of as few as 1 organism, the closed spaces of hospital rooms and wards place health care workers (HCW's), visitors and other hospital patients at high risk for acquiring TB. Medical procedures such as cough inducement or contaminated medical equipment such as bronchoscopes also increase exposure. Often these patients present with advanced disease that is highly infectious exposing hospital workers in the emergency room, before the diagnosis is suspected or confirmed. With more subtle disease, diagnosis may be delayed for days and occur during their hospital stay, when they are on a general medicine or pediatric ward. In fact, this risk often begins in the outpatient clinics as patients present with respiratory symptoms, frequently with multiple visits before the diagnosis of TB is finally made.

Microscopic examination of sputum smears is usually the first and fastest test performed to detect the presence and quantity of acid fast bacilli (AFB) which may indicate TB disease which can then be confirmed by culture. The American Thoracic Society (ATS) and the CDC defines a positive AFB sputum smear result as an indication of increased risk for infectiousness and recommends 3 consecutive sputum smears negative for AFB before the patient can be released from respiratory isolation (either in a healthcare facility or at home) (2). It is estimated that after 2 months of standard treatment for TB, 80% of patients have negative sputum cultures and after 3 months, 90 - 95% will have negative test results (3). One study found that the average time for a patient to convert from smear positive to smear negative was 33 days (median: 23 days) (4). These figures illustrate that a patient with TB is on average, infectious for one month, that 20% of patients remain infectious after 2 months of therapy and between 5-10% remain infectious after 3 months of therapy.

If the patient still has positive cultures after 3 months of standard treatment, the ATS and the CDC recommend performing drug susceptibility testing, and after 4 months of treatment, positive sputum cultures indicate treatment failure (3). At this point, MDR-TB or XDR-TB are suspect. In patients with MDR or XDR disease, the period of infectiousness is extended even longer than for TB patients without drug resistance. One study found that on average, MDR-TB patients have sputum smear conversion at 69 days and culture conversion at 81 days (5). The same study found even longer conversion periods in XDR-TB patients: 130 and 181 days respectively. This translates into MDR-TB patients remaining infectious for approximately 2 to 3 months and XDR-TB patients remaining infectious for 4 to 6 months.

It takes a minimum of 6 to 8 weeks before a HCW can return to work after being diagnosed with TB, which is a loss of a valuable resource.

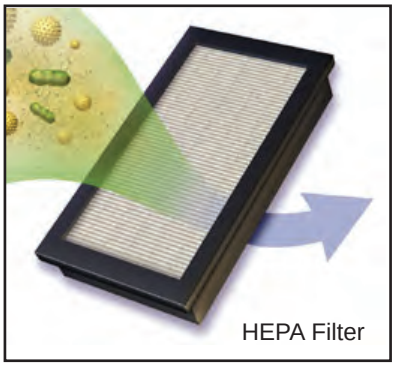
Transmission of TB in clinics and hospitals has been documented through studies in multiple countries. In Tijuana specifically, a well conducted study at a major hospital over a 4 year period concluded that HCWs were 11 times more likely to be infected than the general population in Tijuana. Disease occurred most commonly in physicians in training, followed by physicians, and then nurses (6). As this study focused on persons who developed active disease; the incidence of acquiring latent infection would be substantially higher. A recent study of an outbreak of TB among

HCW's in a Tijuana hospital detected latent TB infection in 33 HCW's, only 2 of which completed the 4 months recommended treatment with rifampin (7). A HCW with active TB is of particular concern as HCW's may also have delayed diagnosis, with possible transmission to hospitalized patients and outpatients. Also, once a HCW is diagnosed there is a minimum of 6 to 8 weeks before the HCW can return to work, which is loss of a valuable resource.

Infection control is also a major problem outside of hospital settings. Patients and their families have very limited knowledge about how TB is spread and so are not aware of how to prevent transmission in their home or during daily activities. Wearing a mask, limiting excursions, staying off work, and minimizing contact to vulnerable persons is not routinely done due to lack of information and practical means to adhere to these practices.

Mexican providers also have limited access to effective infection control means in outpatient settings. Clinics where TB patients come for monthly visits and for supervised therapy are not engineered for protection of workers against airborne illnesses. Workers who provide in-home DOT are not provided masks and are not trained on infection control. Therefore, there is concern among health care workers regarding their personal risk. This anxiety causes providers to limit interaction with TB patients, which in turn makes patients feel stigmatized about their condition.

