APPENDIX A

DEPARTMENT OF HEALTH & HUMAN SERVICES Public Health Service

Centers for Disease Control
and Prevention (CDC)
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EIS Officer, EBMDB, DBMD, NCID

EPI-AID TRIP Report: Investigation of Respiratory Illness in Boston Harbor Project Inter-Island and Outfall Tunnels, Deer Island, Massachusetts (95-64-1).

Pamela Chin, Acting Director, Division of Training, EPO
Through: Director, DBMD, NCID
Acting Chief, ES, EBMDB, DBMD, NCID

BACKGROUND

From April through June 1995, local physicians reported an increase of respiratory illness among workers from the Boston Harbor Project, Deer Island tunnels. This project consists of two long, deep tunnels being bored beneath Boston Harbor to carry sewage to the Deer Island Sewage Treatment Facility for processing and disposal in the Atlantic Ocean (Fig. #1). The labor force consists of members of three union groups: tunnel workers, electricians, and engineers. The Inter-Island Tunnel will be approximately 300 feet deep, 17 feet wide, and 5 miles long, carrying sewage from the South Shore area to Deer Island. It is cool and damp since the seawater-impermeable concrete lining will not be applied to the walls until October 1995. The Outfall Tunnel, which will carry treated sewage out to sea, is now 8 miles long and 30 feet in diameter and will be 9 miles long at completion. It is a much drier tunnel, partly because it is 100 feet deeper, but also because it is sealed with a concrete ring and grout applied directly behind the tunnel boring machine. The project was initiated in 1991, with completion expected in 1998.

In June 1995, the Boston City Department of Health and Hospitals investigated reports of respiratory illness in tunnel workers by administering a questionnaire to approximately 400 Deer Island tunnel construction employees, inquiring about fever, cough, wheezing, or difficulty breathing over the previous year. A total of 132 persons from all job categories responded, and 100 of these reported that they had had a respiratory illness during the last year. Boston Department of Health and Hospitals reviewed records by telephone of those who responded that they had seen a physician.

On July 14 the Massachusetts Department of Public Health and the Boston Department of Health and Hospitals requested CDC assistance to investigate this possible increase in respiratory illness among those workers. The Emerging Bacterial and Mycotic Diseases Branch, Division of Bacterial and Mycotic Diseases (DBMD), National Center for Infectious Disease (NCID), requested National Institute for Occupational Safety and Health (NIOSH) involvement since the respiratory illness was reported to be occupationally-related. Emily M. McClure, M.D., M.P.H., and David A. Ashford, D.V.M., M.P.H., EIS Fellows, and Annie Kao, ASPH intern, traveled to Boston on July 20. They were joined on July 21 by David C. Sylvain, industrial hygienist with the Boston regional NIOSH office, and on July 22 by Mary E. Brown, D.V.M., M.P.H., EIS Fellow at NIOSH, Cincinnati. The team was joined on July 25 by Udo Buchholz, M.D., visiting NCID Fellow.

The objectives of the investigation were to determine the nature and etiology of the respiratory illness affecting workers; to attempt to identify a common infectious source for this illness, if any; and, based on these findings, to develop prevention strategies.

METHODS

Case Definition

We defined a case as the occurrence of one of the following in a worker on the Deer Island Tunnel Project: an infiltrate on chest radiograph, with one of the following; fever, cough, wheezing, or difficulty breathing. We suspected that those persons who had been diagnosed with pneumonia would have received the most thorough evaluation and would, therefore, be most likely to have an etiologic diagnosis.

Case Finding and Ascertainment

For case finding, we examined all available medical records of tunnel workers reporting respiratory symptoms of dry or productive cough, fever, wheezing, or difficulty breathing from June 1, 1994, through July 15, 1995, on questionnaires administered in June 1995 by the Boston Department of Health and Hospitals and by the NCID/NIOSH investigation team on July 23, 1995.

