

## TUBERCULOSIS: A HEALTH EDUCATION IMPERATIVE RETURNS

George L. White, Jr., PA-C, MSPH, PhD;  
Beth Hogan Henthorne, PhD; S. Eugene Barnes, PhD; and  
Jay T. Segarra, MD, FCCP

**ABSTRACT:** The ominous resurgence of tuberculosis after many years of containment necessitates a review of the various factors responsible. An intense collaborative effort is needed to avoid potentially catastrophic consequences of the new epidemic. To provide a basis for health education recommendations, the factors contributing to the resurgence of tuberculosis, the nature of the current epidemic, and past health education efforts are reviewed. Further, an expanded Health Belief Model is offered as a foundation to guide educational campaigns.

### INTRODUCTION

Tuberculosis antedates recorded history. It has been and continues to be a major cause of suffering and death in the human population. The World Health Organization estimated in 1990 that fully one third of the world's population, at that time, was or had been infected with the tubercle bacillus.<sup>1</sup> Globally, about 8 million new cases of tuberculosis occur each year. These new cases result in approximately three million deaths per year.<sup>2</sup>

The high morbidity and mortality rates from tuberculosis worldwide are public health enigmas given the facts that it is an ancient disease, that much of its pathogenesis has been fairly well described, and that chemotherapeutic agents are available for effectively treating all but the most stubborn of drug-resistant cases.<sup>1,3-6</sup> Perhaps even more puzzling to some is an incidence of 26,000 cases in the United States,

---

George L. White, Jr., is Professor in the Center for Community Health; University of Southern Mississippi, Hattiesburg, Mississippi. Beth Hogan Henthorne is Owner of Practice Innovations, Hattiesburg, Mississippi and a Health Education Consultant. S. Eugene Barnes is Professor of Health Education, Dept. of HPELS, College of Education, The University of South Alabama, Mobile, Alabama. Jay T. Segarra is Chief of the Pulmonary Section, Department of Medicine at Kessler Medical Center, Keesler Air Force Base, Mississippi. He is Board Certified in Internal Medicine, Pulmonary Diseases and Critical Care.

Requests for reprints should be addressed to Beth Hogan Henthorne, PhD, P.O. Box 16582, Hattiesburg, Mississippi 39404-6582.

where, until 1985, there was considerable and justifiable hope for eventual eradication of the disease. Although all hope for the eradication has not been lost, the web of causation of the disease has recently become entangled with the AIDS crisis. If the hope for eradication is to be restored, all health professionals must become aware of the epidemiological factors that have spawned the new pandemic and fully grasp the gravity of the situation. Anything less than a concerted effort by all health professionals to prevent and adequately treat the disease offers ominous implications for community health.

### FACTORS COMPLICATING CURRENT CONTAINMENT EFFORTS

Changing host and environmental conditions have created a scenario ripe for tuberculosis resurgence. For instance, HIV infection, homelessness, drug abuse and underfunded tuberculosis programs are responsible for most new cases.<sup>7</sup> With barely two-thirds of current patients completing therapy, non-compliance contributes to the emergence of drug-resistant strains.<sup>8</sup> A review of such factors and an understanding of historical eradication efforts provide a basis for understanding and responding to the current challenge.

#### HIV Infection

Much, though not all, of the increase in TB infection observed over the past few years can be attributed to its association with HIV infection.<sup>9-16</sup> The defect in cellular immunity in HIV-infected individuals makes them extraordinarily susceptible to acquiring active tuberculosis. In some areas of the U.S., 50% of newly diagnosed TB cases have concomitant HIV infection, either known or unknown at the time of the initial diagnosis of tuberculosis. IV drug abuse is also powerfully associated with both HIV infection and tuberculosis: in one recent study of tuberculosis prevalence among HIV patients with histories of parental drug abuse, 15.1% of patients had tuberculosis, whereas only 4.4% of HIV patients without histories of drug abuse had tuberculosis.<sup>17</sup>

Individual HIV patients with active tuberculosis are no more contagious to the public than HIV-negative TB patients. Popular belief to the contrary stems from observations that health care workers were more likely to convert their TB skin tests to positive after contact with HIV-positive patients than after contact with HIV-negative patients. This observation is almost certainly explained by factors other than the

degree of contagiousness. For instance, the most dangerous practice for respiratory care personnel in terms of transmission of *M. tuberculosis* is administration of inhaled pentamine to HIV patients (for prophylaxis against *Pneumocystis Carinii*) in respiratory departments, especially those with inadequate safety protocols.<sup>18</sup>

Nevertheless, there are several reasons why conventional tuberculosis control strategies may be ineffective in HIV-infected patients. First, TB infection progresses rapidly in HIV patients. In one report, 37% of HIV-infected occupants of a San Francisco residence developed active tuberculosis within three months of exposure to an index case.<sup>19</sup>

In a case control study of 62 cases of multi-drug resistant tuberculosis (compared to drug-sensitive cases) in Miami<sup>20</sup> the factors statistically associated with multi-drug resistance were frequent attendance at an HIV clinic, and having a diagnosis of AIDS. Another large study in New York, however, found that the most powerful factor in emergence of drug resistance was non-compliance with initial therapy.<sup>8</sup> Of additional interest, a very high proportion of HIV patients with tuberculosis develop disease outside of the respiratory system.<sup>21</sup>

Another factor that frustrates identification of tuberculosis infection in HIV-infected individuals is the skin test anergy (inability to react to PPD) that is quite common in HIV patients. Thus infectious persons with active tuberculosis may not be recognized through skin testing. Although most anergic HIV patients with tuberculosis can be diagnosed by chest x-ray, positive sputum cultures for *M. tuberculosis* have been recovered from patients with normal chest x-rays.<sup>22</sup>

These concerns have led the Centers for Disease Control to recommend that at least two control antigens be added to the skin testing panel during PPD testing of HIV-infected individuals. Although drug prophylaxis of anergic patients is not yet routinely recommended, one analysis<sup>17</sup> suggests that this strategy would be beneficial in sub-populations with a prevalence of tuberculosis infection of at least 10% (such as HIV-positive, anergic, intravenous drug users).

## Age

The decrease in general resistance to disease processes among the elderly, increasing numbers of elderly persons in the United States, the relatively high prevalence of chronic conditions, and the relatively high prevalence of dormant tuberculosis lesions among the elderly provide *M. tuberculosis* the opportunity for multiplication and dissemination.<sup>23</sup> The vulnerability of old age has been documented historically.<sup>24</sup>

There is the additional opportunity for spread of the bacilli among the elderly who live in institutional settings. Five percent of the elderly live in nursing homes; yet 20 percent of all tuberculosis cases among the elderly is found within nursing home populations.<sup>25</sup>

Not to be discounted is the trend toward caring for the elderly in the homes of grown children. Eighty to ninety percent of frail elders are cared for by family members, rather than formal services.<sup>26</sup> This affords yet another opportunity for transmission of the disease to infect other vulnerable populations. As the incidence and prevalence of tuberculosis among adults increase, the risk of infection among children also increases. As early as 1946, medical literature has warned of the risk of pediatric tuberculosis from exposure to infected elderly persons.<sup>27</sup> Tuberculosis cases among children under the age of fourteen have increased 35.4% since 1985.<sup>28</sup> Most childhood cases are found among children in clusters of high risk adults.<sup>29</sup> For this reason, educational intervention with patients who are parents of young children should receive additional emphasis. Children under three years of age who live with a mother who has active tuberculosis are at disproportionately high risk of infection.<sup>30</sup> Complicating the situation with children is a very high incidence of asymptomatic disease. Approximately 80 percent of the cases of tuberculosis among children in the United States are found among racial/ethnic minorities or those who are foreign born.<sup>31</sup> Elementary school systems might be considered a breeding ground for tuberculosis cases. Screening within school systems might be especially advantageous as supported by a study that showed that eighty percent of new tuberculosis cases among children were found through contact screening.<sup>32</sup> It has been recommended that children who have been exposed to a case of active tuberculosis receive annual or biennial screening tests.<sup>32,33</sup>