Infection control guidelines exist to prevent hospital borne transmission of TB and effectively protect HCW's, patients and visitors (2, 8). These guidelines involve specifically outlined administrative, environmental and respiratory-protection controls which include: 1) development of a written TB infection-control plan and assigning infection-control responsibilities, 2) proper handling and sterilization of contaminated equipment, 3) HCW training, education and screening, 4) prompt medical assessment and screening of patients for cough and suspected TB, 5) putting patients with suspected or confirmed TB in airborne infection isolation (AII) rooms, 6) utilizing local and general ventilation, 7)



use of HEPA (high efficiency particulate air) filtration or UVGI (ultraviolet germicidal irradiation) for contamination prevention, and 8) training and use of proper respiratory hygiene and personal protective equipment such as N95 respiratory masks.
With emergence of XDR-TB outbreaks primarily linked to clinic and hospital transmission, there is renewed urgency to both evaluate the efficacy of TB infection control procedures and initiate wider implementation of infection control programs, applying tailored methodologies. For instance, in countries with high rates of TB, this would include aggressive screening of possible active TB cases in crowded waiting rooms with a short list of questions.

Since patients with HIV infection are more prone to transmitting and becoming infected with TB, special attention should be given to HIV clinics where patients may expose each other in waiting areas.

Needs: According to the current Tijuana Tuberculosis Coordinator, there are currently 5 inpatient facilities and 35 outpatient facilities spread throughout Tijuana which treat and manage TB. Of the 5 that treat inpatients, two are IMSS (Social Security) facilities which serve the general working population, 2 are ISSSTE (Social Security for government workers) facilities which serve government workers, and 1 is the SSA (Secretary of Health) general hospital which serves the unemployed and workers in the informal sector. Of the outpatient facilities, 26 are SSA centers, 5 are IMSS facilities, 2 are ISSSTE facilities and one is a Municipal medical center. The vast majority of TB patients, approximately 70%, are seen by SSA facilities at the primary care level.


N95 Respirator

An Inside Look at Infection Control

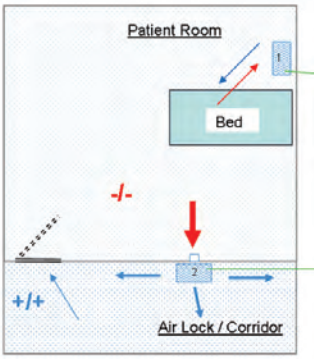
In his office at Tijuana General Hospital where he volunteers, a 47 year old doctor has an N95 mask sitting next to his computer. He has MDR-TB and believes he originally acquired his infection by contact with his urgent care patients back when he was a practicing physician. In his opinion, sufficient training, protection and adherence to existing TB control protocols are not standard practice in Mexico. Although he says that Tijuana General Hospital has UV lights and ventilation to protect against TB, he fears it is not enough for only select hospitals to take infection control precautions. Imagining an ideal Mexico, he says he would like to see all secondary and tertiary care facilities with strong TB infection control training and protection for healthcare workers. After becoming infected with TB, he now wears an N95 mask whenever he enters a hospital and whenever he visits a patient.

Infection control measures for TB are not operational within the government hospitals and clinics managing TB in the Tijuana region. The absence of infection control guidelines was scheduled to be addressed in October 2009 by a USAID funded initiative. Also lacking is the provision of personal protective gear for health care workers (N95 respirators or equivalent); screening policies to identify suspect patients with active TB in high risk clinics and hospital departments; increased ventilation and air purification through HEPA filters and ultraviolet germicidal irradiation (UVGI); regular maintenance of installed devices and equipment; a minimum of 1 AII room for each

of the 5 hospitals; infection control education for health care workers, including those at correctional facilities. Implementation of these new guidelines will be highly dependent on the availability of funding.

Approach: Development of Infection Control guidelines is currently underway. Health sectors should identify the infection control settings that need to be addressed. Goals, risk assessments, implementation steps and evaluations should be developed for each setting.

In hospitals, isolation rooms are warranted for all suspect and confirmed active cases. A variety of designs can be used, but each must be developed and maintained according to environmental hygiene standards. Screening policies to identify potential infectious patients need to be put in place and personal protective gear for health care workers needs to be available and enforced. Outpatient settings should be structured to minimize risk to practitioner, as well as other patients.



Unit 1

Unit 2

AII Isolation Room Plan

TB patients need clear information and instructions, as well as the tools to keep themselves from transmitting disease to others while infectious. This can be done through better dissemination of ISESALUD patient education materials and provider training. The private sector can assist by supporting capital investments for inpatient and outpatient facilities, and can promote safe practices (such as “cough” precautions) in work settings, and can support public information campaigns.

