Surveillance of Healthcare Workers for Latent M. tuberculosis Infection

By Abe Timmons, DO, MPH, FACOEM

Tuberculosis continues to be a significant healthcare problem as globally an estimated 9 million people develop active tuberculosis annually and approximately 2 billion people, one-third of the world’s population, are thought to be latently infected with *Mycobacterium tuberculosis*. In the United States, new cases of *M. tuberculosis* have been declining annually since 1993, with an average decline in the TB case rate of 3.8% per year from 2000-2008. Last year the TB case rate (3.8 cases per 100,000) was the lowest reported rate since recording began in 1953, representing an 11.3% decline in the TB case rate for 2009. The Centers for Disease Control (CDC) reports however that foreign-born persons in the U.S. have an 11 times greater TB case rate than U.S.-born persons. Despite this decrease in (Continued on page 2)

The Chilean miners survived their long ordeal underground but many others have not been so lucky.

CHILEAN GOVERNMENT/HANDOUT/REUTERS

By Anne-Emanuelle Birn, Dr. Timothy Holtz and Dr. Thomas H. Gassert

With the world’s eyes focused on the dramatic rescue of 33 miners trapped in Chile’s San José mine, it is high time to shed light on mining’s bleak reality.

Across the globe, some 13 million of the world’s most impoverished people — including 1 million children — work as miners, either in underground ore extraction or surface-level quarries and pits.

Mining is one of the world’s most dangerous occupations.

In addition to the explosions, falling rock and entrapments that have killed thousands of people in recent years (as this article was going to press, a blast at a Chinese mine killed at least 20 workers and trapped another 17), miners experience among the highest rates of work-related illness and premature death of any industry.

Chronic obstructive lung (Continued on page 7)
The tuberculin skin test (TST) had been the only practical, commercially available immunologic test for *M. tuberculosis* until 2001. However, new tests have been developed since the recognition that interferon gamma (IFN-γ) plays a critical role in cell-mediated immune response to *M. tuberculosis* infection. Interferon gamma release assays (IGRA’s) detect sensitization to *M. tuberculosis* by measuring IFN-γ release in response to antigens representing *M. tuberculosis*. QuantiFERON-TB test (QFT) was the first IGRA developed by Cellestis Limited in Australia and approved by the Food and Drug Administration (FDA) in 2001 as a diagnostic aid for *M. tuberculosis* infection. Cellestis also developed QuantiFERON-TB Gold (QFT-G), which was FDA approved in 2005. The CDC published guidelines for using QFT in 2003, and for using QFT-G in 2005. Since then, two new IGRA tests have been developed: QuantiFERON-TB Gold In-Tube test (QFT-GIT) (Cellestis Ltd.) and T-Spot.TB Test (T-Spot), the latter developed by Oxford Immunotec in the United Kingdom and FDA approved in July 2008. In light of the two new commercially available IGRA’s, the CDC published new guidelines in July 2010 for their use in tuberculosis detection since their antigens, methods and interpretation criteria differ from the previous two IGRA’s available.

Currently the common practice for surveillance and detection of latent tuberculosis infection (LTBI) among healthcare workers (HCW’s) is skin testing using the TST. Skin testing with the TST continues to be used by many facilities, presumably because of familiarity with the test and its interpretation. There are several concerns with accomplishing skin testing. One is that it requires visual interpretation of the test by a clinician within a narrow window (48-72 hours within planting the skin test). If for some reason this timeframe is missed, the test must be replanted. Another is the possibility of inaccuracy or bias in the interpretation of the test by the clinician, given a 9mm induration reading is considered negative while a 10mm induration reading would be positive. This can come down to a judgement call on the part of the person interpreting the test. Also, a valid TST requires the proper administration by the Mantoux method with intradermal injection of the tuberculin purified protein derivative (PPD) into the forearm. Some people can have reactions to the PPD itself, such as an allergy, and thus are unable to be screened for LTBI by this method.

In addition there is the issue of false-positive TST’s resulting from reaction with nontuberculous mycobacteria or prior vaccination with Bacille Calmette-Guerin (BCG), a common practice in other countries, because PPD contains antigens that are also in BCG and some nontuberculous mycobacteria. There is anecdotal evidence of increased false positives that leads to poor positive-predictive value of the TST, especially in low prevalence populations such as the US. Other concerns expressed include the likelihood that the reaction wanes over time from exposure, the increased cost and time associated with multiple patient visits required to complete the TST process, and the lack of a gold standard for comparison.

