UVGI Control of TB Infection in a Prison System

Because of their often crowded living conditions and other factors, correctional institutions are high-risk settings for the spread of pulmonary tuberculosis (TB). Moreover, many inmates already have elevated risk for TB because of their lifestyles, inadequate pre-incarceration healthcare, and increased risk for HIV infection.

In the mid 70s the Arkansas Department of Correction (ADC) diagnosed ten cases of TB in a single Arkansas prison. Dr. William Stead, Director of the Arkansas Department of Health’s Tuberculosis Program, determined that the institution’s TB case rate was 670 per 100,000—more than 30 times higher than the rate in Arkansas’ general population for the same year.

One of every 11 known TB cases among adult male Arkansas residents during the previous five years occurred in a person who had “done time” in that prison.

Dr. Stead, in conjunction with the Arkansas Board of Correction, took immediate steps to stem the prison’s ongoing TB epidemic. But he saw that a TB outbreak in Arkansas’ prisons could also “seed” the disease into the state’s at-large population. Today by installing ultraviolet germicidal irradiation (UVGI) in its prisons, the ADC does more than add a powerful tool to combat TB in prisons—it defuses a latent, infectious threat to society.

When persons infected with TB or other airborne infectious diseases such as measles and influenza, cough, sneeze, or speak, they expel small “droplet nuclei” into the air. As droplet nuclei circulate on room air currents, other persons can inhale them. Droplet nuclei that contain pathogenic organisms and lodge in lungs or respiratory tracts can spread the diseases.

Several studies have documented the transmission of TB infection from recently released inmates to persons in the free community. “A lot of people think of prisons as places where people go and stay,” states Dr. Stead. “Well, by and large, they don’t. A graphic example occurred when a child died of TB transmitted from a former inmate who was shown to have been infected while incarcerated but released without therapy.” Other factors such as TB’s potentially decades-long dormancy period heighten the threat.

Adequate ventilation can dilute or remove potentially contaminated air. However, security considerations and environmental factors such as the locations and types of windows and fans often make airflow difficult to control. High efficiency particulate air (HEPA) filtration, another alternative, may be too costly and can be unsuitable in most general prison settings.

ADC’s array of TB control measures includes ongoing educational and training programs for employees and PPD testing to determine previous TB exposure for new hires and newly admitted or re-committed inmates. In addition, all inmates and staff having day-to-day contact with inmates are retested annually.

ADC’s newest weapon, UVGI, destroys tubercle bacilli in each protected room’s upper-air zone with UV-C radiation created by low-pressure mercury vapor lamps. Mounting fixtures at heights of at least seven feet help protect the eyes of inmates and staff from UV radiation.

Before installing UVGI fixtures, the Arkansas Department of Correction surveys each area for factors such as airflow, adequacy of any existing HVAC system, and potential for inmate abuse or self-injury. After the types and numbers of UVGI fixtures have been determined, they are assembled by inmates in the prison industry program, using heavy-duty components. To help ensure acceptance of UVGI, inmates are kept informed through written notices and meetings, which include question/answer sessions.

Based on its evaluation of all TB risk factors, ADC decided to protect inmates’ living areas and healthcare spaces with UVGI first. Other sites include common visitation areas, kitchens and food service areas, chapels, and prison industries. UVGI will be included in all new Arkansas Department of Correction facilities during their construction.
UVGI and ADC's other TB infection control measures have reduced the number of active TB cases among inmates and provided many other benefits.

No New TB Conversions. Currently no new converters (individuals who previously tested negative for TB but later tested positive) are emerging within the Arkansas Department of Correction inmate population.

Declining TB Case Rate. Since 1994, the cases among ADC inmates have declined from 18 in 1994, to 13 in 1995, and only 6 in 1996, a decrease of 67%.

Safer Working Conditions. Correctional workers value the increased protection UVGI gives them against TB and other airborne infectious diseases.

Increased Inmate Peace of Mind. Many prisoners also appreciate UVGI's benefits. Some inmates complain when they leave a UVGI-protected institution and go to one that is not.

A Safer Society. UVGI helps ensure that inmates will not later infect others with TB. If an inmate already under treatment for TB is paroled, continuing treatment is a condition of parole.

A UVGI fixture costs on average $600 to $800 to purchase and install. While the economic savings provided by such preventive measures are difficult to quantify, consider the following: Costs to treat a single TB-infected individual can range from $10,000 for minimum care to as much as $500,000 for the hospital care and drugs needed to combat a multiple drug-resistant (MDR) strain—enough to purchase more than 600 UVGI fixtures and irradiate more than 180,000 square feet.

Because of frequent moving of inmates between institutions, prisoners infected with TB while incarcerated may spread that infection to other prisoners and correctional workers—and later, into the state's population at-large.

TB can result in death if undetected and/or untreated. MDR TB may cause death in an immunocompromised person within as little as a few weeks.

When paroled or released, infected individuals can disseminate TB among innocent people in their families and the community at large. The new TB cases can plague society and lead to ever-expanding treatment costs borne by states and insurance companies for years. So UVGI in Arkansas prisons does much more than protect inmates and correctional workers against TB—it adds a measure of protection for all the state's residents.

Lumalier™ Commercial Lighting Design, Inc. of Memphis, TN designs and manufactures UVGI fixtures for a variety of applications in hospitals, clinics, public healthcare facilities, and other institutions. Working closely with the Health Department and ADC in evaluating its UVGI requirements, Lumalier designed a fixture especially for correctional institutions where high germicidal capability and economy are primary concerns.

Entergy Corporation is a major energy service company that provides worldwide power production and energy services to over 4.8 million customers in the US and overseas. Included in its customer base are several medical and correctional facilities in Arkansas, Louisiana, Mississippi, and Texas. A Managed Account Team is available to these customers 24-hours a day to proactively provide value-added solutions to their needs.

Department of Correction Profile
Located in Pine Bluff, Arkansas, the Arkansas Department of Correction (ADC) employs approximately 2600 people at 15 facilities across all geographical regions of the state.

Director-Larry B. Norris
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