### **Substance Abuse and Smoking**

Among the cultural variables that contribute to the resurgence of tuberculosis, the problem of drug addiction should not be minimized especially as it applies to AIDS patients and their vulnerability to opportunistic infections.<sup>34</sup> An investigative report supported by *The Los Angeles Times* focused on the plight of inner city addicts who were AIDS patients, dealing with the multiple struggles of obtaining their drug of choice. Many such residents in New York City are housed in single occupancy hotels, (SRO's), subsidized by the municipality to provide a solution of sorts for the housing problems of AIDS patients. As such it would seem a fertile breeding ground for tuberculosis, yet tuberculosis

screening is not done among this group. Motivation is so low that patients are driven to accomplish nothing more than escape from the pain of their existence. Any behavior that would promote health is overridden by the addiction. It is recognized that with such overwhelming problems, most residents are not concerned with on-going medical check-ups or treatment, and are surely not concerned with the possibility of contracting tuberculosis.<sup>35</sup>

Recent research has revealed that both smoking and alcohol use should be considered risk factors for tuberculosis.<sup>36</sup> Historical studies that have suggested a higher incidence of tuberculosis among the elderly and males may have largely been due to the smoking effect. A study among workers in the sanitation department in Shanghai showed a strong relationship between smoking and the development of pulmonary tuberculosis.<sup>36</sup> Such findings should be considered especially disturbing since the most rapidly growing segment of smokers in the United States is teen age females. As a possible exacerbation of the situation, limited research has supported a structural predisposition to tuberculosis among females because of the smaller diameter of bronchi.<sup>37</sup>

In addition to placing one at higher than average risk of tuberculosis, there is limited research to support a negative effect of smoking on the efficacy of rifampin, one of the drugs of choice for treating many tuberculosis cases.<sup>38</sup> The rise of pulmonary tuberculosis and the emergence of drug-resistant strains may indeed provide a powerful incentive to stop smoking.

### **Migrant Farm Workers, the Homeless and Prisoners**

The tuberculosis bacillus is thriving also among migrant farm workers, the homeless and in prisons. The incidence of tuberculosis among migrant workers is six times that of all employed persons.<sup>39</sup>

Housing status has been shown to be one of the most reliable predictors of non-compliance.<sup>40</sup> In one study of homeless men, it was found that 42.8 percent were infected.<sup>41</sup> Similarly, a New York City hospital reported a 19% prevalence rate of drug-resistant tuberculosis among homeless patients, which further complicates their treatment and lengthens the amount of time needed for treatment and/or confinement.<sup>40</sup> Crowding, alcoholism, drug abuse, cigarette smoking, HIV infection, and other factors place the homeless and persons in prison at disproportionately high risk of contracting the disease. In addition to routine screening of homeless persons, there should be suspicion of tuberculosis in homeless persons with a fever and a productive cough of

more than a week. Confirmed cases should be reported to the health department and contact screening should begin. Among transient patients (other than the homeless) continued follow-up of persons from one geographic area to another is essential to assure compliance. Given that our society in general is more mobile than ever before, new strategies must be developed that will allow for sustained contact with patients needing an enhanced level of follow-up.

It has been recommended that *all* inmates be screened upon entry and reentry into correctional facilities. Employees of correctional institutions should be periodically screened.<sup>42</sup> In addition to inmates of state and federal prisons, detainees of local and county jail systems should also be considered at risk.<sup>43</sup>

### **International Travelers and Foreign-born Persons**

As a group, foreign born persons have a much higher prevalence of tuberculosis than is found in the general population. Over 20 percent of the cases diagnosed in the late 1980's were in the foreign-born population. It is also noteworthy that tuberculosis, once known as the "white plague," was for the first time in 1987, found in a larger number among blacks than among non-hispanic whites.<sup>44</sup> In addition, the prevalence among native Americans is two to three times that of the general population. There is some controversy about the origin of the term "white plague", but it has been used loosely to allude to the fact that many Europeans in the 19'th and 20'th century developed tuberculosis.<sup>45</sup> However, it has also been referred to as the white plague because of the white necrotic material seen at autopsy.

Screening of immigrants for active tuberculosis is mandated by the Immigration and Nationality Act. The disproportionately high incidence of tuberculosis among foreign-born persons in the United States justifies continuation of this policy. This policy, unfortunately, will not affect the large numbers of international travelers that may be at risk. Advice to international travelers quite possibly should be expanded to include baseline and periodic tuberculin testing.

### **Environmental Factors**

In addition to host factors, environmental factors contribute to the current threat. It is generally accepted that infection is more likely in situations of repeated exposure to a contagious person in a confined environment (long periods of close contact) yet numerous case studies reveal that a one time exposure is all that is necessary for some to con-

tract the illness. For example, some concern has been levied by airline workers who insist that they have contracted active tuberculosis during lengthy international flights. Such cases have ignited the interest of the Centers for Disease Control, who reportedly are studying four similar cases believed to have been transmitted in flight. One of the cases involved the transmission of the disease from a flight attendant to other crew members. Contagion in the circumstances described is thought to depend upon the degree of contagion, the general resistance of the potential host and the existence of a sufficient number of air exchanges to carry the microbe.<sup>46</sup> Although much of the above information is speculative at this time, further scientific investigation is warranted to determine the degree of threat.

An increase in air travel since the 1960's and earlier experience with airborne diseases has prompted concern regarding ventilation systems within aircraft. System designs that allow for recirculation of air within closed systems increase the possibility of the spread of infection to many by a single tuberculous passenger with active disease. With the rapidly developing global economy, business travelers frequently are required to travel internationally. Some executives relocate to countries with a high prevalence of tuberculosis for extended periods of time. Similarly, concerns might be extended to participants of international study programs, especially those programs that target underdeveloped countries and/or countries with endemic tuberculosis. Upon eventual re-entry to the United States, an argument could certainly be made for education regarding the symptoms and signs of tuberculosis.

The connection between flight and air-borne illnesses has strengthened since the 1980's when cost-containment measures were responsible for aircraft design that reduced the cabin air mix from 100% fresh air, to a mix of 50% fresh air and 50% recirculated air. Recirculated air contains a high level of contaminants, not only from passengers, but also from animals stored beneath deck, solvents and other chemicals in the aircraft. Airlines, however, defend their "highly efficient HEPA filtration systems," which consist of particulate filters that are said to entrap any bacteria exceeding one micron in size. A disturbing aspect of the situation is the fact that filters must be changed regularly to maintain effectiveness, and currently there are no monitoring processes to assure maintenance procedures. Further, representatives of one major carrier has stated that aircraft ventilation is healthier than that of other mass transit vehicles, such as buses or trains.<sup>46</sup> Concerns over the role of closed ventilation systems to tuberculosis exposure also extends to industry. The American Review of Respiratory Disease re-

ported a case in which 27 of 67 workers in one office building were infected with tuberculosis by a co-worker over a four-week period.<sup>40</sup> One only needs to observe the structure of massive professional towers in metropolitan areas to imagine the potential threats that may be imposed by the dual risk factors of crowding and a contained ventilation system. The highest risk of contagion in the workplace probably resides within health care facilities. Nationally, nosocomial transmission of tuberculosis to health care workers is an increasing risk.<sup>16</sup> Often such cases are drug-resistant and the death toll from tuberculosis among this group is rising.<sup>45</sup>

Such environmental concerns seem to dictate that basic engineering designs have veered too far from earlier structures that were built to promote fresh air flow and sunshine. One might theorize that even generalized air pollution may impact the resistance of lung tissue to tuberculosis.