Benefits: Preventing the spread of TB in health care settings protects workers, visitors and other patients. This is particularly important for patients with HIV who are at significantly increased risk of developing active TB following exposure to the bacterium. Screening in correctional facilities provides an opportunity to identify and potentially treat individuals with pulmonary TB before they are released back into the community. Promoting safe practices in the community, and especially in the workplace, can improve the health of the workforce.

Approximate Costs: Costs would include renovations to provide a minimum of 1 AII room at each of the 5 hospitals with providing TB inpatient care. Expansion of respiratory isolation rooms can be achieved through installation of UVGI devices in a few select rooms of the adult and pediatric wards within the 5 inpatient facilities. This would cost a minimum of $5,000 per device. More sophisticated equipment can cost up to $125,000, however the lower cost models have been shown to be effective. The addition of HEPA filter air purifiers for inpatient respiratory isolation rooms would cost an additional $300 - $500 per unit. Personal protective gear (N95 respirators) should be provided for HCWs managing suspected and confirmed cases of TB at a ll 35 of the outpatient facilities and the 5 hospitals, with each mask costing approximately $1.25 per mask. Training for HCWs would vary in cost, dependent on intensity and modality. On-line curriculums are available and trainings could also be incorporated into required medical in-services.

References:

1. Institute of Medicine (U.S.). Committee on the Elimination of Tuberculosis in the United States, & Geiter, L. (2000). Ending neglect : The elimination of tuberculosis in the United States. Washington, D.C.: National Academy Press.
2. Jensen, P. A., Lambert, L. A., Iademarco, M. F., & Ridzon, R. (2005). Guidelines for preventing the transmission of mycobacterium tuberculosis in health-care settings, 2005. MMWR.Recommendations and Reports: Morbidity and Mortality Weekly Report.Recommendations and Reports / Centers for Disease Control, 54(-17), 1-141.
3. Blumberg, H. M., Burman, W. J., Chaisson, R. E., Daley, C. L., Etkind, S. C., Friedman, L. N., et al. (2003). American thoracic Society/Centers for disease control and Prevention/Infectious diseases society of america: Treatment of tuberculosis. American Journal of Respiratory and Critical Care Medicine, 167(4), 603-662.
4. Telzak, E. E., Fazal, B. A., Pollard, C. L., Turett, G. S., Justman, J. E., & Blum, S. (1997). Factors influencing time to sputum conversion among patients with smear-positive pulmonary tuberculosis. Clinical Infectious Diseases: An Official Publication of the Infectious Diseases Society of America, 25(3), 666-670.
5. Eker, B., Ortmann, J., Migliori, G. B., Sotgiu, G., Muetterlein, R., Centis, R., et al. (2008). Multidrug- and extensively drug-resistant tuberculosis, Germany. Emerging Infectious Diseases, 14(11), 1700-1706.
6. Laniado-Laborín, R., & Cabrales-Vargas, N. (2006). Tuberculosis in healthcare workers at a general hospital in Mexico. Infection Control and Hospital Epidemiology: The Official Journal of the Society of Hospital Epidemiologists of America, 27(5), 449-452.
7. Laniado-Laborín, R., & Navarro-Alvarez, S. (2007). Brote de tuberculosis en trabajadores de la salud en un Hospital General. Rev Inst Nal Enf Resp Mex, 20(3), 189-194.
8. Secretaria de Salud, Subsecretaria de Servicios de Salud, Dirección General de Medicina Preventiva. Para la prevención y control de la tuberculosis en la atención primaria a la salud. México City, México, Publicada en el Diario Oficial de la Federación, 1995. Publication Norma Oficial Mexicana NOM-006-SSA2-1993.

e. Surveillance

Background: Surveillance is one of the pillars of public health. It allows health officials, policy makers, and healthcare providers to assess the magnitude of the problem that a disease presents, monitor the effectiveness of interventions to reduce the incidence of the disease, detect outbreaks so that appropriate public health responses can be taken to bring he disease under control, and ideally to track progress toward elimination of the disease. Tuberculosis surveillance involves enumeration of TB cases that are diagnosed either clinically, via laboratory testing, or both. In 2001, Mexico instituted the Sistema Nacional de Vigilancia Epidemiológica (SINAVE), an internet-based national surveillance system that includes TB. Cases diagnosed in both public and private healthcare settings are eligible to be entered in the system. Through this system, healthcare providers and health officials can enter TB case reports, and depending on the level of authorization, users can generate reports at the level of the facility, institution, city, state, and country.