In June 1995, the Boston Department of Health and Hospitals (BDHH) had distributed a questionnaire at Deer Island asking workers where and for how long they worked in the tunnel, and whether they had respiratory symptoms during the preceding 12 months. The NCID/NIOSH investigation team obtained records for those patients found on follow-up from the BDHH questionnaire to have had a chest radiograph taken.

On July 23, the investigation team attended a meeting of the Tunnel Workers Union Local #4, where 78 of the approximately 150 union members present completed an NCID/NIOSH questionnaire that attempted to identify those who had developed any respiratory illness since April 1, 1995. The 53 persons reporting respiratory symptoms were contacted by telephone to collect

more detailed information on their illness and to identify their medical provider during their respiratory illness. These patients were also asked whether they had had a chest radiograph for their reported respiratory illness. Hospital and clinic charts were requested and reviewed by the NCID/NIOSH investigators. Data were collected on a standard form and included findings on physical examination, medical and smoking history, laboratory findings, and type of work task performed.

RESULTS

Health and Hospitals Questionnaire

Of the 132 respondents to the Health and Hospitals questionnaire, 100 reported having a respiratory illness between June 1, 1994, and May 31, 1995. In the last year, 61 of 100 ill reported trouble breathing, 97 reported cough, and 54 reported sputum production. Physicians were consulted by 70 of the 100 ill workers for these respiratory symptoms.

NCID/NIOSH questionnaire

Of the 78 respondents to the NCID/NIOSH questionnaire distributed to the Tunnel Workers Local #4 on July 23, 1995, 53 reported that they had experienced a respiratory illness since April 1, 1995. Four persons stated that they had been ill only during the previous week, 19 said that they had a respiratory illness between April 1, 1995 and July 15, 1995, and 30 said that they had been ill several times or continuously since April 1, 1995.

Of the 50 who supplied contact information, 30 said that they had seen a physician for the respiratory illness, 18 had not seen a physician, and two could not recall whether or not they had seen a physician for respiratory problems. Four of the 19 pneumonia cases were identified by responses to this questionnaire.

Boston Department of Health and Hospitals, CDC combined questionnaire results

We reviewed 62 records of those who said that they had been diagnosed with pneumonia or received a chest radiograph since June 1994, as reported from either the BDHH or CDC questionnaire. Of these 62 workers who stated they had seen a physician for respiratory complaints suggestive of pneumonia, 17 did not have a chest radiograph taken, 21 had a negative radiograph, and 19 had infiltrates diagnostic of pneumonia. Five patients' radiology reports were not readily available.

Those 17 who did not have a chest radiograph were diagnosed with bronchitis (5), sinusitis (5), otitis media (3), viral infection (3), and allergies (1). Of the 21 who had a chest radiograph without reported pneumonia, 16 were diagnosed with bronchitis, five with otitis media, five with sinusitis, three with viral upper and lower respiratory infection, one with a bacterial upper

respiratory infection, one with silicosis pneumonitis, and one with asthma. Some patients had more than one diagnosis. Radiology reports were not readily available for five persons.

Eighteen persons met the case definition. Ages of patients ranged from 27 to 53 years, and all were male. One patient developed pneumonia following blunt chest trauma and was not considered a case. Of the other 18, nine worked in the Inter-Island and nine in the Outfall Tunnel. Ten patients spent most of their workday near the tunnel boring machine, two at ground level, three in the mid-shaft area and other sites, and three had no job site reported. In the 11 cases in which smoking history was known, six cases of pneumonia occurred in persons with a known history of smoking, five in persons who had never smoked.

Nine cases of pneumonia occurred among 303 workers in the Inter-Island Tunnel, for a 13.5 month incidence rate of 3.0 %. Nine cases occurred in 431 Outfall Tunnel workers, for an incidence rate of 2.1%. There was no clustering of cases by tunnel (InterIsland vs. Outfall) or by onset date (Fig. #2).