### **Cultural Factors**

The trend toward expanded civil rights has focused significant attention on the rights of the individual over those of the public. The "right" of law enforcement or public health officials to quarantine or force treatment among non-compliant individuals who are contagious is being challenged by civil libertarians and the existence of restrictive laws could be considered at risk.<sup>47</sup> The legality of quarantine and forced medical treatment will become more visibly challenged in the coming years. New York City has reportedly quarantined 90 people in the last two years to contain tuberculosis under a polio-era law allowing the state to literally lock-up patients without a hearing or legal advice. Hospitals are using mandatory, direct-observed treatment (DOT) protocols for those known to be active tuberculosis carriers, but non-compliant with therapy. Civil libertarians are opposed to restrictive laws and further are concerned about the possible role of juror bias in cases where the non-compliant person is a racial or ethnic minority member. They advocate the use of methods other than confinement, which may place the public at increased risk. Currently, health care providers are hampered in their efforts to restrict the spread of tuberculosis because few court systems have truly made clear the circumstances in which a tuberculosis patient can be legally detained. Of the restrictive laws in place, many were legislated in the early 1900's as part of a massive campaign toward tuberculosis control and many have since been eliminated.<sup>47</sup> Few patients have actually filed suit against providers who have detained them

for coerced treatment for tuberculosis, but that seems probable if the legal situation is not clarified.

Notably, New York and Boston laws currently support mandatory hospitalization for patients that will not take medication,<sup>2</sup> adding to tuberculosis containment costs within systems that already feel budgetary strain. Recent research revealing the patterns and predictability of non-compliance supports the need for mandatory confinement in some cases.<sup>40</sup>

Contributing to the tuberculosis problem is a general apathy among both the lay public and health care professionals. Since the resurgence of the disease has begun to heighten awareness of the threat, there is an increasing number of articles appearing in the lay media,<sup>28,48,49</sup> but the impact of those educational efforts is restricted to small segments of the population, not reaching those at greatest risk.

Health care professionals are also in need of basic tuberculosis education. According to recent research, 1,772 physicians were surveyed to determine their handling of tuberculosis cases. When asked to interpret a routine tuberculin skin test, 65 percent of the doctors answered incorrectly and only 58 percent followed the treatment guidelines recommended by the American Lung Association. Seven percent were not aware that cases should be reported to health officials. The report showed that not only public education, but health provider education is essential.<sup>49</sup> A decline in tuberculosis control programs has been the norm throughout the United States as metropolitan health care budgets have been slashed and funds diverted to more pressing concerns. Brudney and Dobkin tracked the history of tuberculosis programs in New York City and found that even though officials were forewarned of impending problems, tuberculosis control efforts were continually downgraded and financial support withdrawn to the point that *M. tuberculosis* has become well-established among some population segments. In the words of a 1980 task force:

It must be strongly suspected that the increase in newly reported cases in New York City is in part the result of fiscal neglect of the tuberculosis problem in the State's largest city. The resurgence of the disease, a bitter reversal of the expected trend, is related to a failure of both health authorities and government at all levels to muster a public health program . . . At federal, state and local levels, public health funds allocated to tuberculosis are inadequate, in some instances so grievously inadequate as nearly to amount to dereliction and default on legal mandates<sup>40</sup> (p 442).

Although the level of financial support needed for effective tuberculosis control programs is not likely to materialize in the near fu-

ture<sup>23,40,45</sup> recent increases in funding for the purpose indicate that the need is being taken seriously.

### Occupational Hazards

An increased risk of tuberculosis in occupational settings has been recognized, especially among health care workers. Those who work and are preparing to work in close proximity to tuberculosis patients and high-risk groups should be targeted for specific professional education programs. The obvious need for added precautions among health care personnel is implied in findings of a study of members of a health clinic in Florida. Thirty of 76 staff members showed positive tuberculin skin tests as a result of treating patients with tuberculosis.<sup>50</sup>

Any workplace that has a closed ventilation system that affords exposure to recirculated air should be considered increasingly threatening, with the growing rate of contagion among the general public. Additionally, limited research supports the notion that long periods of inactivity in constrained positions may support tuberculosis infection.<sup>51</sup> With the rise in use of computer terminals and subsequent periods of physical inactivity, it might be theorized that job design may contribute to heightened occupational risk among some workers. If crowding and a closed ventilation system are present, the risk may be magnified.

## A HISTORY OF PREVENTIVE EFFORTS

Hans Zinsser presented in his classic, *Rats, Lice and History*, an almost sympathetic account of the struggles of various pathogens to sustain an advantage over hosts that were determined to eradicate them.<sup>52</sup> Zinsser would no doubt have been intrigued by the current situation in which the tubercle bacillus has once again shifted the balance of power in the ongoing war between disease-causing organisms and mankind.

There were more than 84,000 cases of tuberculosis in the United States in 1953, whereas in 1984, only 22,000 cases were reported.<sup>53</sup> However, by the mid 1980's, there was a rather dramatic reversal in the long-term trend toward eradication. From 1985 to 1990 there was a 15.8 % increase in the incidence of tuberculosis.<sup>54</sup> And, The American Lung Association reported 26,673 new cases in 1992 (a 15% increase from 1991).<sup>28</sup> As a consequence, health professionals are facing new challenges as they grapple to identify new strategies to regain the upper hand.

The enormity of the potential threat is clearly seen when reviewing the confounding variables as summarized in the preceding discussion. It is not possible to quantify the cumulative damage of *M. tuberculosis*, however disastrous its impact on society, but, the remembrance of its virulence could be considered as having a positive impact on preventive efforts. Current apathy may be the result of not having the lingering threat of the disease at the forefront of consciousness.

Earlier efforts towards the containment of tuberculosis were promoted with the same spirit of communitarianism that supported volunteerism during both world wars. A rebirth of that spirit, however unlikely, may be necessary for future success. As a society, we are far from beginning to address the complex psychosocial issues that surround the target groups described, and are not able, at the current time to initiate the all-out effort that would place us in a vantage position over the persistent mycobacterium.

It would be remiss and presumptuous to address educational efforts to prevent tuberculosis without a retrospective view of historical efforts and the degree of success or failure associated with those campaigns. As is so often the case, it is essential to recognize the problematic patterns of the past to avoid repeating history.

It is beyond the scope of this review to examine all historical aspects of the tuberculosis challenge, yet it was a massive collaborative effort between researchers, physicians, community volunteers, industry, government health officials and voluntary agencies that was responsible for the containment and reduction of tuberculosis contagion. The following discussion will focus on the extent of the educational effort.

It is of interest to note that not only was the earlier battle against tuberculosis successful, but the effort heralded the beginning of modern health education campaigns. Many of the educational campaigns against tuberculosis involved multi-disciplinary efforts that worked synergistically to support the ongoing efforts of government-based public health programs. Ironically, much of the public health education methodology that is used today was a result of the tuberculosis movement.