Since the IGRA tests have become available, the CDC has recommended their use as an adjunct or alternative to the TST. Though QFT was introduced commercially in 2001, it lacked specificity compared to the TST and has not been commercially available since 2005. The IGRA’s developed since then have improved specificity since they detect proteins that stimulate measurable release of IFN-g present in all *M. tuberculosis*, but absent from BCG vaccine strains and most nontuberculous mycobacteria. Initially the cost of IGRA’s was much higher than that of doing a TST test, however it appears the cost is

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<th>Table1: Differences in Currently Available IGRA’s</th>
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<td><strong>Format</strong></td>
<td><strong>QFT-G</strong></td>
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<tr>
<td><strong>Process whole blood within 12 hours.</strong></td>
<td><strong>Process whole blood within 16 hours</strong></td>
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<td><strong>M. tuberculosis Antigen</strong></td>
<td>Separate mixtures of synthetic peptides representing ESAT-6 &amp; CFP-10</td>
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<td><strong>Measurement</strong></td>
<td>IFN-g concentration</td>
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<td><strong>Possible Results</strong></td>
<td>Positive, negative, indeterminate</td>
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coming down especially now that competing tests are available. According to a study by Lambert, et al, the cost of TST testing on one person can range from $41-362 dollars, depending on the need for one step vs. two-step testing, and whether other diagnostics (chest x-rays in the event of a positive TST) are required. The cost of IGRA’s has been given to be anywhere from around $30 to $80 for bulk order testing, though anecdotal reports of $300 per test for single request tests continue to be reported.

It has been proposed that despite the cost of IGRA testing, utilizing these assays in latent tuberculosis infection surveillance of healthcare workers actually provides long term value in that it allows for better targeting those with true latent TB infection, especially in the context of high risk exposed individuals (eg, tuberculosis-endemic country of origin), and those with a history of BCG vaccination. Both of these populations would be expected to have a high rate of positive tuberculin skin test. Many hospital employee health programs are making the move to incorporating use of blood-based IGRA tests for latent tuberculosis surveillance of their employees. Some have even eliminated the use of skin testing completely, opting to use solely IGRA tests in their tuberculosis surveillance of employees.

IGRA’s offer several potential advantages over TST for LTBI surveillance. One is that only 1 visit is needed vs. two to four visits required for administration and follow up interpretation of TST’s. This decrease in time, labor and monetary resources is highly desirable in a large hospital setting with hundreds to thousands of healthcare workers needing annual surveillance for LTBI. Another is that interpretation bias is essentially removed from IGRA testing as opposed to TST testing, where one person may call a test negative at 9mm but another person may interpret the same test as 10mm and therefore a positive skin test. IGRA’s have excellent specificity that is not affected by BCG vaccination, whereas TST specificity is high in non-BCG-vaccinated population but variable to low those who are BCG vaccinated.

In regards to T-Spot, it offers an additional advantage of the results not being affected by immunosuppression. The benefit is that this would prevent the costs of false negative results due to immunosuppressive disease, a population of patients at potentially increased risk for LTBI activation. TST can be falsely negative due to immunosuppression, which can lead to missed cases of LTBI that convert to active TB disease and causing morbidity and higher costs of treatment. While sensitivity of IGRA’s as well as TST is inconsistent across tests and populations of those tested, T-Spot does appear to be more sensitive than TST and Quantiferon based tests.

While IGRA’s offer several potential benefits over traditional skin testing for LTBI surveillance, there are several concerns that remain. Pollock, et al, noted the problem of discordant results between TST and IGRA testing raising the concern of the sensitivity of QFT-G assay for detection of LTBI in healthcare workers. There is also the issue of how to manage the indeterminate result of an IGRA, though this appears to be a relatively rare event, occurring in less than 5% of cases in one hospital’s experience. In regards to QFT-G testing, the thresholds for interpretation were set for higher specificity, which should have the effect of reducing the number of false positives but raises concern for increasing false negative results. The dynamics of T-Cell responses during and after treatment for LTBI remain unknown. Pollock, et al, provided another small study on the evaluation of treatment effect of LTBI on QFT-G assay results, finding that after 9 months of INH treatment all participants continued to have positive QFT-G assays. More study is needed, as there is no long-term data on conversions, reversion, discordant results with TST, management of changing results and evidence-based thresholds for conversion.