Laboratory Findings

Laboratory specimens were submitted for 12 patients meeting the case definition. None of the 18 pneumonia cases meeting the case definition had an etiologic agent identified. Two patients submitted sputum cultures, which were negative. One patient had negative blood cultures. Legionella antigen tests were performed in three cases and were negative. Two patients had moderately elevated titers to Mycoplasma in acute phase serum samples, but no convalescent phase sera were obtained to confirm the diagnosis. No other serologic tests were performed.

Discussion

The tunnel workers' respiratory illnesses appear to represent a spectrum of clinical disease and have no identifiable common source or etiology. Diagnoses from medical records included other respiratory illnesses such as tracheobronchitis, sinusitis, otitis, and asthma in addition to pneumonia. Most patients were treated empirically with antibiotics.

This investigation was limited by the low response rate to our questionnaires and by incomplete medical records. Of the 400 workers who received a Health and Hospitals questionnaire, only 132 (33%) responded, and only 78 (39%) of the estimated 200 InterIsland and Outfall Tunnel Workers Union members returned the NCID/NIOSH questionnaire. The July 23, 1995, meeting of the Tunnel Workers Local #4 was called to discuss health concerns on the worksite. Those attending the meeting and responding to the NCID/NIOSH questionnaire distributed there may have been those who had experienced respiratory illness, possibly introducing a reporting bias into the initial case finding. The attack rates per tunnel, therefore, cannot be interpreted with certainty.

Despite repeated attempts to meet with the engineers and electricians unions who make up approximately 30% and 12% of the tunnel workforce, respectively, we were not able to distribute the NCID/NIOSH questionnaire to these unions, probably resulting in underreporting of respiratory illness among workers in these groups. Recall of respiratory illness of all types might have been greater for those becoming ill most recently.

CONCLUSIONS AND RECOMMENDATIONS

Our retrospective review of available medical records could not determine a specific infectious etiology for the respiratory illness. Our analysis of the medical records for epidemiologic purposes was limited by the incomplete laboratory diagnostic testing of the pneumonia cases. It is important to note that diagnostic evaluations appropriate for epidemiologic or surveillance purposes may differ from those appropriate for individual medical care and treatment of illness. There was no clustering of cases in time or by tunnel. Prospective evaluation using a standard data collection protocol would be more useful for determining the exact nature of this illness and possibly identifying an etiologic agent.

We agree with the recommendation of the Boston Department of Health and Hospitals letter of August 1, 1995, that cooperation of labor, management, and government authorities is essential for the success of all phases of this surveillance effort.

We recommend that top management from the governmental agencies, contractors, and the unions participate fully in the critical components of the surveillance effort put forth by the Boston City Department of Health and Hospitals. All parties should have involvement in decisions on appropriate interventions affecting employees with respiratory symptoms in the tunnels.

Management should provide specific education and information to the employees at the tunnels regarding recognition of respiratory symptoms and the importance of early reporting of symptoms. Workers complaining of cough, fever, difficulty breathing, or wheezing should be identified as soon as possible through self-referral on the job site. They should be evaluated in a timely manner by a health care provider familiar with occupational health issues, particularly respiratory conditions, and, if possible, tunnel or mining hazards. We recommend that an occupational, medical, and smoking history be taken at this initial visit. All persons with pneumonia should be evaluated with a chest radiograph and sputum gram stain and culture (if a productive cough is present). They should have serum samples collected (both acute- and convalescent-phase) for further serologic testing. The data collection form (see addendum) used by the investigation team for chart review should be strongly considered for use for prospective surveillance and case reporting.

When this surveillance system is implemented, we will be interested in assisting all parties in the interpretation of data and development of a strategy for prevention of respiratory illness in the workers.

NIOSH has responded to requests for a Health Hazard Evaluation from Deer Island tunnel workers and is currently collecting data for environmental analysis. Should any NIOSH assays suggest that infectious agents are a hazard in the Deer Island tunnels, NCID will resume its work on this investigation.

Emily McClure, M.D., M.P.H.
EIS Fellow
National Center for
Infectious Diseases

Mary E. Brown, D.V.M., M.P.H.
EIS Fellow
National Institute for
Occupational Safety and Health

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