Based on data included in SINAVE from 2006-2007, there were 1,171 and 1,161 reported

Table 1

Total Pulmonary Tuberculosis Cases in Baja California and Tijuana by Year

	2006			2007		
	Baja California	Tijuana		Baja California	Tijuana	
	Total	n	%	Total	n	(%)
Registered Cases	1,171	614	(52.4)	1,161	650	(56.0)
Gender						
Male	797	419	(52.6)	799	446	(55.8)
Female	374	195	(52.1)	362	204	(56.4)
Age						
0-4	18	8	(44.4)	18	8	(44.4)
5-14	34	20	(58.8)	36	14	(38.9)
15-24	247	146	(59.1)	236	143	(60.6)
25-44	525	296	(56.4)	531	309	(58.2)
45-64	270	120	(44.4)	264	141	(53.4)
>65	77	24	(31.2)	76	35	(46.1)

SOURCE: SINAVE Plataforma Única de Información Módulo Tuberculosis, Jan-Dec 2006 and 2007.

Table 2

Total Reported Tuberculosis Cases by Institution in Tijuana, Baja California, Mexico, 2007

435	Secretary of Salud (SSA)
80	Mexican Institute of Social Security (IMSS)
1	Institute of Social Security and Services for State Workers (ISSSTE)
14	State Medical Service (SME)
64	Other*
594	**Total****

Source: Mexican Secretary of Health, Health Establishments Key (CLUES) http://clues.salud.gob.mx/
Source: SINAVE Plataforma Unica de Informacion Modulo Tuberculosis
* Includes 57 (89%) cases from State Penitentiary.
**Excludes Rosarito and Tecate.

cases of TB in Baja California, respectively (Table 1). Tijuana represented over half of the state's cases in both years (52% and 56%, respectively). Nearly two-thirds of the cases were male, but the proportion of male cases in Tijuana was similar to that of the state. The proportion of TB cases between 15-44 years old was greater for Tijuana than for the state as a whole. By far, the largest number of cases in 2007 was reported by ISESALUD (Table 2), which is not surprising given that this institution also supports the state's TB control program. IMSS reported he second largest number of cases. Notably, no cases were reported in SINAVE by any of the city's private medical service providers. The rate of TB cases in Baja California (40.5/100,000 pop.) is several times higher than in its neighboring state to the north (7.0/100,000 pop.); a scenario observed in all Mexico/US border states (see Figure 1, Chapter 1). However, the disparity between countries may be even greater because of underreporting in Mexico.

In Tijuana, underreporting within ISESALUD might occur in part because physicians from each clinic must complete a paper report and send it via currier to the TB Control Program located at the central ISESALUD clinic, where the data are entered by an epidemiologist into the SINAVE system. Reporting is encouraged by requiring the case reporting forms before ISESALUD will release TB medications provided free-of-charge by the National TB Control Program; however, this is a passive reporting system that relies on the diagnosing physicians to collect and report data about their patients. After the initial report is filed, physicians are supposed to track their patients' status and submit follow-up data to the TB Control Program, which is then entered into SINAVE. However, there is not fax or internet service available to send these forms electronically to the Program office. Thus, once a month, physicians are required to personally travel to the Program office and dictate their follow-up data to an epidemiologist who enters the data in the system. This process can take the physician away from their clinic for up to half a day each month. In the IMSS system in Tijuana, one provider at each facility is responsible for collecting TB case data and entering it into the SINAVE system and making a separate copy for the Tijuana TB Control Program. Most TB cases are seen in Family Medicine or Pulmonology clinics and tracked by the clinic's epidemiologist. However, patients who are seen in the emergency department can sometimes be missed by the epidemiologist. ISSSTECALI is a smaller system than IMSS, but follows a similar protocol for reporting TB cases to SINAVE.

Private providers rarely, if ever, report cases of TB to the jurisdictional or national TB control program, because their patients do not need publicly subsidized medication, reporting is time consuming and uncompensated, and providers risk losing patients. Typically, the only time a patient diagnosed in the private sector is counted in SINAVE is when the patient is referred to ISESALUD for TB care. The incidence of TB among patients who seek care in the private sector is likely to be lower than the general population; however, this is impossible to verify as long as private providers cannot easily include their cases in the system.

Needs:

- Although Mexico has a state-of-the-art, national TB surveillance system, the responsibility for entering cases varies across institutions. The TB Control Program in Tijuana encourages providers to report their TB cases by requiring providers to documenting each case before the patient is given free TB medications that are provided by the national TB Program.

- TB is not effectively diagnosed (see lab Needs), so only the most overtly infected

patients are detected.

- Patients are not effectively followed up to determine the outcome of treatment

- Reporting is time consuming, often involves duplicate effort, and is rarely used by private providers.