In summary, as the cost of IGRA testing comes down and the CDC continues to support its use based on growing evidence of its utility, the use of IGRA’s in LTBI surveillance of healthcare workers appears to be gaining traction. Blood-based TB testing appears to provide more believable results with less bias and potentially less need for excess resources to administer the test. There is both short and long term potential for decreased program costs and increased public safety. Surveillance program efficiency could be positively affected by eliminating unnecessary follow up testing, ancillary testing, and evaluation and treatment of false positives, not to mention retesting of non-compliant (Continued on page 8)
Elements to be considered for Occupational and Environmental Health Services in the Industry
by Gerardo Durand, MD, MPH

It is well known that Occupational and Environmental Health (OEH) services are able to provide industry and general businesses with multiple and varied programs. The necessity of different programs may vary dramatically between all sectors of industry, and even between companies that compete in the same field. Among others, the factors that determine prioritization of different programs include legal responsibilities, government regulations, excessive exposure to hazardous conditions, and company’s commitment in occupational and environmental health.

A program’s success is not only the result of its suitability for the company’s needs. In addition to this, the reasons of a program failure might be beyond the competency of the OEH professionals involved.

There is no doubt that the sine qua non condition for the OEH services success is to be regarded as trustworthy by clients. This condition might be achieved by giving realistic advice and also by avoiding the installation of programs based on revenues generated to the service, without taking the client’s requirements into consideration. An atmosphere of trust progressively nourishes the service-client relationship toward a partnership. Establishing a partnership allows the service to have further access to key information and to have larger resources available. Hence, the programs are able to be more effective and sustained.

In the process of attaining the previously described high level of engagement with the client, the OEH professional may face a number of challenging circumstances. As Dr. William Patterson recommended in his chapter of “A Practical Approach to Occupational and Environmental Medicine,” the Occupational Health professionals must be prepared for a range of relationships and effectiveness with their clients.

The recognition of the client’s values is probably the most important task in the preparation to establish a relationship. The recognition of such values should be followed by a deep introspective evaluation of the willingness to get along with them.

Another preparatory step is to identify the actual or future location of the service within the company’s organizational structure. The OEH services usually have to report either to Human Resources (HR) or to the Safety Department. The decision to report to one or the other department depends on several factors including the expected functions of the service and the company’s mission in relation to Occupational Health and Safety. Since HR and Safety are typically considered supportive activities to the business operations, the company’s commitment to Occupational and Environmental Health and Safety might be reflected by how close the OEH service is located to the business core elements. In corporations with a strong commitment to Occupational and Environmental Health and Safety, the health service has access to the business operations and has complete ownership of OEH Programs that fulfill essential corporate needs and protects the employees, the company’s technology, and the final consumers. In contrast, companies that are not very committed to Occupational Health and Safety tend to allocate the OEH services under an on-site HR or Safety department, placing the service far away from the business core elements.

The classic functions that an OEH service has along with HR are disease management, absenteeism monitoring and health promotion. On the other hand, the interaction with the safety department has consisted of activities such as elaborating and managing surveillance programs in order to identify work related medical conditions and define individuals at risk, accommodating individuals with medical restrictions, and determining the relationship between medical results and occupational exposures.

Since the OEH service might manage programs with either department, it is important that a good flow of communication between HR and Safety is established. Traditionally, the communication flow between HR and Safety has been considered poor. Given that the OEH service may be located in one of each department, the effective management of programs that require coordination with the other side might be challenging. World-class companies have addressed this lack of commu-

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Does Age Matter?

By David Berube, MD, MPH, FACOEM.

The October 13, 2010 dinner meeting was held at the Hawthorne Inn in Berlin, Connecticut. Martin Cherniack, MD, MPH, Professor of Medicine, Division of Occupational and Environmental Medicine, University of Connecticut Health Center presented Healthy Aging and Work: a Northeastern Perspective. Dr. Cherniack began by pointing out that older workers are defined by the Department of Labor as individuals who are older than 40, and that AARP defines older workers as individuals who are older than 55. With this introduction, nearly every meeting attendee quickly realized that this presentation was as relevant to him or her as it was to his or her patients.

Dr. Cherniack noted that Connecticut has the oldest working population in the United States, and that it will remain the leader through at least the year 2030. He noted that the other New England states have employee demographics similar to Connecticut.

The aging workforce is particularly important when it comes to health issues, Dr. Cherniack explained. A significant increase in the number of chronic conditions after the age of 40 occurs, with associated reductions in physical and emotional capacities over time. The incidence in work injuries, however, is not found to increase greatly with age, but rather, the recovery period for medical injury and illness is longer in older workers.