The early 1900's brought the recognition that public health education was a foundation for preventive efforts toward tuberculosis control. The National Association for the Study and Prevention of Tuberculosis (NASPT) launched a national movement to control the spread of tuberculosis, based on the belief that the disease could be controlled and eventually eradicated.<sup>55</sup> Their ambitious leader began the first meeting of the NASPT with the following statement:

The first and greatest need is education, education of the people and through them education of the state. It is evident that if every man and woman in the United States were familiar with the main facts relating to the manner in which tuberculosis is communicated and the simple measures necessary for their protection, not only might we reasonably expect as a direct result of this knowledge a great diminution in the death rate of this disease, but the people would soon demand and easily obtain effective legislation for its prevention and control<sup>55</sup> (p 15).

The optimistic view of the effectiveness of public education was based on the belief that the public would respond appropriately if they were adequately informed. Initial educational efforts were hampered by an apathetic and fatalistic public, whose prevailing belief was that the disease was incurable and hereditary. Disparate views among scientists and physicians about the basic nature of tuberculosis further complicated efforts. Researchers had not reached a consensus regarding the mode of infection, role of host resistance, or the desired method of treatment. The uncertainty and evolving knowledge base of the time was reflected in the chosen health education methodologies.

The NASPT drive to control tuberculosis was joined by voluntary agencies, government-sponsored health organizations, and local task forces. During the early days of the tuberculosis movement, protection of public health was largely a local responsibility, with the federal government assuming a minor role. Legislation regarding tuberculosis varied widely from state to state, with many having laws that provided for the arrest of public spitters, abolition of the common cup, and in some states, mandatory establishment of sanatoriums.<sup>57</sup>

To counter pervasive public apathy, fear appeals predominated early educational messages, with an understandable subsequent backlash. Fear of consumptives (*phthisiophobia*) led to discrimination and mistreatment of that group, similar to that experienced currently by some AIDS patients. Phthisiophobia was injurious both to tuberculosis patients and to the campaign to control the disease. Compulsory isolation to treat the disease stimulated and reinforced phthisiophobia, negatively impacting general educational efforts and prompting public disapproval of locating sanatoriums adjacent to homes<sup>55</sup> (p56-57, 63, 79, 94,110).

Lectures on the topic and books were among the first public education efforts. The creativity of the various approaches used is evidenced by the means in which print media was extensively distributed. Every available avenue was employed to accomplish the task at hand, from inserts in church bulletins to messages imprinted on streetcar transfers. Circulars were distributed to millions. Weekly tuberculosis

bulletins were supplied to thousands of newspapers and wire services, supplemented by biweekly releases to state and local organizations. Personal accounts of tuberculosis cases and human interest stories were often used in educational appeals.

In addition to print media, visual art was employed to communicate anti-tuberculosis messages. Educators employed the use of posters, photographic documentaries, cartoons, drawings, lantern slides, fair exhibits and often displays that included pathological specimens. Massive exhibitions were commonplace and widespread.

The advent of motion pictures afforded a new medium for tuberculosis education efforts. The first motion picture for tuberculosis control, produced jointly by The Red Cross and The Edison Company, was the most popular educational tool of the time and began an era in which motion pictures would be the choice medium for health education.<sup>55</sup>

Early educational messages focused on general hygienic measures such as the value of fresh air, open windows, sunshine, cleanliness, adequate ventilation in the home, schools and workplaces; good diet and balanced nutrition. Individual precautions against tuberculosis were also promoted and included such messages as the dangers of public spitting, abolishing "common cup" practices, the need to cover one's mouth when coughing, and the dangers of dry sweeping with feathers. In spite of the seemingly primitive nature of some of these health recommendations, it is somewhat disturbing to remember that we may still be facing some of these basic problems in our impending war against the opportunistic bacilli. One current researcher has suggested that we return to teaching general hygienic measures among students, a retrenchment to early health curricula.<sup>36</sup>

As knowledge of the etiology and treatment of the disease advanced, educational messages began to employ sound germ theory and more progressive methodology for tuberculosis containment. *Huber the Tuber*, one of the more popular publications, was extensively used in the 1940's for health education among various public and private groups.<sup>55</sup>

Among professionals there was no doubt that the public support generated by health education greatly impacted passage of measures for curbing the disease, but the impact of the campaign on both knowledge and behavior was questionable. A Gallup Poll in 1939 revealed that 86 percent of the public believed tuberculosis was curable, half still thought it was an inherited disease, and one fourth did not know of the contagious nature of the disease. This lack of knowledge was also pervasive among patients dismissed from sanatoriums in spite of intense educational intervention during confinement.<sup>55</sup>

The massive educational drive successfully reached the middle class but failed to impact the populations that were most in need of education. It was recognized that education alone was not adequate to address the ongoing problem:

Education could prepare the public for legislation but it could not replace it. Control of tuberculosis would have to depend on the power and efficiency of public health agencies<sup>55</sup> (p 64).

Educators realized the futility of preaching prevention to those who will not or can not follow the guidelines. An observation by a tuberculosis nurse also summarized the philosophy:

Education must reach those who will be taught; compulsory legislation those who through ignorance will not<sup>55</sup> (p 926).

The parallels with the problems inherent to current health education efforts are obvious. The current resurgence of tuberculosis is felt most among hard to reach populations that are often overwhelmed by addiction, HIV infection and other problems that underlie non-compliant behaviors. In those cases, legislative actions may be necessary to prevent spread of the disease.

The role of an intact immune system in resisting tuberculosis infection is not a new discovery, having been recognized in the earlier drive toward tuberculosis control. The impact of poverty, insufficient diet, late medical care, stress, alcoholism, environment, housing and occupational hazards as contributors to the development of tuberculosis are mentioned repeatedly in the historical literature.

In general, we have found that anything that impairs the general health of a person may be a predisposing cause of tuberculosis<sup>55</sup> (p 61).

The relationship of occupation to the development of tuberculosis was recognized as early as 1556 by Agricola, who described the role of dust as a risk factor for consumption among miners. Rammazini, in 1740, also described the impact of occupation in developing consumption.<sup>56</sup>

The tuberculosis movement of the early 1900's also focused on the role of the workplace as a source of infection, with crowding and poor ventilation recognized as risk factors. Workers found to be at higher than average risk of tuberculosis included cotton mill workers, garment factory workers, printers, and cigar-makers. Recent accounts

of tuberculosis contagion in the workplace are a reminder of earlier tuberculosis outbreaks.

Both the professional literature and company archives are replete with descriptions of historical tuberculosis containment efforts within industry. A historical account by Metropolitan Life Insurance Company described a company-based 40-year effort to control tuberculosis. Corporate leaders realized that their particular industry would be dealt a devastating blow if tuberculosis were allowed to sweep the country unchecked. Their subsequent efforts provide an excellent example of the extent to which industry can positively contribute to tuberculosis containment strategies. The company initiative was a direct result of the disruptive impact of tuberculosis on productivity that was noted when 15,000 workers became infected. Premature deaths, long periods of disability, and costs of treatment were among the results of infection. Among Metropolitan policyholders in 1911, one-fifth of all death claims were due to tuberculosis. Corporate leaders believed that the company would benefit from supporting the containment tasks of local, state and national health officials.<sup>57</sup>

Metropolitan's initial thrust in their tuberculosis campaign included screening of all job applicants, life insurance applicants and employees for the disease. Treatment as well as rehabilitation were provided for active cases. In addition, a massive educational effort via pamphlet distribution targeted policyholders, promoting personal hygiene, proper nutrition and sunlight, with an emphasis on early treatment. Consumer health education pamphlets that addressed quackery and fraudulent tuberculosis treatments were also distributed.<sup>57</sup>

In addition to the visiting nurse services that were provided to policyholders that had tuberculosis, Metropolitan instituted an industrial health service that advised management of the need for disease prevention and control within the workplace, a precursor of modern occupational health programs. High risk occupations were identified and on-site clinics established within vulnerable occupational settings. Among targeted workers were pottery operatives, buffers and polishers, glass factory workers, miners, stone cutters, metal grinders, clerks, salesmen, saloon-keepers, bartenders, longshoremen, printers, barbers, cigar and tobacco factory workers.<sup>57</sup>

Massive expenditures were directed towards printed materials (with some circulars exceeding 38 million in distribution), support of research and demonstration projects, and even radio exercise programs during which tuberculosis control messages were broadcast.