Approach: TB surveillance in Tijuana could be vastly enhanced by making a computer and internet access available in all ISESALUD hospitals and clinics in the city for use by physicians, epidemiologists, or administrative personnel to enter their TB case data directly into SINAVE. The TB Control Program epidemiologist could then actively monitor TB case reports in the system and follow up with physicians to be sure their data are complete and accurate. Education programs are needed to inform and encourage private providers to report their TB cases. Since each new TB case is likely to infect 10 of his/her contacts, contact tracing is a vital component of an effective TB control program. Thus, SINAVE can be used by the TB Control Program staff members to identify cases who should be interviewed and their contacts examined for TB infection.

Benefits: Complete surveillance data is essential for monitoring trends in TB cases at both the local and national level in order to inform policy, implement and evaluate TB control practices, and effectively allocate precious healthcare resources. High quality surveillance data can also be used to justify requests for additional resources in areas of greatest need. By enabling more healthcare providers to directly enter their data into SINAVE, end-users at all levels (clinic, institution, jurisdiction, state and national) will have faster access to more complete case reporting data. Furthermore, by decreasing the burden of data entry on Tijuana's TB Control Program staff, they will have more time to perform quality control checks of the data, follow-up with providers to ensure the fidelity of the data, analyze the data to identify trends in TB cases, and conduct contact tracing activities.

Approximate Costs: One-time costs would consist of purchasing computers for each clinic at a cost of approximately $1500 each. Ongoing costs include: internet access ($50/connection); salary support for an epidemiologist to monitor SINAVE data and a Disease Investigation Specialist to follow up with patients who have incomplete data and conduct contact tracing; ongoing training for physicians to ensure that they are consistently entering data for all of their TB cases.

Recommendations:

- Simplify the process of including TB cases in local and national (SINAVE) surveillance systems in Tijuana, with technologies such as electronic transfer of case information (e.g., email, fax, websites). This would require the placement of computers with internet access in all healthcare facilities that manage TB cases. The computers should be made available for multipurpose use to attain secondary benefits from their placement. Future funding would be used for systems analysis, equipment and training to enhance the existing systems.

- Improve methods for monitoring DOT initiation and completion through the existing surveillance system. Also, explore the feasibility and cost-effectiveness of novel technologies (e.g., wirelessly monitored pill dispensers) to facilitate and track DOT.

- Develop procedures and systems for sharing TB data between Mexico and the United States, such as public access to online epidemiological data.

References:

1. Schneider E, Laserson KF, Wells CD, Moore M. Tuberculosis along the United States-Mexico border, 1993-2001. Pan American Journal of Public Health. Jul 2004;16(1):23-34.

IV. *Role of Businesses in Tuberculosis Control*

Background: Cross border collaboration among critical public health authorities, academia and private business is essential for the development and implementation of an effective TB health education, diagnosis and treatment program in the San Diego-Tijuana region. Local businesses can and must contribute to solutions in TB control across the border region.

The San Diego-Tijuana border region is experiencing unparalleled bidirectional border crossings and growing cross border residences and businesses. As a result, addressing the spread of TB must involve partnership with local businesses on both sides of the border as the impacts to lost productivity and potential of infection to others in the workplace is great.

Sadly, many cases of TB go unreported early on so the risk of infection in the workplace remains an on-going challenge. With the increasing incidence of multi-drug resistant (MDR) TB, it is critical that TB in the border region be addressed by the business community before it becomes a crises situation similar to what countries in Asia and Africa are experiencing.

Needs: There have been several examples in recent years of TB cases in San Diego that have involved a broad spectrum of businesses including nurseries, biotech firms, manufacturers, nail salons, hotels and casinos. An increasing incidence of TB will have a growing negative impact on a broad spectrum of businesses on both sides of the border. Although there are a number of existing employer based TB programs in various parts of the world, there do not appear to be any programs that focus specifically on a border region.
Beyond the absence of workplace education programs, the issue of paid sick leave for employers needs to be actively considered. Today, nearly 40 percent of California's work force, totaling 5.4 million workers, do not

have the right to take paid time off work when they are sick, according to data from the Institute for Women's Policy Research, or IWPR, in Washington, D.C. (1).
Today neither the State of California nor the County of San Diego have paid sick workplace laws although legislation has been recently introduced at the State level and Federally making paid sick leave mandatory (2, 3). In the case of San Francisco, job growth in that city was higher than nearly every other county in the Bay Area following passage of this legislation. Accordingly such a public policy should be actively considered by the County of San Diego and supported by local chambers of commerce and other trade associations to not only to reduce the risk of TB but other airborne infectious diseases such as the H1NI virus. It is worth noting that in the case of the County of San Francisco, even prior opponents of the paid sick leave legislation changed their views on the issue. According to Kevin Westlye, director of the Golden Gate Restaurant Association, "Sick leave, especially for people who handle food for a living, is an important public policy (4)." While such legislation has proven controversial and has been opposed by small business interests, similar legislation should also be considered in the State of Baja California given the growing workplace risk of infectious disease in the region (5).