Arthritis and large joint conditions are major issues in the older workforce. In simple terms, Dr. Cherniack summarized that “as you get older you get stiff,” which is a significant issue for physically active industrial workers. Over 45% of workers aged 55 and older have arthritis. Injuries from falls and fractures occur at a much higher rate over the age of 65, as does the need for large joint replacements. He added that heat intolerance is also a significant issue as hypertension occurs in over 40% of workers aged 55 and older, and cardiac disease in over 10%. Because of these and other age specific health issues, Dr. Cherniack noted that it is important for physicians to not only assess the anatomical site and organ systems that may be stressed by work, but also to consider the impact that age may have on health and productivity. For example, the tolerance for plumbers to kneel, and for construction workers to lift and climb, decreases with age and may require work modification and redesign.

Dr. Cherniack concluded that physicians and employers need to consider work process and design solutions to address the health issues of the older worker. In addition, he added that older workers may have different work/life balance expectations than younger workers, and that they may require or desire more time off for recreation, healthcare, and other needs. He offered in closing that Worksite health programs and research that focuses on the needs of older workers may provide future solutions.


| Table 1. Actual and Predicted Workforce Participation Rates – 2000-2020 |
|-----------------|-----|-----|-----|-----|-----------|
| **Age Group**   | 2000 | 2010 | 2020 | % change: 2000 to 2020 |
| years           |     |     |     |                     |
| 45-54           | 88.6% | 78.6% | 86.5% | 77.1% | 85.2% | 80.1% | -3.8% | 1.9% |
| 55-64           | 67.3% | 51.9% | 68.7% | 59.7% | 69.1% | 65.0% | 2.7% | 25.2% |
| 65-74           | 24.6% | 14.9% | 29.7% | 21.0% | 32.8% | 25.0% | 33.3% | 67.8% |
communication through the integration of their process systems. In those cases, the lines of communication are well-defined in the standards or functioning protocols of the company. The limited access to essential information—information which goes far beyond a walk through survey—is another condition that the OEH services might cope with for the development of successful programs. Going back to the initial statement, the development of trusting relationships is crucial to the disclosure of essential operational information necessary for program achievement. The OEH professionals are responsible for building trusting relationships with the different stakeholders of the company. It is also crucial for the OEH health service to be aligned with the goals, vision and culture of the organization, as well as being familiar with the company’s business model. Having this information available will potentially allow OEH professionals to identify beneficial opportunities previously unrecognized even inside the organization; this achievement might provide additional value to the OEH service.

When Velasquez appeared at the courthouse for a hearing, he was met by immigration officers who arrested him, jailed him for a month and then deported him to his native Chiapas, Mexico. In Chiapas he lives up a mountain four hours from the nearest telephone. His attorney worked through the Mexican consulate in Boston to obtain a compassionate visa to bring Velasquez back to RI where he had both a civil and workers’ compensation cases pending. This visa also allowed him to get necessary treatment for residual drainage from his facial wound. In December, the courts ruled in his favor and gave an award of $30,000, miniscule but better than nothing. His physicians and attorney all waived their fees in order to maximize what Mr. Velasquez can realize from this award. As he will need revisional surgery for his left eyelid, $30K will not go very far. His ex-employer agreed to pay $100 per month until the fine has been paid. It is improbable that the payments will ever be completed, however. While the ex-employer cannot file for bankruptcy right now—he filed five years ago—it is likely that he will file again.

LEONARDO COS-ELIAS is a Guatemalan illegal who was pulled into a computerized router machine he operated at a company in Pawtucket. His employer, Packaging Concepts, does carry insurance. Cos was severely injured and underwent a hemipelvectomy, disarticulation of his left lower extremity and diverting colostomy. He has survived to be transferred to a rehabilitation hospital. He cannot be fitted for a prosthesis that will allow him to walk but he will have a prosthesis that will permit him to sit without toppling over. Rhode Island workers’ comp law extends to cover all employees whether legal or not. The publicity generated by these two cases has prompted Governor Carcieri to question whether that law should be altered. One hopes that the legislature will be more enlightened than that.

Submitted by
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Dr. Durand completed his residency in Occupational & Environmental Medicine at the Harvard School of Public Health in June 2010, and previously completed a residency in internal medicine at Metro West Medical Center in Framingham, MA. He originally got involved in occupational medicine in his home country of Peru, working as a company doctor for Backus and Johnson Brewery. He assumed the role of Medical Director of Occupational Health at Carlsbad Medical Center in Carlsbad, NM.
disease, tuberculosis, lung damage from exposure to heavy metals, exposure to asbestos and silica which cause lung cancer, and black lung disease are all common.