Teachers were targeted with health bulletins that advised early

detection and treatment. Periodic examinations, proper hygiene and nutrition, as well as the role of voluntary agencies in treatment were included. The need for mass X-ray screening, and the role of medication in treatment were explained. A special set of brochures for classroom use, entitled "Health Heroes," focused on famous names in tuberculosis research and treatment. In addition, a film called "Health Through the Ages" was produced and distributed to over 45,000 sites for use in educational efforts.<sup>57</sup>

Metropolitan was also actively involved at the grass roots level, adopting a community planning approach to disease prevention. The firm instigated public support for legislation mandating tuberculosis hospitals and also coordinated educational efforts through local welfare workers. A collaborative approach was employed, working with local tuberculosis associations, health departments and sanatorium authorities. Further, they spearheaded local efforts for identification and isolation of those with tuberculosis, stimulated expansion of information and educational services, and assisted in fund-raising. Professional tuberculosis education was promoted through exhibits at national medical conventions. Metropolitan's advertising expenditures to promote tuberculosis prevention totaled over \$1.5 million in 1922.<sup>58</sup>

### RECOMMENDATIONS FOR HEALTH EDUCATION INITIATIVES

Effective prevention and control of tuberculosis in the near future will quite possibly involve replicating some of the efforts of our forefathers, while incorporating the welcome advances in screening and treatment procedures. A healthy respect for previous successes will lead to an adoption of some of the tactics used earlier. The changing host and environmental conditions which offer the tubercle bacillus newer opportunities must be recognized and acknowledged by all health professionals.

Public information programs are needed to alert a public that grew apathetic about tuberculosis as its incidence continually declined over a thirty-year period. Large numbers of people are ignorant of how the disease is transmitted and of the risk factors associated with it. The importance of screening and the essential nature of compliance with long-term prescriptions must be made known to the general public and especially to high risk groups.

School health education and community health education pro-

grams should be well conceived; and clearly, they should be distinguishable from public information programs. They should be designed through the use of contemporary planning models that require analyses of the etiology of disease, the nature of screening programs, the unique aspects of long-term treatment, descriptive epidemiology, and other relevant information. Target populations should receive added attention in health education programming, and HIV/AIDS education should emphasize tuberculosis as a significant opportunistic disease.

Patient education programs, in order to be effective, must address among other issues, difficulties encountered in compliance with long term prescriptions. Compliance rates among the homeless, migrant farm workers, and others provides a definite challenge for patient educators, as will the lack of motivation and depression that often accompany chronic illness, especially among underprivileged groups.

Planning, development and implementing screening programs at the local level should be a joint effort coordinated with the local health department, public and private community organizations, and health care providers in the community. Medicare and private health-care funding should be sought to support screening and prevention programs.<sup>58</sup>

### **AN EXPANDED HEALTH BELIEF MODEL**

At no time in the history of tuberculosis has the health education challenge been greater. A considerable amount of energy has been spent reviewing factors that will that will complicate control efforts. Yet some current situational variables will contribute to the fight against tuberculosis. Unlike our predecessors, we possess a solid knowledge base regarding preventive efforts. Additionally, we have the clinical technology to diagnose cases more cost-effectively and treat most tuberculosis cases successfully. Because of a more effective pharmaceutical arsenal, the length of contagion has been reduced. A more rapid recovery is usually the case when the disease is detected and treated at an early stage.

In spite of chronic underfunding, we have an underlying public health infrastructure that will be instrumental in control tactics. Information can be more rapidly disseminated on a national and global basis, and the major voluntary agencies typically have grassroots support to meet challenges when necessary. Current efforts toward health care reform may result in a more cohesive health care system. The Environ-

mental Protection Agency, The National Institute of Occupational Safety and Health, and the Centers for Disease Control and Prevention may become instrumental in activities to reduce occupational and environmental threats that contribute to the current problem.

In spite of those factors that should provide an advantage in fighting tuberculosis, there are both blatant and subtle factors that provide substantial barriers to success. Our health care system is structured to address complex technical challenges such as coronary artery disease and organ transplantation. Yet that structure may not be as effective in combating contagious diseases capable of widespread transmission. This is evidenced by the fact that our effort against HIV infection has been less than exemplary. Frank Ryan, in his recent book *The Forgotten Plague* quoted a blunt statement of the cause of the recent tuberculosis threat:

The neglect of tuberculosis as a major public health priority over the last two decades is simply extraordinary. Perhaps the most important contributor to this state of ignorance was the greatly reduced clinical and epidemiological importance of tuberculosis in the wealthy nations<sup>45</sup> (p. 404).

The predominant attitude may be due to the fact that we have simply forgotten the devastation wrought by diseases such as tuberculosis before the advent of modern medicine and have come to rely on pharmaceutical cures for whatever infectious diseases appear on the scene.

Only historians can really appreciate the struggles against contagious diseases and their impact on every aspect of our ancestor's lives. Ryan's work involves a poignant account of a handful of researchers and physicians who were responsible for much of the collaborative effort that eventually led to the containment of the tubercle bacilli. Many of those involved in the struggle actually died from the disease. It is only through a retrospective look at the struggle that we can appreciate the extent of the effort that led to success against this persistent enemy.

Even with astute practitioners of known and proven methods of health education, the challenges are such that they will not be easily met, as is so thoroughly addressed in Ryan's book. The challenge calls for an intense collaborative effort such that we have probably never witnessed, to contain this disease. Educational efforts must encompass the research community, medical professionals, public health practitioners, engineers, corporate decision-makers, lawmakers and the general public to insure the collaborative effort that is needed.

Many models of health education for tuberculosis control have

been tried throughout the history of the disease. Health propaganda, based on scientifically erroneous or moralistic principles, fear tactics as well as knowledge-based educational tactics have been used. The need for a behavioral approach, taking into consideration the individual's unique circumstances has also been recognized and utilized historically.

The health belief model has long been described as a starting point for health education. The preventive model, credited to the work of Rosenstock and Hochbaum, sets forth major generalizations about preventive behaviors.<sup>59,60</sup> It is based on the foundation that motivation in relation to any particular health issue is determined largely by three kinds of beliefs: the degree to which personal susceptibility is felt, the degree to which the entity would impact life as he or she views it, and the existence of a reasonable course of action to reduce susceptibility. When adopting this "reasonable course of action," the individual must feel that such actions are feasible in terms of personal resources, that the cost of said actions will be consistent with what he/she is willing to expend (in terms of not only finances, but emotional or social costs) and that such action will result in reduction of personal susceptibility. Further, the individual must believe that taking the action will not be as great a threat as is the threat implied by the disease.