The vast majority of individuals that contract TB are employed and many times may be attending work for weeks prior to being diagnosed. TB tends to infect individuals in their most productive years and is the world's greatest infectious killer of women of reproductive age. The spread of TB can have a substantial negative financial impact on business due to lost employee days, disruption at the workplace due to contact tracing, additional costs for employee testing and treatment and a high level of anxiety amongst employees. In addition, especially in Mexican businesses, there is a disjointed path of TB care and treatment. Many large maquiladoras or assembly plants in Mexico employ physicians that may initiate treatment for the TB patient, but are then referred out to government operated health systems (IMSS) for treatment. It is not uncommon that treatment initiated by the company doctor is different from treatment given by IMSS (personal communication 2009). Often employees suspected of having TB will not seek medical care from IMSS because once diagnosed they are placed on disability and their pay is reduced to 60%. This provides an incentive to seek care from an alternate source such as ISESALUD or a

Infectious at Work?

Patient One: At least one week on the job as a tank cleaner in San Diego with symptoms of cough, weakness and fatigue.

Patient Two: Worked at a factory in Tijuana for three different periods that consisted of several months between multiple relapses of TB.

Patient Three: Immediately went to the doctor upon having symptoms of weakness, fever, cough and fatigue and did not return to work in Tijuana until released by his doctor to do so.

Patient Four: At least one month working as a bar manager in a San Diego hotel with symptoms of cough, fatigue and weakness.

private physician and continue to work and receive 100% pay. In addition, concerns about missing work and/or the stigma attached to being diagnosed with TB prevents adherence among many patients.

Furthermore, the different Mexican health organizations (IMSS, ISESALUD) are not required to report TB cases to the patient's employer nor to each other, which creates a large communication and information gap that hinders the management of TB. One private doctor employed by a manufacturing company in Tijuana explained that after she refers a patient/employee to IMSS, she is no longer responsible for the care, treatment or follow up of that patient/employee. Only on her own initiative is she able to determine the treatment regimen and care that the patient/employee is receiving through IMSS, but this is not required nor expected of company doctors (personal communication 2009). Also, when cases of TB are detected by the Mexican health system, contact investigations in the workplace are not common practice, and most only take place within the home sphere (personal communication 2009). This disconnect could lead to unknown cases of TB in the workplace and an unnecessarily exposed workforce.

Another obstacle to effective TB management and control in workers is the absence of directly observed therapy (DOT) in the workplace. Currently, TB patients in Mexico who have returned to work but are still receiving treatment cannot receive DOT at the workplace through the private company doctor. This means the employee must adjust his or her work schedule and potentially lose work hours due to the necessity of traveling away from the worksite to receive DOT. There are programs which do furnish medication and clinical oversight at the workplace, such as the diabetes programs, which suggests DOT may be feasible.

US Workers Cross the Border for Healthcare

Two US citizens, one a tank cleaner and the other a bar manager in San Diego, opted to seek medical care in Tijuana when they first had symptoms for TB. One chose to receive healthcare in Tijuana because he lacked health insurance through work and the other chose to receive healthcare in Tijuana precisely because he had health insurance through work - an innovative new type of insurance in fact, which covers cross-border care. However, both patients received an incorrect diagnosis and improper treatment from the private doctors they chose to see in Tijuana, prolonging their infectiousness with TB and complicating their eventual recovery. Once their TB disease was accurately diagnosed with cultures and drug susceptibility tests - two methods rarely done in Mexico - and once they were given the proper medications through a DOT program - rather than self administering their treatment - both patients began to successfully recover.

A business that makes the health of its employees a priority by offering health education and quality health insurance coverage, has the opportunity to play a part in earlier and more accurate TB diagnosis, avoiding weeks or possibly months of TB exposure to other employees, customers and the general public.

Approach: Businesses can be effective by supporting employees diagnosed with a communicable disease such as TB, by providing a workplace TB health education program for all employees, and by providing diagnosis at the workplace as well as on-site DOT and contact tracing. This will result in fewer obstacles for individuals to seek and

complete treatment and; therefore minimize the stigma of the disease. It is important for companies to consider developing nondiscrimination policies that can also help to de-stigmatize TB and other diseases.