There are frequent ergonomic and crush injuries and deaths due to equipment failure, mine collapse and falls. Chemical, gas and hazardous dust exposures to radon, uranium, diesel particulates, methane, cyanide (used as a gold and copper solvent), and other substances can result in fatal poisonings and lead to tortuous deaths from cancer.

No global tears are shed over these horrendous conditions. Although safety measures – including masks and respirators, adequately maintained equipment and limited working hours – have all been proven to reduce disability and death, occupational safety and health standards are lax or poorly enforced. The 1966 International Covenant on Economic, Social and Cultural Rights, which Chile signed and ratified, explicitly describes the foundations of labour rights, which include the right to just and healthy working conditions. However, these human rights are routinely violated in Chile and nearly every country where mining takes place in the Americas, Europe, Asia, Africa and Oceania.

Indeed, the company that operates the San José copper-gold mine, Empresa Minera San Esteban, was cited 42 times for safety violations between 2004 and 2010, and in fact was shut down temporarily in 2007 due to safety concerns after the death of a miner.

Between 2003 and 2007, at least three miners have died in the San José mine, and at least one has lost a leg. Several of the miners rescued this week reportedly told the company that they feared a collapse in the mine, but the management did nothing to prevent this occurrence.

In addition, the type of grid mining that the company was conducting generates the highest profits for mining companies, but is also the most dangerous for miners underground. To compensate, their salaries were reportedly 20 per cent higher than in comparable mines, but their safety was not assured.

Mining also causes enormous environmental damage, including seepage of heavy metals, acids and other toxic by-products into the land and waterways, erosion of topsoil, destruction of forests and natural habitats, and killing of wildlife. Surface strip mining, now occurring with more frequency in northern Canada, is particularly damaging to ecosystems as it strips all vegetation from the earth.

Amidst such human and environmental destruction, mining is one of the world’s most lucrative industries, with hundreds of billions in annual revenues. It is also one of the most exploitative industries, with CEOs typically earning thousands of times the wages of miners. One of the most poignant aspects in the early days after the trapped miners were discovered to be alive was the fear they expressed that they would be unable to pay their bills while they were not working.

All of these problems could have been addressed, in large part, through strong unions protecting the safety and livelihoods of miners.

However, the mining sector has one of the most sordid union-busting histories of any industry, from the 1914 massacre of several dozen Ludlow, Colo., miners and their families seeking to obtain union protection to improve working conditions, to present-day repression of miners and mining critics in settings as disparate as Peru, Tanzania and Papua New Guinea.

Indeed, mining multinationals, among which figure prominently Canadian-owned Barrick Gold and Anaconda Mining, have huge interests across Latin America and have ensured profits by fending off protestors and union organizers alike. The great irony of the rescue of the brave and resilient miners in Chile this week is that the mining sector, as well as Chile’s heavily pro-corporate government, has garnered a huge public relations coup. Meanwhile, its role in what led to the mining collapse in the first place is left unspoken.

Although the San José mine has now been closed, the health and safety conditions of all the other miners across the country and the region remain unknown, and it is unclear whether the Chilean government will take home the lessons learned in order to improve the safety of the hundreds of other mines in the Atacama Desert region.

Ultimately, the most fitting tribute to the survival of Chile’s 33 is to improve the health, safety and well-being of miners and their families around the world. Following Canada’s humiliating defeat for a UN Security Council seat just as the miners were being rescued, this country has a chance to resurrect its international reputation by becoming a lead player in global mining safety.

Professor Anne-Emanuelle Birn is Canada Research Chair in International Health at the University of Toronto. Dr. Timothy Holtz is a founding member of Doctors for Global Health in Decatur, Ga. They are co-authors (with Yogan Pillay) of Oxford University Press’s Textbook of International Health: Global Health in a Dynamic World (2009). Dr. Thomas H. Gassert is an occupational and environmental medicine specialist at the Harvard School of Public Health and the University of Massachusetts Medical School.
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participants who fail to show up for readings and/or require two step testing. As more evidence evolves regarding *M. tuberculosis* surveillance for LTBI in healthcare workers, IGRA testing appears to be gaining foothold as a useful adjunct if not outright viable alternative to TST testing.

REFERENCES