To use the health belief model effectively, the health educator must consider predisposing, enabling and reinforcing factors. Factors that predispose an individual to adopt a preventive behavior (or even acknowledge susceptibility) might include knowledge of the problem, personal likes and dislikes, his or her prevailing values and beliefs and the individual's unique perception of his or her universe. Factors that enable preventive behaviors may include specific skills, available facilities or care, personal resources, including financial; and the individual's physical and mental capabilities. If significant barriers prevent the individual from adopting the desirable health action, those barriers must be removed or modified to facilitate health education. Reinforcing factors such as financial incentives, praise, recognition, and feelings of achievement are also necessary to maximize efforts. Such reinforcing factors may be internal or external, thus the health educator must identify specifically what rewards typically motivate behavior of the targeted group. For instance, financial incentives are prime external motivators of both individuals and corporations, yet peer recognition or feelings of accomplishment may be a primary motivator of gang-related activity or athletic performance.<sup>59,60</sup>

Effective preventive efforts can be planned to impact any stage (or level) of the disease process. The primary level of prevention focuses

on preventing the disease before it begins and is based on an understanding of the cause of the disease. The only way to accomplish primary prevention of tuberculosis is to prevent exposure to the bacilli or to adopt a lifestyle that is conducive to promoting a generally high level of disease resistance. The second level of prevention focuses on early detection. We do have the means to detect tuberculosis at an early stage and begin treatment before it has become unmanageable and life-threatening. The third level of prevention is based on damage control—keeping the disease from becoming worse, through an extension of treatment begun in the second level or through rehabilitative efforts.<sup>61</sup>

In combining the health belief model with the three levels of prevention, a broader foundation for planning educational efforts emerges. At each level of prevention and for each aspect of the health belief model, there are crucial issues to address. The health educator can apply each aspect of the expanded model to the targeted individual or group. The expanded model can be applied on a collective basis as well as within individualized health education, as evidenced by the following discussion and illustrations.

If using the expanded health belief model to guide mass public education campaigns, the starting point would be building awareness of individual susceptibility, i.e., each aspect of the health belief model at primary level of prevention (see Table 1).

When using the expanded health belief model to target individual behaviors at the primary level of prevention, the individual must perceive his or her susceptibility to tuberculosis, understand how it might negatively affect his or her life as it is perceived, and then understand and believe that specific measures will reduce susceptibility to exposure and infection, and subsequently reduce the possibility of a negative impact. In addition, that person must find those actions acceptable in terms of cost and expected benefit.

At the secondary level of prevention, the individual must believe that an undiscovered, untreated case of tuberculosis is possible, that his or her life would be negatively impacted by late detection and treatment and that testing and possible treatment can reduce susceptibility to the impact of late treatment. If the targeted individual has been found to have active tuberculosis, efforts should also focus on the necessity of treatment compliance.

Efforts at the tertiary level of prevention involve an extension of level two. The individual must perceive that continuation of the entire treatment is necessary to avoid susceptibility to the devastating consequences of drug-resistant tuberculosis. Further efforts of secondary and

TABLE 1 continued

<p>not detected in its earliest stages. If infection is not found early, the possibility of spread to significant others is great. Simple tests are available that can determine the presence of tuberculosis.</p>	<p>suming to treat and the possibility of spread to others is increased. There is a greater degree of impairment and personal loss if the disease is allowed to continue without treatment.</p>	<p>Follow recommended treatment if positive for reversal of disease and communicability. If contagious, reduce contagion to others by following advice of physician.</p>
<p><b>Tertiary Prevention</b> If positive for tuberculosis, yet not active disease, the individual is susceptible to conversion if immune system becomes compromised. If entire therapy course is not followed, tuberculosis may become worse, could become drug-resistant and may become life-threatening; in addition, contagion to others will remain.</p>	<p>If therapy is not followed, personal impact will become increasingly negative. Drug-resistant infection, poor prognosis and an exacerbation of the threat to significant others and general public are possible. The conversion of inactive to active tuberculosis could cause significant disruptions in life. An extended illness will further the negative impact of the disease on the individual's life.</p>	<p>If inactive disease, follow recommendations of physician for follow-up. Choose a healthy lifestyle that promotes the highest possible resistance to disease. Follow entire course of the prescribed therapy, if active disease.</p>

**TABLE 1**

**A Model for Tuberculosis Prevention Targeting Individuals**

<i>Components of the Health Belief Model</i>		
<i>Levels of Prevention</i>	<i>Susceptibility</i>	<i>Degree of Impact</i>
<b>Primary Prevention</b>	<p>Everyone is susceptible to tuberculosis infection.</p> <p>Some individuals are at higher than average risk.</p> <p>Knowledge of individual risk factors to determine susceptibility.</p>	<p>Tuberculosis infection can have a significant impact on the lives of both the individual and their significant others.</p>
<b>Secondary Prevention</b>	<p>The individual is prone to a more devastating impact of tuberculosis if the infection is</p>	<p>Support public health and legislative measures to control tuberculosis.</p> <p>Practice general hygienic measures.</p> <p>Smoking cessation.</p> <p>Assure ventilation &amp; engineering controls to decrease personal susceptibility.</p> <p>Adopt/maintain a lifestyle conducive to a high level of health, and high level of resistance to disease.</p> <p>If at higher than average risk, avoidance of exposure-prone situations in which risk is great.</p>
	<p>If infection is not found and treated at an early stage, it is more difficult and time consuming</p>	<p>Seek tuberculin testing to establish whether or not you have the infection.</p>

tertiary prevention can focus on reduction of contagion to significant others, if the individual is a patient who has tuberculosis. A reinforcing factor that is often present with parents is the belief that their treatment will have a positive impact on the health and welfare of their children. They often will do for children what they might not be motivated to do for themselves.

When applied in a corporate setting, the expanded health belief model of preventive education must address the prevailing beliefs, values and perceptions of the decision-makers with the organizational setting, which would include occupational health professionals or personnel officers (see Table 2). In levying health education efforts towards the corporation, certain industries may be more prone to experiencing a negative impact from tuberculosis resurgence than are others, therefore a first step in application of the model would be to determine vulnerability of various industrial/corporate settings to higher tuberculosis risk. For instance, the health care provider setting, whether small organization or large, may be more susceptible than would be the offices of the state highway department. The employees of fast food restaurant chains, who come into close contact with many people might be more susceptible than would an accountant working largely in isolation. Companies whose employees work in crowded or poorly ventilated areas would be more susceptible to contagion, as would airline personnel who routinely fly long an/or international routes.

Actions to prevent tuberculosis would not be undertaken unless corporate decision-makers were motivated by a belief of organizational susceptibility, knowledge of the degree of negative impact (seriousness of consequences) that could occur with a tuberculosis outbreak within their setting (worst case scenario approach) and an understanding of the measures that could be taken to prevent the occurrence. Further the reasonable course of action would have to be feasible in terms of cost for the decision maker to consider implementation of tuberculosis prevention. The health educator would, by necessity have to address each of those "corporate beliefs" to effectively motivate executives towards preventive actions. The astute health educator would employ whatever methodology necessary to accomplish the task within that setting, whether accomplished by articles in the industry journals, displays at annual meetings, or one-on-one discussions between organizational leaders and the state epidemiologist.