Case studies have demonstrated that it makes good business sense for companies to take an active role in the health of their employees, and the workplace is often the best site for disease prevention and treatment programs. Business has significant influence as well as financial incentives to protect the health of their employees who become sick with TB. Employers can play a substantial role by:

- Providing workplace health education programs
- Developing fair policies on discrimination/workers rights
- Offering diagnosis and treatment (DOT) at the workplace, where feasible
- Reducing TB transmission to other employees and their families through contact tracing
- Assisting with the coordination/communication with IMSS or ISESALUD (in Mexico)

There are two organizations that have been identified that have successfully developed, implemented and evaluated employee based TB programs in various countries in Africa and Asia including the Global Business Coalition on HIV/AIDS, Tuberculosis and Malaria (GBC) and the World Economic Forum (6, 7). The GBC is a membership organization created in 2001 to allow large, for-profit international companies to share their expertise and resources to fight specific diseases including TB, HIV/AIDS and Malaria. The GBC builds public-private partnerships by bringing together companies and local non-governmental organizations (NGOs) to address pressing public health needs within the global communities in which the companies operate. The GBC has allowed member companies to utilize their business expertise to improve the public health of their employees and the community. It is especially imperative for a US company operating a business in a foreign country to demonstrate to the local government and community that the company is a responsible

A Factory with Potential to Combat TB

One Tijuana factory which employs 300 individuals between the ages of 20 and 35, is considered a “medium” sized factory. It currently has excellent Occupational and General Health programs in place, with a private physician who works onsite and who sees everything from tonsillitis to tuberculosis. Once a year, the physician coordinates a Health Week held during work hours which includes cholesterol testing, health education, vaccinations and dental cleanings, among other offerings, at no cost to the employee. Ninety-eight percent of employees participate in the annual Health Weeks. In addition to this, employees also receive an annual medical exam. With the framework already in place at this factory, latent or active TB testing could be included in the annual health weeks or medical exams, and having a private physician onsite could facilitate DOT programs in the workplace.

In the industrial area of Otay Mesa of Tijuana, there are approximately 197 businesses with 57,000 employees - tremendous potential for businesses to take action against TB and ensure a healthy workforce.

Global Business Coalition for HIV/AIDS, Tuberculosis and Malaria (GBC) (GBCimpact.org)

- **Created 2001**
- **Currently 220 member businesses**
  - 40% provide TB education at the workplace
  - 33% employ strategies to prevent transmission of active disease
  - 31% integrate TB and HIV programs
  - 28% administer treatment in line with national TB programs
  - 25% promote early identification of TB cases
  - 19% employ strategies to address MDR and XDR-TB
- **Incentives for businesses to join the GBC**
  - Protect their workforce
  - Educate the workforce about public health issues
  - Attract local and global talent by being a socially responsible company
  - Attract and retain customers
- **Featured members**
  - Eskom Holdings Company, South Africa
    - *32,000 employees with access to a comprehensive TB workplace program which includes surveillance, monitoring and active treatment of TB through DOTS and education and prevention*
  - XStrata Coal, South Africa
    - *8,000 employees have access to HIV and TB workplace programs and the program extends into the local community through trained outreach workers*

citizen and cares about the health of the members of the community.

Another international organization with well documented experience in developing and implementing employee based TB programs is the Global Health Initiative (GHI) of the World Economic Forum. GHI was launched in 2002 by Kofi Annan, and their mission is to engage business in public-private partnerships to tackle HIV/AIDS, TB, Malaria and Health Systems. In 2008, with support from the Eli Lilly MDR-TB Partnership, GHI launched two toolkits (one for South Africa, one for China) that aim to boost the involvement of companies in tackling the TB crisis in their respective countries. In South Africa 70% of patients infected with HIV are also infected with TB, and China has experienced a resurgence of TB worsened by the emergence of MDR-TB and the HIV/AIDS epidemic. The objective of the toolkits is to assist Chinese and South African companies in the planning and implementing of workplace and community TB prevention, care and control programs. According to a spokesperson for Eli Lilly "business has a fundamental responsibility towards both their employees and the wider community, and for the preservation of their long term interests by ensuring the national development of human capital to drive economic growth-TB has the capacity to undermined all of this."

Through the use of available TB toolkits

successfully utilized in other countries, a TB program that meets the unique needs of businesses in the San Diego-Tijuana border region can be created and pilot tested. Building on the success of GBC, it is recommended that GBC member companies with subsidiaries located in the San Diego-Tijuana border region be approached for participation in a regional program focused on TB prevention and control. These companies include:

San Diego
Eli Lilly
Glaxo Smithkline
Novartis
Pfizer
Walmart

San Diego/Tijuana
Citibank
Coca Cola
Pepsico

Tijuana
Johnson & Johnson
HSBC
Unilever
Walmart de Mexico

Based on the initial success in working with GBC member companies a more expansive program can be undertaken to involve other San Diego and Tijuana area companies.