The expanded model might be applied to an industry that is vulnerable to the impact of a tuberculosis outbreak. Industry-wide educational campaigns might focus on raising awareness so that each com-

**TABLE 2**

**A Model for Tuberculosis Prevention Efforts Targeting Corporations**

<i>Levels of Prevention</i>	<i>Components of the Health Belief Model</i>		
	<i>Susceptibility</i>	<i>Degree of Impact</i>	<i>Actions</i>
<b>Primary Prevention</b>	<p>Certain occupational and environmental settings render a higher degree of tuberculosis contagion within the workplace.</p> <p>Knowledge of risk factors can help identify corporate susceptibility.</p>	<p>If tuberculosis infection is present within workers, a tremendous reduction in productivity can result with spread of disease, resulting in financial loss, worker impairment and general overall disruption to the company.</p>	<p>Support public health and legislative measures to contain tuberculosis.</p> <p>Identify the presence of risk factors within company.</p> <p>Environmental manipulation: correct occupational and behavioral hazards that would facilitate spread of tuberculosis, to prevent worker exposure.</p> <p>Employee education regarding tuberculosis.</p>
<b>Secondary Prevention</b>	<p>A company is more susceptible to the negative impact of tuberculosis if not detected at an early stage.</p> <p>Tuberculosis is likely to</p>	<p>If tuberculosis exists in the workplace undetected, the likelihood of contagion to other employees is great and the negative impact of the</p>	<p>Screen all job applicants for tuberculosis.</p> <p>Periodic testing of all employees and the institution of further testing and/or treatment.</p>

TABLE 2 continued

<p>spread among employees if infection is allowed to disseminate among the work force.</p>	<p>disease on the corporation is increased.</p>	<p>ment in those that have disease. Employee education about tuberculosis screening.</p>
<p>Tertiary Prevention The discovery of tuberculosis within the workplace calls for damage control to reduce the spread of disease. The company risks loss of valued employees if the impact of tuberculosis is not minimized. Further, the company risks continued contagion among workers if the entire course of therapy is not followed.</p>	<p>If disease is allowed to spread further, negative impact to the organization will increase. Negatively impact will increase if tuberculous employees are not rehabilitated adequately. Limitation of worker disability will benefit company.</p>	<p>Development and implementation of socially responsible policies to address long-term follow-up of employees who harbor tuberculosis. Financing treatment Reintroduction of employee to workplace following therapy.</p>
<p>Similarly, if the employee does not receive proper medical treatment, the risk of developing drug-resistant tuberculosis is more likely. Follow-up of employees with active disease, to assure therapy compliance.</p>		<p>Limitation of disability through restoring worker to highest possible functional level with minimal residual impact</p>

pany within the targeted industry could begin to question their individual vulnerability, the impact of the disease on their specific setting/employees, financial status, and could also determine needed actions and analyze the feasibility of instituting control measures. An example of an imperiled industry would be the entire health care system. Individual ambulatory care settings, hospitals and long term care institutions are especially vulnerable. Yet case by case inspection reveals that some are much more vulnerable than others. Inner city hospitals that treat an inordinate number of homeless, drug addicted or HIV infected patients would be much more inclined to accept their vulnerability than a rural ambulatory care setting whose patient base does not overtly include the primary high-risk groups.

#### IN SUMMARY

The challenge currently presented by *M. tuberculosis* mandates the immediate development of containment strategies to deter further progress of the disease. Because no single targeted effort will likely result in control of the disease, a massive effort with widespread public support will be needed. The preceding review of factors contributing to tuberculosis resurgence paints a rather grim picture and is a reminder of the multidisciplinary effort that will be necessary to control or eradicate the disease. It may be simply too late to prevent a devastating epidemic.

However, history provides a model of successful containment efforts. If we are able to internalize the lessons of the past, we will let that experience guide us in future efforts. In spite of technological advances, many of the basic tenets of contagious disease prevention and control remain the same. In our technologically advanced setting, such concepts have slowly become unfamiliar and challenging. We no doubt feel somewhat incompetent in our ability (as a society) to develop the massive campaign that could lead to control and/or eradication of tuberculosis. At the pinnacle of efforts, a responsible leadership must be present to begin and unify the campaign for tuberculosis control.

Historically massive health education campaigns were necessary not only to deter complacency, but also to elicit the needed grass roots support of legislative action for adequate funding of needed services. Support of tuberculosis control will not evolve unless the threat and potential negative impact is perceived and acted upon. This is true regardless of the nature of the target market, whether the general public,

health care professionals or corporate executives. The expanded health belief model provides a structure for initiating and maintaining a comprehensive health education campaign to control tuberculosis.

## REFERENCES

1. Kochi A. Government intervention programs in HIV/tuberculosis infection. Outline of guidelines for national tuberculosis control programs in view of the HIV epidemic. *Bull Int Union Tuberc Lung Dis* 1991; 66:33-6.
2. Trubo R. The new TB: conspicuous consumption. *Harvard Health Letter* 1993; 18:6-8.
3. Centers for Disease Control. *Core Curriculum on Tuberculosis, Second Edition*. Atlanta: CDC, 1991.
4. Centers for Disease Control. Initial therapy for tuberculosis in the era of multi-drug resistance: Recommendations of the advisory council for the elimination of tuberculosis. *MMWR* 1993; 42:(RR-7).
5. Davidson PT, Le HQ. Drug Treatment of tuberculosis—1992. *Drugs* 1992; 43:651-73.
6. Centers for Disease Control. National action plan to combat multidrug-resistant tuberculosis—meeting the challenge of multi-resistant tuberculosis: Summary of a conference—management of persons exposed to multidrug-resistant tuberculosis. *MMWR* 1992; 41:(RR-11)6-25.
7. Barnes PF, Barrows SA. Tuberculosis in the 1990s. *Ann Intern Med* 1993; 119:400-410.
8. Frieden TR, Sterling T, Pablos-Mendez A, Kilburn JO, Cauthen GM, Dooley SW. The emergence of drug-resistant tuberculosis in New York City. N.Y. *New Engl J Med* 1993; 328:521-526.
9. Barnes SE, White GL JR, Sharkey PW, Parkman CJ. Pulmonary tuberculosis resurgence after near eradication. *Clinician Reviews* 1992; 3:69-93.
10. Boom BR, Murray CJL. Tuberculosis: commentary on a reemerging killer. *Science* 1992; 257:10555-1064.
11. American Thoracic Society and Centers for Disease Control—Joint position paper. Mycobacterioses and the acquired immunodeficiency syndrome. *AM Rev Respir Dis* 1987; 136:492-6.
12. Beck-Saque C, Dooley SW, Hutton MD, Otten J, Breeden A, Crawford JT, Pitchenik AE, Woodley C, Cauthen G, Jarvis WR. Hospital Outbreak of Multi-drug resistant Mycobacterium tuberculosis infections. *JAMA* 1992; 268:1280-1286.
13. Goldsmith MF. Medical exorcism required as revitalized revenant of tuberculosis haunts and harries the land. *JAMA* 1992; 268:174-175.
14. Miller AB. Respiratory manifestations of AIDS. *Br J Hosp Med* 1988; 39:204-15.
15. Collins FM. Mycobacterial diseases immunosuppression, and acquired immunodeficiency syndrome. *Clin Microbiol Rev* 1989; Oct:360-377.
16. Dooley SW, Villarino ME, Lawrence M, Salinas L, Amil S, Rullan JV, Jarvis WR, Bloch AB, Cauthen GM. Nosocomial transmission of tuberculosis in a hospital unit for HIV-infected patients. *JAMA* 1992; 267:2632-2534.
17. Jordan T, Lewit E, Montgomery R, Reichman L. Isoniazid as preventive therapy in HIV-infected intravenous drug abusers. *JAMA* 1991; 265:2987-2991.
18. Sepkowitz KA. Tuberculosis and the health care worker: A historical perspective. *Ann Intern Med* 1994; 120:71-79.
19. Daley CL, Small PM, Schecter GF, Schoolnik GK, Mcadam RA, Jacobs WR JR, Hopewell PC. An outbreak of tuberculosis with accelerated progression among persons infected with the human immunodeficiency virus—an analysis using restriction-fragment length polymorphisms. *N. Engl J Med* 1992; 326:231-235.
20. Fischl MA, Uttamchandani RB, Daikos GL, Poblete RB, Moreno JN, Reyes RR, Boota AM, Thompson LM, Cleary TJ, Lai S. An outbreak of tuberculosis caused by multiple drug-resistant tubercle bacilli among patients with HIV infection. *Ann Intern Med* 1992; 117:177-183.
21. Chaisson, RE. Mycobacterial infections and HIV. *Current Opinion in Infectious Disease* 1993; 6:237-243.
22. Pedro-Botet ET JR, Gutierrez J, Miralles R, Coll J, Rubies-Prat J. Pulmonary tuberculosis in HIV-infected patients with normal chest radiographs. *Aids* 1992; 6:91-93.