Time is of the essence-there is no reason to wait until the TB situation in the San Diego-Tijuana region is as dire as the crises in Africa and Asia. It is imperative to take action now to encourage companies to implement workplace TB programs that focus on education, diagnosis, treatment and prevention. It is essential for the businesses in the San Diego-Tijuana border region to begin to take an active role in TB prevention and control ensuring a win-win scenario for their companies, employees and the health of the entire community.

References:

1. Dean Calbreath, "With no paid sick leave, workers face grim choices," San Diego Union, August 10, 2008 http://www.signonsandiego.com/news/business/calbreath/20 080810-9999-1b10dean.html
2. Healthy Families, Healthy Workplace Act of 2008 (AB 2716) and AB 1000 (March 2009)
3. Healthy Families Act (H.R. 2460), was introduced by Representative Rosa DeLauro (D-CT) in May 2009
4. Scott McDonald, "Paid sick days is smart business", Hartford Business Journal online, June 1, 2009 http://www.hartfordbusiness.com/news9089.html
5. Human Impact Partners. *A Health Impact Assessment of the California (2008*) http://www.humanimpact.org/PSD/
6. Global Business Coalition on HIV/AIDS, Tuberculosis and Malaria. *The State of Business and HIV/AIDS, Tuberculosis and Malaria (2008).* http://www.gbcimpact.org/soba. Accessed June 2, 2009.
7. World Economic Forum. *Global Health Initiative Brochure.* http://www.gbcimpact.org/itcs_type/4/12/report. Accessed June 2, 2009.

V. Appendix (List of Acronyms)

a.	AFB:	ACID FAST BACILLI
b.	AII:	AIRBORNE INFECTION ISOLATION (ROOMS)
c.	ATS:	AMERICAN THORACIC SOCIETY
d.	BCG:	BACILLE CALMETTE-GUERIN (VACCINE)
e.	CDC:	UNITED STATES CENTER FOR DISEASE CONTROL AND PREVENTION
f.	COEFAR:	STATE COMMITTEE FOR DRUG RESISTANCE (MEXICO)
g.	DOT:	DIRECTLY OBSERVED THERAPY
h.	DOT BAL:	A COMBINATION PREPARATION OF INH, RIFAMPIN, ETHAMBUTOL, PYRAZINAMIDE
i.	DOT-BAL-S:	A COMBINATION PREPARATION OF INH AND RIFAMPIN
j.	GBC:	GLOBAL HEALTH COALITION FOR HIV/AIDS, TUBERCULOSIS AND MALARIA
k.	GHI:	GLOBAL HEALTH INITIATIVE
l.	HCW:	HEALTH CARE WORKERS
m.	HEPA:	HIGH EFFICIENCY PARTICULATE AIR (FILTRATION)
n.	IGRA:	IFN-_ RELEASE ASSAYS
o.	IMSS:	MEXICAN INSTITUTE OF SOCIAL SECURITY
p.	INDRE:	NATIONAL INSTITUTE FOR EPIDEMIOLOGY AND DIAGNOSTICS
q.	INH:	ISONIAZID
r.	ISESALUD:	STATE PUBLIC HEALTH SERVICES INSTITUTE (MEXICO)
s.	LTBI:	LATENT TUBERCULOSIS INFECTION
t.	M.BOVIS:	MYCOBACTERIUM BOVIS
u.	MDR-TB:	MULTI DRUG RESISTANT TUBERCULOSIS
v.	M.TB:	MYCOBACTERIUM TUBERCULOSIS
w.	PZA:	PYRAZINAMIDE
x.	QFT:	QUANTIFERONGOLD TB TEST
y.	SANDAG:	SAN DIEGO ASSOCIATION OF GOVERNMENTS
z.	SAT:	SELF ADMINISTERED TREATMENT
aa.	TB:	TUBERCULOSIS
bb.	TDR-TB:	TOTALLY DRUG RESISTANT TUBERCULOSIS
cc.	TST:	TUBERCULIN SKIN TEST
dd.	USAID:	UNITED STATES AGENCY FOR INTERNATIONAL DEVELOPMENT
ee.	UVGI:	ULTRAVIOLET GERMICIDAL IRRADIATION
ff.	WHO:	WORLD HEALTH ORGANIZATION
gg.	XDR-TB:	EXTREMELY DRUG RESISTANT TUBERCULOSIS