23. Stead WW, Dutt AK. Tuberculosis in the elderly. *Semin Respir Infect* 1988; 4:189-197.
24. Myers JA. Tuberculosis among persons over fifty years of age. *Geriatrics* 1948; 4:27-39.
25. Handwerker S, Mildvan D, Senie R, McLinley FW. Tuberculosis and the acquired immunodeficiency syndrome at a New York City Hospital. *Chest* 1987; 91:176-80.
26. Ferrini AF, Ferrini RL. *Health in the Later Years*. Madison: Brown and Benchmark, 1992, 423-439.
27. Myers JA. Tuberculosis in the elderly—a threat to children. *Geriatrics* 1946; 1: 456.
28. Manning A. Disgraceful rise in tuberculosis. *USA Today* 1993; May 20: (Thurs)D-1.
29. Abernathy RS. Tuberculosis in children and its arrangement. *Semin Respir Infect* 1989; 4: 232-42.
30. Nolan RJ JR. Childhood tuberculosis in North Carolina: A study of the opportunities for intervention in the transmission of tuberculosis to children. *Am J Public Health* 1986; 76:26-30.
31. Starke JR. Modern approach to the diagnosis and treatment of tuberculosis in children. *Pediatr Clin North Am* 1988; 35:441-64.
32. Kendig EL JR. Tuberculin testing in the young. *Compr Ther* 1986; 12:66-70.
33. Ovsiankina ES, Kafakova GA. Anketirovanie v vyjavlenii faktorov riska tuberkulezno: i infektsii u dete: i i podrozkov shkol-internatov. (Questionnaire of detecting the risk of tuberculosis infection in children and adolescents in boarding schools) *Probl Tuberk* 1991; 12:10-12 (Russian).
34. Haverkos HW. Infectious disease and drug abuse. Prevention and treatment in the drug abuse treatment system. *J. Sust Abuse Treat* 1991; 8:269-275.
35. Bearak B. (Los Angeles Times), Waiting to die at the 'AIDS hotel'. *Arkansas Democrat Gazette* 1993; Aug 29: J1-3.
36. Yu GP, Hsieh CC, Peng J. Risk factors associated with the prevalence of pulmonary tuberculosis among sanitary workers in Shanghai. *Tubercle* 1988; 69:105-12.
37. Rikimaru T, Tanaka Y, Yokoyama T, Futapami E, Ginnouchi Y, Ichikawa Y, Oizumi K. Active bronchial tuberculosis—a clinical study of 36 cases. *Kekkaku* 1991; 8:511-6. (Japanese).
38. Xie ZY, A study of blood rifampin concentration in smoking and non-smoking healthy individuals and in patients with tuberculosis. *Chung-hua Chieh Ho Ho Hu Hsi Tsa Chih* (Chinese Journal of Tuberculosis and Respiratory Diseases) 1989; 12:3-5,60.
39. Center For Disease Control. Prevention and control of tuberculosis in migrant farm workers. *MMWR* 1992; 41:(RR-10)1-15.
40. Brudney K, Dobkin J. Resurgent tuberculosis in New York City: human immunodeficiency virus, homelessness, and the decline of tuberculosis control programs. *Journal of Public Health Policy* 1992; 13:435-450.
41. McAdam JM, Brickner PW, Scharer LL, Crocco JA, Duff AE. The spectrum of tuberculosis in a New York city men's shelter clinic (1982-1988). *Chest* 1990; 97:798-805.
42. Anderson KM, Keith EP, Norstead SW. Tuberculosis screening in Washington State male correctional facilities. *Chest* 1986; 89:817-21.
43. Cowley G, Leonard EA, Hager M. Tuberculosis, a deadly return. *Newsweek* 1992; 16:53-57.
44. Snider DE JR, Salina L, Kelly GD. Tuberculosis: an increasing health problem among minorities in the United States. *Public Health Rep* 1989; 104:646-53.
45. Ryan F. *The Forgotten Plague, How the Battle Against Tuberculosis was Won and Lost*. Boston: Little, Brown and Company, 1992, p 404.
46. Manning A. CDC studies four fliers who had TB. *USA Today* 1993; 22: (Tues) A-1,2.
47. Woo J. Tuberculosis is reviving concern on legality of forced treatment. *Wall Street Journal* 1993; Feb.16 (Tues): B-7.
48. Mayo Foundation For Medical Education. Tuberculosis, a ticking time bomb. *Mayo Clinic Health Letter* 1993; April 11:1-3.
49. Health (staff writer). Doctors Fail the TB test. *Health* 1993; 7:10,12.
50. Calder RA, Duclos P, Wilder MH, Pryor VL, Scheel WJ. Mycobacterium tuberculosis transmission in a health clinic. *Bull Int Union Tuberc Lung Dis* 1991; 66:103-6.
51. Khudshina TA, Maslakova MG, Dmitrienko LV. O gruppakh riska azbolevaniia tuberkulezom (Groups with the risk of tuberculosis). *Prob Tuberk* 1991; 8:25-7 (Russian).
52. Zinsser H. *Rats, Lice and History*. Boston: Atlantic Monthly Press, 1935, pp 1-301.
53. Centers For Disease Control. National action plan to combat multidrug-resistant tuberculosis. Recommendations and reports. *MMWR* 1992; 41:(RR-11) 5-48.
54. Jereb JA, Kelly GD, Dooley SW JR, Cauthen GM, Snider DE JR. Tuberculosis morbidity in the United States: final data 19 90. *MMWR CDC Surveillance Survey* 1991; 40:23-7.

55. Teller ME. *The Tuberculosis Movement—A Public Health Campaign in the Progressive Era*. New York: Greenwood Press, 1988, pp 15-926.
56. Ramazzini B. *Diseases of Workers: The Latin Text of 1713* (revised translation and notes by Wilmer Cave Wright. Chicago: University of Chicago Press, 1940. As cited in Teller ME. *The Tuberculosis Movement—A Public Health Campaign in the Progressive Era*. New York: Greenwood Press, 1988.
57. Dublin L. *A 40 Year Campaign Against Tuberculosis*. New York: Metropolitan Life Insurance Company, 1952, pp 2-203.
58. Centers For Disease Control. Prevention and control of tuberculosis in U.S. communities with at-risk minority populations. Recommendations of the Advisory council for the Elimination of Tuberculosis. *MMWR* 1992; 41: (RR5)1-11.
59. Hales D. *An Invitation to Health*. Redwood City, Ca: Benjamin Cummings Publishing Company, Inc., 1992, pp 8-12.
60. Russell RD. *Health Education, Sixth Edition*. Washington, D.C.: National Education Association, 1975, pp 88-101.
61. Mausner, JS, Bahn, AK. *Epidemiology, an Introductory Text*. Philadelphia: WB Saunders Company, 1974, pp 9-12.